Corporate Process Requirement No: CPR400.1.1.32
Sponsor: Dori Ellis, 4000, Acting

Revision Date: June 15, 2007
Replaces Document Dated: May 24, 2007

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Sandia National Laboratories
ENVIRONMENT, Safety & HEALTH

Radiological Protection Procedures Manual

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Subject Matter Expert: M. Keith Matzen; CA Counterpart: Albert Lau
MN471016, Issue BC
Revision Date: June 15, 2007; Replaces Document Dated: March 24, 2007
Review Date: October 11, 2006
Administrative Changes: June 6, 2007

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* Indicates a substantive change

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ENVIRONMENT, Safety & HEALTH

Radiological Protection Procedures Manual

Change History

June 15, 2007

* Indicates a substantive change

Chapter 10 "Radiation-Generating Devices (RGDs)," was revised to:

- **Add:** A review date to the header to indicate that an ES&H Manual Self- assessment (SA) checklist was completed for this chapter.
- Under topic, “2.0 Scope, subtopic 2.1 Devices that are considered RGDs”:
  - ***Delete:** The note stating that “Any accountable sealed radioactive source that is subject to the requirements of this chapter must also comply with Chapter 6, "Control of Radioactive Material," and Chapter 9, "Control of Accountable Radioactive Sources.”
- Under topic, “2.0 Scope, subtopic 2.1 Devices that are Not Considered RGDs”:
  - ***Change:** “Sealed radioactive sources that produce radiation fields not exceeding 100 millirem in 1 hour at a distance of 30 centimeters from the source” **to** “All sealed radioactive sources” as an exemption from the requirements of this chapter.
  - ***Delete:** “Neutron sources used for reactor startup if part of the reactor assembly,” as an exemption from the requirements of this chapter.
- Under topic, “3.0 Responsibilities, subtopic 3.3 RGD Custodians”:
  - ***Delete:** The requirement for RGD custodians to, “ensure that out-of-service RGDs containing radioactive sources are physically secured to prevent unauthorized use.”
- Under topic, “4.7 Registration/Labeling/Notification of Change in Status (ISMS Function: Plan Work), subtopic 4.7.2 Labeling”:

- **Change:** Guidance from, “If radiation sources are located remotely from their power supplies, attach additional labels bearing the device identification number to the radiation source” **to** “If x-ray generating heads are located remotely from their power supplies, attach additional labels bearing the RGD identification number to the heads” for custodians to affix labels.”

- Under topic, “4.8 Training, subtopic 4.8.1 Radiological Training”:

  - ***Change:** Work activity from “RGDs that contain radioactive material, emit neutrons, have the potential to contaminate or activate other materials, or who require access to radiological areas other than radiation areas” **to** “RGDs that emit neutrons, have the potential to contaminate or activate other materials, or who require access to radiological areas other than radiation areas,” for radiological training.

- Under topic, “4.13 Disposal of RGDs (ISMS Function: Analyze Hazards)”:

  - ***Delete:** The requirement for RGD custodians to, “physically secure the source (e. g., locking) to prevent inadvertent radiation exposure, for RGDs containing radioactive material.”

- In Attachment 10-1, “Classification of Radiation-Generating Devices,” topic, “2.0 Shielded Installation”:

  - **Delete:** Subtopic section, “2.1 Source Irradiators” and its entire contents. Renumbered the remaining subtopic areas of the section.

- In Attachment 10-1, Classification of Radiation-Generating Devices, topic, 3.0 Open Installation”:

  - **Delete:** Radiography units containing Ir-192 or Co-60 sources and soil densitometers containing a neutron source as examples of open installations from the opening paragraph of the section.

- In Attachment 10-1, “Classification of Radiation-Generating Devices,” under topic, “3.0 Open Installation, subtopic, 3.1 Portable or Mobile Radiography”:

  - **Delete:** Sealed radioactive sources used in radiography as a type of portable or mobile radiography.

- In Attachment 10-1, “Classification of Radiation-Generating Devices,” under topic, “4.0 Unattended Installation”:

- **Delete:** Nuclear gauges containing a Cs-137 or Ra-226 sources for measurement or process controls as examples of unattended installations.

- In Attachment 10-3, “Technical Work Documents (TWDs) for Radiation-Generating Devices,” under topic, “4.0 Emergency Information”:

  - **Delete:** Loss of a sealed radioactive sources as a type of reasonable credible emergency.

Administrative Changes Only
June 6, 2007

Chapter 6 "Control of Radioactive Material," was revised to:

- **Add:** Optical Glass Containing ≤5% by Wt. of Uranium to the conditionally controlled materials list in Attachment 6-3.

May 24, 2007

* Indicates a substantive change

This document has been altered by greater than 75% and should be read in its entirety.

Chapter 9, “Control of Accountable Radioactive Sources,” was revised to:

The changes in this issue (G) reflect the replacement of the previous accountable radioactive source tracking system with the Device and Radioactive Source Tracking System (DARTS). All of the existing requirements are addressed in this current issue and new requirements are highlighted in the document with green text. A summary of general document changes and requirement additions and deletions are listed below.

General

- **Change:** The title to, “Control of Accountable Sealed Radioactive Sources.”
- ***Add:** Attachment 9-2 – Changes that Could Increase Radiation Exposure From a High Strength Radioactive Source.

- ***Add:** Attachment 9-3 – Radiation Survey Conditions that Require Operating Restrictions in Associated Technical Work Documents (TWDs) for High Strength Radioactive Sources.
- **Add:** A review date to the header to indicate that an ES&H Manual Self-assessment (SA) checklist was completed for this chapter.

Additions

- **Add**: Guidance to the Scope.
- ***Add:** New requirements for managers.
- ***Add:** New requirements for source custodians.
- ***Add:** New requirements for radioactive source users.
- ***Add:** New requirements for radiation protection personnel.
- ***Add:** New requirements for acquiring and receiving ARS.
- ***Add:** New requirements for registering ARS in DARTS.
- ***Add:** New requirements for labeling ARS.
- ***Add:** Requirements for high strength radioactive sources.
- ***Add:** New requirements for source inventorying ARS.
- ***Add:** New requirements for placing ARS into storage or returning one to active service.
- ***Add:** New requirements for moving ARS to a new physical location.
- ***Add:** New requirements for transferring custodianship or loaning ARS to another MOW.
- ***Add:** New requirements for making ARS available for reapplication.
- ***Add:** New requirements for disposing of ARS.

Deletions

- ***Delete:** The requirement for source custodians to, “Notifying the responsible Division

ES&H Team and the responsible manager of loss of, or damage to, an ARS."

- ***Delete:** Requirements for radiation protection personnel to:
  - Advise line customers about posting/labeling and training requirements; and
  - Review ARS-related technical work documents (TWDs) (see Section 4.5 and CPR400.1.1, MN471001, *ES&H Manual*, Chapter 21, "Technical Work Documents (TWDs).
- ***Delete:** Requirement "Prior to removing a sealed accountable radioactive source (ARS) from its package, consult the appropriate Division ES&H Team and ensure that the ARS is subjected to a leak test upon removal (see Section 4.7), unless specifically excepted in Section 4.7.2 " for acquisition and receiving of an ARS.
- ***Delete:** The following requirements for registering an ARS:
  - "The Source Registrar will, upon registration of a new ARS, furnish the source custodian with the following:
    - A Radioactive Source Information sheet.
    - An initial Inventory Checklist.
    - A barcode identification label.
  - Source custodians shall, upon receipt of the "Radioactive Source Information sheet," "Initial Inventory Checklist," and "barcode identification label" from the Source Registrar:
    - Review relevant information on the "Radioactive Source Information sheet" or in the Radioactive Source Database.
    - Consult the Source Registrar to correct any discrepancies.
    - Attach the "barcode identification label" to the applicable source (see Section 4.6).
    - Complete and return the "Initial Inventory Checklist" to the Source Registrar."
- ***Delete:** The following requirements for transferring an ARS:

- Source custodians shall, when transferring custody of accountable radioactive sources (ARS), submit a completed SF 2001-RS, Radioactive Source Change Form (Word file/Acrobat file) to the Source Registrar.

- Source custodians who accept custody of an ARS shall acknowledge the transfer by signing the completed SF 2001-RS, Radioactive Source Change Form (Word file/ Acrobat file).

- ***Delete:** The following requirement for onsite movement of an ARS:

  - Source custodians shall notify the Source Registrar when a source is moved to a new onsite location for longer than 2 months.

    Note: Source custodians are not required to report temporary onsite movements (i. e., when an accountable radioactive source (ARS) is purposely moved from its assigned location to another onsite location for 2 months or less with the intent of returning it to its original location).

    Note: SF 2001-RS, Radioactive Source Change Form (Word file/Acrobat file), may be used for notifications when moving an ARS to a new onsite location.

- ***Delete:** The following requirement for scheduling leak tests:

  - Source custodians shall schedule leak tests by consulting the appropriate Division ES&H Team or by calling the Radiation Protection Hotline at 844-4621.

    Note: The Source Registrar sends a reminder notice to the source custodian when a source is due for a leak test. Leak tests are performed by radiological control technicians (RCTs) when requested.

    Note: A leak test history is maintained as part of the database record for each accountable radioactive source (ARS).

- ***Delete:** The following requirement for inventorying ARS:

  - Complete and sign inventory checklists and return them to the Source Registrar.

    Note: When an accountable radioactive source (ARS) is due for an inventory, the Source Registrar provides the source custodian with an inventory checklist.

- ***Delete:** The following requirement for reapplication of an ARS:

- Source custodians shall notify the Source Registrar to make unwanted radioactive sources (either accountable or non-accountable) available for reapplication.

  Note: The Source Registrar will indicate in the database record when a source is available for reapplication.

  Note: SF 2001-RS, Radioactive Source Change Form (Word file/Acrobat file), may be used for notifications when making unwanted sources available for reapplication.

  Note: The source can remain available for reapplication while a disposal request is in process, but it must be taken off the list when the source is picked up as radioactive waste.

- ***Delete:** The following requirement for disposal of an ARS:

  - The source custodian shall notify the Source Registrar:

    - Upon submission of a disposal request and provide the disposal request number, if applicable. The Source Registrar will mark the record as being in storage.

    - When the source has been picked up as waste, the Source Registrar will mark the record as "Inactive."

  Note: An SF 2001-RS, Radioactive Source Change Form (Word file/Acrobat file), may be used for notification that a radioactive source is available for disposal.

* Indicates a substantive change

Glossary" was revised to:

- ***Add: Affected manager (affected by a radiological operation)** – A manager who has members of the workforce, space, equipment, real property or operations that could be impacted by radiological work for which they are not responsible.

- ***Add: Inaccessible area (applies only to radiological area posting)** – An area that cannot reasonably be occupied by a major portion of an individual's whole body (head, trunk (including male gonads), arms above the elbow, or legs above the knee). Examples of areas that do not need to be posted as entrances are the man way to a tank or vessel that has its cover bolted in place or an opening in a shield wall that is physically difficult to access without a ladder or mobile platform.

Note: Openings in physical barriers around a radiological area are not required to be posted as entrances if exceptional measures are needed to access them.

- ***Add: Void Point** – Stoppage in a work process when radiological controls or other conditions specified are inadequate. Affected operations may not proceed until the process is revised. However, work may proceed to place the operation in a safe and stable state.

Administrative Changes Only
May 18, 2007

Chapter 11 "Radiological Incidents," was revised to:

- **Add:** Review date to signify that a self-assessment of the chapter is complete. All changes documented below are the results of the self-assessment:
  - **Update:** All department titles and organization numbers.
  - **Update:** Section titles.
  - **Rearrange:** Various sentences to allow for a uniform parallel structure.
  - **Update:** References to (KAO) with NNSA/SSO.
- **Update:** Section 6.0, “References” titles.
- **Update:** Section 6.0 References, per, Part III – Section J, Appendix G, “List of Applicable Directives and NNSA Policy Letters”:
  - **Replace:** DOE O 232.1A, *Occurrence Reporting and Processing of Operations* Information with DOE M 231.1-2, *Occurrence Reporting and Processing of Operations Information.*

March 6, 2007

* Indicates a substantive change.

Chapter 1, "Radiological Work Planning and Controls," was revised to:

- Under the topic "4.2, Planning Radiological Work":
  - ***Delete:** Note that states; "An eTWD may be used as a TWD for radiological work, but eTWDs do not negate the need for an RWP when conditions require one to be prepared. A template for preparing a TWD for radiological work is provided in Attachment 1-7"
  - ***Change:** Requirement for "managers to ensure that TWDs **used as the sole administrative control** for radiological work include:
    - Detail and content commensurate with the radiological hazards created by the activity and be consistent with the education, training, and skills of the individuals exposed to those hazards.
    - Sufficient description of the work to be performed to allow for planning of radiological controls.
    - Specific training requirements, including a pre-job briefing if the task is complex.
    - Description of current radiological conditions.
    - Requirements for radiological monitoring and dosimetry.
    - Requirements for personal protective equipment (PPE) for radiological controls.
    - Other radiological work controls as applicable.
    - Radiological hold points or work controls.
    - Correct authorized user lists, when applicable.
  - ***Add:** Requirement for managers to ensure that all TWDs for radiological work include concurrence of the appropriate Radiation Protection Project Leader.

November 27, 2006

* Indicates a substantive change.

Chapter 8 "Monitoring Areas and Material," was revised to:

- **Add:** A review date to the header to indicate that an ES&H Manual Self-Assessment (SA) checklist was completed for this section.
- Under the topic, “4.10.1, Purpose of Monitoring”:
  - ***Add:** Requirement for managers to “ensure that radiological monitoring of radiation exposure levels, contamination, and airborne radioactivity are conducted to meet regulatory requirements as indicated above in Section 4.1.”
  - ***Delete:** Requirement for managers to ensure that radiological monitoring of radiation exposure levels, contamination, and airborne radioactivity are conducted to:
    - “Demonstrate compliance with the regulations in 10 CFR 835, Subpart E. **[R - 10 CFR 835.401(a)(1)]**
    - Document radiological conditions. **[R - 10 CFR 835.401(a)(2)]**
    - Detect changes in radiological conditions. **[R - 10 CFR 835.401(a)(3)]**
    - Detect the gradual buildup of radioactive material. **[R - 10 CFR 835.401(a)(4)]**
    - Verify the effectiveness of engineering and process controls in containing radioactive material and reducing radiation exposure. **[R - 10 CFR 835.401(a)(5)]**
    - Identify and control potential sources of individual exposure to radiation and/or radioactive material. **[R - 10 CFR 835.401(a)(6)]”**
- Under the topic, “4.10.2, Routine Monitoring Schedules”:
  - ***Add:** Requirement for managers, in conjunction with the Radiological Protection Line Support Project Leader (or designee), to ensure that routine monitoring schedules are established.
  - ***Delete:** Requirement for managers, in conjunction with the Radiological Protection Line Support Project Leader (or designee) to ensure that routine monitoring schedules are establishing in accordance with the recommended routine schedule

frequency provided in Attachment 8-1, “Guidance for Establishing Radiological Survey Frequency.”

- **Add:** Guidance, “Use Attachment 8-1 as a basis for establishing routine survey frequencies along with process knowledge and historical data.”

- Under the topic, “4.10.3, Deviations from Schedules”:

  - ***Add:** Requirement for radiation protection line support project leaders or designees to notify the line manager in advance of all deviations from or permanent changes to the established monitoring schedule.

  - ***Delete:** Requirement for radiation protection line support project leaders or designees to only use one of the following reasons as justification for the deviation:

    - Agreement with the line manager in advance on an alternate schedule.

    - Altering schedule to accommodate the work activities.

Chapter 12 "Radiation Instrumentation," was revised to:

- This document has been altered by greater than 75% and should be read in its entirety.

- **Add:** A review date to the header to indicate that an ES&H Manual Self-Assessment (SA) checklist was completed for this section.

November 3, 2006

* Indicates a substantive change.

Chapter 1, “Radiological Work Planning and Controls,” was revised to:

- Under the topic “2.0, Scope”:

  - ***Change:** Note from “full implementation of the changes outlined in Issue L (TWD disengagement from RWPs) are expected within six months of the effective date” **to** “Full implementation of the changes outlined in Issue M (TWD disengagement from RWPs) is expected by April 30, 2007. TWDs shall be in place for all radiological work performed as of that date. The intent of this deadline is to allow for the replacement of RWPs by TWDs as they come due – no new RWPs will be written for which there is not an active TWD in place.”

Administrative Changes Only
October 30, 2006

"TOC," was revised to:

- **Change:** The subject matter expert from Anthony J. Medina to M. Keith Matzen.

September 22, 2006

Chapter 2, "Posting and Labeling for Radiological Control," was revised to:

- **Add:** A review date to the header to indicate that an ES&H Manual & Supplements Self-Assessment checklist was completed on this supplement.
- Under the topic "4.1, General Posting and Labeling":
  - **Correct:** The requirement for managers to ensure that radiological postings and labels reflect current conditions in the area by removing the requirement citation **[10 CFR 835.601(a)].**
- Under the topic "4.2.1, Controlled Areas":
  - ***Add:** Requirement for Managers to ensure that, "each access point to controlled areas is posted, whenever radiological areas or radioactive material areas exist in the area. Individuals who enter only controlled areas without entering radiological areas or radioactive material areas are not expected to receive a total effective dose equivalent of more than 0.1 rem (0.001 sievert) in a year." **[10 CFR 835.602 (a)]**
  - ***Delete:** Requirement for Managers to ensure that, all access points to controlled areas are posted whenever radiological areas or radioactive material areas exist in the area. **[10 CFR 835.602(a)]**

Chapter 6, "Control of Radioactive Material," was revised to:

- Under the topic "4.2.1, Control of Radioactive Material":

- ❍ ***Add:** Requirement for Managers to ensure that, sealed radioactive sources are: used, handled, and stored in a manner commensurate with the hazards associated with operations involving the sources. **[10 CFR 835.1201]**

Administrative Changes Only
September 21, 2006

"Glossary" was revised to:

- **Delete: PPSC -** Pulsed Power Safety Committee, this committee no longer exists.

September 18, 2006

* Indicates a substantive change

"Glossary," was revised to:

- ***Add: Extremity** – The area of the hands and arms below the elbow or feet and legs below the knee.

- ***Change:** The definition of **general employee** from "An individual who is either a DOE or DOE contractor employee; an employee of a subcontractor to a DOE contractor; or a visitor who performs work for or in conjunction with DOE or who uses DOE facilities" **to** "An individual who is either a DOE or DOE contractor employee; an employee of a subcontractor to a DOE contractor; or an individual who performs work for or in conjunction with DOE or who uses DOE facilities."

- ***Change:** The definition of **radioactive material transportation** from "The movement of radioactive material by aircraft, rail, vessel, or highway vehicle when such movement is subject to Department of Transportation regulations or DOE Orders that govern such movements. Radioactive material transportation does not include preparation of material or packagings for transportation, monitoring required by this part, storage of material awaiting transportation, or application of markings and labels required for transportation" **to** "The movement of radioactive material by aircraft, rail, vessel, or highway vehicle when such movement is subject to Department of Transportation regulations or DOE Orders that govern such movements. Radioactive material transportation does not include preparation of material or packagings for transportation, monitoring required by this part, storage of material awaiting transportation, or application of markings and labels required for transportation."

- ***Delete:** From the definition of “technical work document (TWD)” radiological work permits (RWPs) from the list of examples of technical work documents used at SNL to control hazardous work.

- ***Add:** Note to the definition of “technical work document (TWD)” that states “For the purposes of the RPPM, RWPs are **NOT** considered TWDs.”

Administrative Changes Only
July 5, 2006

Chapter 3 "Radiological Training Program," was revised to:

- Under the topic, “4.3.2, Job Specific Training”:
  - **Delete:** Radiological Work Permits (RWPs) from the list of training examples of technical work documents for which managers are responsible.

Chapter 4 "Radiation Dosimetry," was revised to:

- Under the topic, “4.1.2, Personal Air Sampling”:
  - **Delete:** The word “other” in the last sentence of the section guidance to disengage Radiological Work Permits (RWPs) from technical work documents.

June 21, 2006

"Introduction" was revised to:

- Under the topic “2.1, Does Not Apply”:
  - ***Delete: “**In cases where a subcontractor or member of the public is bringing RGDs or radioactive sources/material on-site, it is the responsibility of the sponsoring SNL Line Organization to inform their appropriate Radiation Protection Line Support organization in a timely manner to assist in undertaking potential impact evaluations and providing other essential guidance” from note 2 of the section.

- Under the topic “4.0, Assistance Support”:

- *__Add:__ Requirement specifics for bringing RGDs or radioactive sources/material on-site.

Chapter 6, "Control of Radioactive Material," was revised to:

- Under the topic, "4.1.3, Receipt of Radioactive Material (ISMS Function: Perform Work)":
  - __*Add:__ Requirement for managers to ensure that all Department of Transportation (DOT) shipping papers, source certificates, and any special form certificates (e.g., ANSI and NIST) are maintained in accordance with Section 5.0 Records of this chapter and that copies are forwarded to the Device and Source Registrar.
- Under the topic, "4.2, Work with Radioactive Material (ISMS Function: Perform Work)":
  - __*Delete:__ RWP from table 4.1 in the conditionally controlled material column for the TWD control requirement category. RWPs have been disengaged from TWDs per Chapter 1 of the Radiological Protection Procedures Manual.

Administrative Changes Only
June 19, 2006

Chapter 10 "Radiation Generating Devices (RGDs)," was revised to:

- Under the topic, "2.3, Devices that May be Exempt from the Requirements of this Chapter":
  - __Delete:__ The reference to accelerators under the oversight of the Pulsed Power Safety Committee from the section note, since this committee no longer exists.

May 23, 2006

Chapter 8, "Monitoring Areas and Material " was revised to:

- Under the topic, "4.2, Air Monitoring":
  - __Change:__ guidance from, managers should ensure that air sampling is performed in circumstances such as the following:
    - To establish the need for posting of airborne radioactive **material** areas and

determine when respiratory protection should be worn by workers;

to

- Establish the need for posting of airborne radioactivity areas and determine when respiratory protection should be worn by workers.

April 26, 2006

Note: An asterisk (*) indicates a substantive change.

Chapter 1, "Radiological Work Planning and Controls "

- ***Add:** Attachment 1-7 – "Template for Radiological TWD."
- ***Add:** Form SF 2001 – WPR, "Radiological Work Permit Request."
- ***Add:** Form SF 2001 –ARA, "General RWP Task Analysis for Added Radiological Activities."
- Under the topic, "2.0, Scope":
  - ***Add:** Note that states; Full implementation of the changes outlined in Issue L (TWD disengagement from RWPs) are expected within six months of the effective date.
  - ***Change:** The requirement that states; "This chapter applies to all radiological work incontrolled areas and all work in radiological areas" to "This chapter applies to all radiological work."
  - ***Change:** The requirement that states; "At Sandia, radiological work controls are implemented through the use of technical work documents (TWDs) (see CPR400.1.1/MN471001, *ES&H Manual*, Chapter 21, Technical Work Documents [TWDs]). Consult the following for assistance with TWDs:" **to** "At Sandia, radiological work controls are implemented through the use of technical work documents (TWDs) (see CPR400.1.1/MN471001, *ES&H Manual*, Chapter 21, Technical Work Documents [TWDs]) and, if required, authorized using Radiological Work Permits (RWPs). Consult the following for assistance:"
- Under the topic, "3.1, Managers of Radiological Workers":

- ***Add:** Requirement for managers of radiological workers to obtain concurrence of the appropriate Radiation Protection Project Leader on TWDs for radiological work.
- ***Add:** Requirement for managers of radiological workers to ensure that RWPs are initiated for all applicable radiological work using SF 2001-WPR *Radiological Work Permit Request*.
- ***Add:** Requirement for managers of radiological workers to ensure that an approved RWP is in place prior to performing any work, which requires an RWP.
- ***Add:** Requirement for managers of radiological workers to ensure that a *General RWP Task Analysis for Added Radiological Activities*, is completed and reviewed for all new radiological work to determine the adequacy of current RWP(s) if a new RWP is not desired

- Under the topic, "3.2, Radiological Workers":
  - ***Change:** The requirement for Radiological workers to comply with all TWDs **to** comply with all TWDs and RWPs, as applicable.
- Under the topic, "3.3, RP Personnel":
  - ***Add:** Requirement for RP Personnel to review TWDs for radiological work.
  - ***Add:** Requirement for RP Personnel to prepare RWPs based on the description of work provided by the line, when applicable.
  - ***Add:** Requirement for RP Personnel to review the *General RWP Task Analysis for Added Radiological Activities* for all new radiological work to determine the adequacy of current RWP(s) when requested by the line.

- Under the topic, "3.5, RP Personnel":
  - ***Add:** Requirement for the Job Coordinator to prepare and submit a *Radiological Work Permit Request* (SF 2001-WPR) when required.
- Under the topic, "4.1.1, Exposure Limits for Radiological Workers":
  - ***Delete:** Requirements driver; **[DOE N 441.1.6a]** from section.
- Under the topic, "4.2, Planning Radiological Work":

- *****This section has been substantively change by greater the 75% and should be read in its entirety.

- Under the topic, “4.3, Radiological Work Permits (RWPs)”:
  - *****This section has been substantively change by greater the 75% and should be read in its entirety.

- Under the topic, “4.4, Radiological Work Implementation”:
  - ***Change**: The requirement for Members of the Workforce from “Attend pre-job briefings when such briefings are cited as mandatory in relevant TWDs” **to** “Attend pre-job briefings when such briefings are cited as mandatory in relevant TWDs, and RWPs if applicable.”
  - ***Change**: The requirement for Members of the Workforce from “Read any associated TWDs” **to** “Read any associated TWDs and RWPs if applicable.”
  - ***Change:** The requirement for Members of the Workforce from “Sign any associated TWDs” **to** “Sign any associated TWDs and RWPs if applicable.”
  - ***Change:** Note 1 from “ When the TWD is an RWP, a signature indicates that the individual meets the requirements of the RWP, understands the content of the RWP, has received any necessary briefings, and will comply with all the requirements of the RWP” **to** “When signing an RWP, a signature indicates that the individual meets the requirements of the RWP, understands the content of the RWP, has received any necessary briefings, and will comply with all the requirements of the RWP.”

- Under the topic, “4.4.2, Personal Protective Equipment (PPE)”:
  - **Delete:** Guidance; Workers should don and remove PPE in accordance with posted instructions (see Attachment 1-4, “ Standard Instructions for Donning and Removing Protective Clothing”) or per the relevant TWD.

- Under the topic, “4.4.3, Personal Contamination Control”:
  - ***Delete:** Requirement for managers to ensure that the nearest frisking station is located inside the radiological buffer area adjoining the contamination area, high contamination area, or airborne radioactivity area from which personnel are exiting.
  - ***Add:** Note that states; the nearest frisking station should be located inside the radiological buffer area that adjoins the contamination area, high contamination

area, or airborne radioactivity area from which personnel are exiting.

- Under the topic, “5.0, Records”:
  - ***Change:** The requirement for managers to ensure “that work planning and control-related record copies (i.e., originals) of the following documents are sent to the Radiation Protection Project Leader” **to** “managers shall ensure that work planning and control-related record copies (i.e., originals) of the following documents are sent to the appropriate RP Personnel.

- Under the topic, “6.0, References”:
  - ***Delete:** Requirements source document;DOE N 441.1, Radiological Protection for DOE Activities.

Chapter 3, “Radiological Training Program”

- Under topic, "4.1, Minimum Radiological Training”:
  - ***Change:** The requirement for Sandia personnel to complete radiation safety training before being: “permitted unescorted access to controlled areas and occupationally exposed to ionizing radiation during access to controlled areas” **to** “Members of the Workforce shall complete radiation safety training before being permitted unescorted access to controlled areas.”
  - ***Add:** The requirement for custodians of radiation-generating devices to complete RAD 219[9]

- Under topic, "4.2.1, Generic Training”:
  - ***Change:** The title of this section from “Area Access” to “Generic Training.”
  - ***Delete:** “prior to occupational exposure to ionizing radiation” from the requirement for nonradiological workers who require unescorted access to controlled areas to complete RAD102, “General Employee Radiological Training.”

- Under topic, "4.3.2, Job Specific Training”:
  - ***Add:** “See CPR400.1.1/MN471001, *ES&H Manual*, Chapter 11, “ES&H Training” to the requirement for managers to verify that individuals responsible for developing and conducting job-specific radiological training have the appropriate education, training, and skills to discharge this responsibility.

- Under topic heading, "4.4, Use of Escorts in Lieu of Training":
    - ***Change:** The opening paragraph from “Under certain conditions and restrictions, constant escort by a suitably trained individual may be used in lieu of training (e.g., for contractors, roving personnel, visitors, and tours) for access to controlled areas, radioactive material areas, soil contamination areas, underground radioactive material areas, radiological buffer areas, and some radiological areas (e.g., radiation areas, and contamination areas), as well as for the performance of some radiological work activities” **to** “Under certain conditions and restrictions, constant escort and direct supervision by a suitably trained individual may be used in lieu of training (e.g., for contractors, roving personnel, visitors, and tours) for access to some radiological areas and non-radiological areas, as well as for the performance of some limited radiological work activities.”
    - ***Delete:** Requirement for Sandia managers/hosts to use escorts in lieu of training for contractors, roving personnel, visitors, and tours under the following conditions:
        - If personnel with RAD102 training may access radiation areas without radiological worker training provided that they are under full-time escort by personnel with appropriate radiological worker training, and provided that the access does not require the RAD102-trained personnel to perform radiological work.
        - If personnel without RAD102, RAD210, RAD230, or RAD214 may use escorts in lieu of training provided that the manager/host obtains concurrence by the appropriate RP Line Support Project Leader (or designee), and written approval from the appropriate facility manager, prior to beginning of escort and/or radiological work activities.
    - ***Add:** Requirement for Sandia managers/hosts to use escorts in lieu of training for contractors, roving personnel, visitors, and tours if the following conditions are met:
        - For escort into Radiation Areas and Contamination Areas, as well as Soil Contamination Areas and Underground Radioactive Material Areas where invasive activities are being (or will be) performed during the escorting activity:
            - Prior knowledge and approval of the escorting activity by the appropriate facility manager (or designee).
            - Prior knowledge and approval of the escorting activity by the appropriate Radiation Protection Project Leader (or designee).

Note: Facility manager and Radiation Protection approval of the escorting activity shall be documented. This documentation shall include: name of the escorted individual; name of the escort; date(s) of the escorting activity; specific details of the escorting activity; and identification of the RWP(s) associated with the area(s) to be entered and/or work to be performed/observed.

- Appropriate monitoring of the escorted individual is performed (see *Radiological Protection Procedures Manual,* Chapter 4).
- Signature on the appropriate RWP(s) of the escort and the escorted individual.

- For escort into Controlled Areas, Radioactive Material Areas, and Radiological Buffer Areas, as well as Soil Contamination Areas and Underground Radioactive Material Areas where invasive activities are not being (or will not be) performed during the escorting activity:
  - Prior knowledge and approval of the escorting activity by the appropriate facility manager (or designee).

  Note: Facility manager approval of the escorting activity shall be documented. This documentation shall include: name of the escorted individual; name of the escort; date(s) of the escorting activity; and specific details of the escorting activity [e.g., area(s) to be entered and/or work to be performed/observed].

- ***Add:** Requirement that states whenever an escort is used in lieu of training, the escort shall be knowledgeable of the facility/area(s) to be entered during the escorting activity.

- ***Add:** Requirements that state escorts in lieu of training are only allowed if:
  - There is no potential for the escorted individual to exceed the annual effective dose equivalent limit for the general public (see Chapter 1, Section 4.1.2).
  - Presence of the escort and escorted individual will not change or affect the radiological conditions in the area(s) being entered.
  - Reliance on the escort provision does not become a routine occurrence.

- ***Change:** Requirement that states that escorts in lieu of training are only allowed if "presence of an escort will be consistent with the ALARA philosophy. This determination should be based upon consideration of the resources (including collective dose) that must be expended to escort the individual versus those necessary to provide the appropriate training" **to** "presence and use of an escort will be consistent with the ALARA philosophy. This determination should be based upon consideration of the resources (including collective dose) that must be expended to escort the individual versus those necessary to provide the appropriate training for the escorted individual."

- ***Add:** Requirement that states " no escorting shall be allowed for High Radiation Areas, Very High Radiation Areas, High Contamination Areas, or Airborne Radioactivity Areas."

- Under topic heading, 4.6, "Training for Managers and Supervisors":

  - ***Add:** Requirement that states managers whose departments own, or are responsible for, radioactive sources (regardless of activity) and/or radiation-generating devices (regardless of classification) shall complete RAD250, "Management of Radiological Operations Training."

  - ***Add:** Requirement that states managers who require unescorted access to controlled areas shall complete RAD102, "General Employee Radiological Training."

  - ***Add:** Note that states the retraining interval for RAD102 is 24 months.

- Under topic heading, 4.7, "Training for Custodians and Operators of Radiation-Generating Devices (RGDs)":

  - **Change** : Section title from "Training for Custodians and Operators of Radiation-Generating Devices (RGDs)" to "Training for Operators and Custodians of Radiation-Generating Devices (RGDs)."

  - ***Separate** : The RGD Operator requirements from the RGD Custodian requirements throughout the entire section.

  - ***Delete:** The requirement for custodians and operators of RGDs to complete radiation safety retraining when there are significant changes to radiation protection policies and procedures that may affect them.

  - ***Add:** Requirement for RGD Custodians to complete RAD219, "Radiation-Generating Device Custodian Training" and RGD Custodians (primary and

secondary) to complete Radiation-Generating Device Custodian retraining at intervals not to exceed 24 months.

- ❍ ***Add:** Requirement for RGD Custodians to complete radiation safety training (e.g., RAD102, RAD210, RAD230, or RAD214, as appropriate) if any part of their job responsibilities requires them to operate radiation-generating devices. This training shall be completed at intervals **not** to exceed 24 months.

March 31, 2006

Chapter 7 "Radiological Design and Control and ALARA Application," was revised to:

- Under the topic, “3.1, Managers”:
  - ❍ ***Change:** The responsibility for managers to ensure that adequate pre-planning of work and ALARA design reviews are conducted such that designs of new or modified facilities meet DOE nuclear and radiological safety requirements as stated in this manual.
  - ❍ * **Change:** The responsibility for managers to ensure that radiological control and area monitoring systems are engineered as required in Chapter 12.
- Under the topic, “3.2, Sandia Personnel, Visitors, and Members of the Public”:
  - ❍ ***Change:** The responsibility for Members of the Workforce , visitors , and members of the public to understand and implement the Sandia ALARA requirements for the locations where they perform work.
- Under the topic, “3.3, RP Personnel”:
  - ❍ ***Change:** The section note to state that the services that follow may be available (subject to resource limitations); consult the appropriate Division ES&H Team for further information.
  - ❍ ***Change**: The independent review of designs for radiological safety and compliance to include the qualifier: Such reviews can meet the inspection requirements for quality-significant contracts that rely on dedication instead of contractor qualification .
  - ❍ ***Add:** Nuclear facilities to the service for coordination of ALARA consultation during design of new and modified radiological facilities.

- Under the topic, “3.4, Sandia Delegated Representatives (SDRs)”:
    - ***Add:** The responsibility for SDRs for contract engineering services to identify these contracts as quality-significant and then implement the quality-significant requirements of these contracts.
    - ***Change:** The responsibility for SDRs to forward any contractor-generated records of ALARA studies and design changes that affect radiological or nuclear facilities to the ALARA Coordinator .
- Under the topic, “3.6, ALARA Coordinator”:
    - ***Change:** The responsibility for the ALARA Coordinator to advise, the Sandia Radiation Protection Program owner and deputies to Sandia Radiation Protection Program Manager regarding the goals, effectiveness, and recommendations of the ALARA Program.
    - ***Add:** The responsibility for the ALARA Coordinator to submit ALARA design review documentation to the ES&H Records Center .
- Under the topic, “4.2, Facility Design and Control”:
    - **Change:** The title of the section from “Design and Control” **to “** Facility Design and Control.”
    - ***Change:** The requirements of this section by greater that 75% and therefore, it should be read in is entirety.
- Under the topic, “4.3, Operational ALARA Reviews”:
    - **Change:** The title of the section from “ALARA Reviews” **to** “Operational ALARA Reviews.”

Chapter 13 "Feedback and Improvement," was revised to:

- **Delete:** Attachments 13-1, 13-2, and 13-3 from chapter.
- Under the topic, “3.1, Line Managers”:
    - **Clarify:** The requirement for managers to ensure that all nonconformances to the requirements of this manual resulting from the owning radiological operations are reported through Radiological Process Improvement Reports (RPIRs) or the

Occurrence Reporting and Processing System (ORPS).

- **Clarify:** The requirement for managers to ensure that a causal analysis is performed for all findings that are specific to the owning radiological facilities and operations.

- *__Change:__ Section note to state a causal analysis need not be performed in accordance with MN471001, ES&H Manual , Section 22B, "Root Cause Analysis (RCA)" unless being performed as a result an Occurrence Reporting & Processing System (ORPS) or Non-compliance Tracking System (NTS) report.

- *__Change:__ The requirement for managers to ensure that corrective actions related to findings that are specific to the owning radiological facilities and operations are developed, tracked to completion, closed, and verified and validated in accordance with the *ES&H Manual,* Chapter 22D.

- **Clarify:** The requirement for managers to ensure that the owning radiological activities are assessed over three years, per Section 4.3.

- *__Add:__ Section note that states: Non-conformances, **identified and reported** through a documented self-assessment (SA) process (e.g., the Triennial SA process), that have been recorded in a database the Nuclear Safety (PAAA)/ DNFSB Liaison Department can review for PAAA applicability, need not be reported through the RPIR process. For such non-conformances, no causal analysis is required; however, the corrective action(s) must be **reported and completed** within 30 calendar days of identification. In addition, evidence of completion of the corrective action must be sent to the Nuclear Safety (PAAA)/ DNFSB Liaison Department. If the non-conformance(s) cannot be corrected within 30 days, an RPIR must be submitted and causal analysis conducted.

- Under the topic, “3.2, Members of the Workforce Identifying Nonconformance”:

  - *__Delete:__ The responsibility for Members of the Workforce to report any nonconformance to the Radiation Protection Program Manager.

- Under the topic, “3.3, Radiological Protection Safety Committee”:

  - **Clarify:** The responsibility for the RPSC to p rovide reports regarding the rollup of assessments of line implementation of radiation protection requirements.

  - *__Change:__ The responsibility for the RPSC to ensure that review, analyze, and summarize the results of the self-assessment information from management, external auditors, DOE/NNSA audits, ORPs, reports, NTS reports , and RPIRs to

identify corporate-wide root causes, develop corrective actions, track corrective actions to completion, and validate and verify corrective actions.

- Under the topic, “3.4, ES&H, Quality, and Safeguards & Security Assessments”:

  - **Change:** Section title from “ Use of Escorts in Lieu of Training “ to “ ES&H, Quality, and Safeguards & Security Assessments.”

  - **Clarify:** The responsibility for the ES&H, Quality, and Safeguards & Security Assessments manager to conduct and document independent assessments of the Radiation Protection Program and line implementation of the requirements in the Radiological Protection Procedures Manual (RPPM).

- Under the topic, “3.5, Nuclear Safety (PAAA)/DNFSB Liaison”:

  - **Change:** Section title from “Price Anderson Amendment Act (PAAA) Program Integration Department “ to “Nuclear Safety (PAAA)/DNFSB Liaison.”

- Under the topic, “3.6, Radiation Protection Department”:

  - **Change:** Section title from “ Radiation Protection Program “ to “Radiation Protection Department.”

  - **Clarify:** The responsibility for the Radiation Protection Department manager to confer with the manager owning a nonconformance regarding reporting requirements, if contacted.

  - *__Add:__ The responsibility for the Radiation Protection Department manager to assess the content of the occupational Radiation Protection Program.

- Under the topic, “4.1, Radiological Process Improvement Report (RPIR)”:

  - **Clarify:** The requirement for nonconformances with this manual (excluding those identified through a documented self-assessment process) shall be reported using one of the following mechanisms:

    - RPIRs, which are reported into the Integrated Reporting Management System (IRMS),

      or

    - ORPS, if a nonconformance meets the threshold criteria for ORPS reporting (report in accordance with *ES&H Manual*, Chapter 18C, “Occurrence

Reporting").

- Under the topic, "4.2, Radiological Protection General Self-Assessments":
  - *__Change:__ The requirement, " SNL personnel shall use Attachment 13-1, "Self-Assessment Checklist - 835 - All Radiological Operations," when performing self-assessments that are part of the triennial self-assessments of radiological operations" **to** "Members of the Workforce shall use the applicable checklists provided by the RPSC when performing self-assessments that are part of the Triennial self-assessment (see Section 4.3) of radiological operations. The checklists are posted on the RPSC Self-Assessment website."
- Under the topic, "4.3, The Triennial Self-Assessment":
  - *__Change:__ The requirements of this section by greater that 75% and therefore, it should be read in is entirety.
- Under the topic, "4.4, Feedback and Improvement":
  - *__Change:__ The requirements of this section by greater that 75% and therefore, it should be read in is entirety.
  - __Change:__ "ES&H Performance Assurance Department" to "ES&H Assurance, Planning & Behavior Based Safety Department" in the section guidance.

March 21 , 2006
Administrative Changes Only

Chapter 8 "Monitoring Areas and Material," was revised to:

- **Remove:** Brian Hunt as a SME for this chapter. Martin Brennan remains as the SME.

March 16, 2006
Administrative Changes Only

Chapter 4 "Radiation Dosimetry," was revised to:

- Under the topic, "4.1.2, Personal Air Sampling":

- **Replace**: " RPDP" with "Radiation Protection" in the guidance for determining the needs for personal air sampling.

- Under the topic, "4.2.4, Non-Returned, Lost, or Damaged Dosimeters":

  - **Correction**: The requirement for Members of the Workforce to provide the information requested in Part IV of the **new** SF 2001-RDR (Word file/Acrobat file), requires removal since there is no **new** SF 2001 – RDR form. This requirement was added to the section in anticipation to an updated SF 2001 RDR form that never occurred.

December 15, 2005
Administrative Changes Only

Chapter 6 "Control of Radiactive Material," was revised to:

- Under the topic, "4.2.4, Radioactive Material Transportation":

  - **Clarify**: That Onsite transfers or movements should be performed in accordance with written procedures. The procedures or other measures should use a graded approach and if necessary should discuss the following:

    - Radiological monitoring.
    - Radiological labeling.
    - ALARA.
    - Spill control/Secondary containment.
    - Notification to impacted personnel of the radioactive material movements.
    - Description of movement route.

December 13, 2005

Chapter 3, "Radiological Training Program" was revised to:

- Under topic heading, 3.4, "Radiological Workers":

- **Add:** note that states – In some instances, computerized training records (e.g., TEDS records) may be used to verify qualification immediately following training until new qualification cards can be issued, to the responsibility for radiological workers to have their current qualification cards in their possession (or readily available) at all times while in radiological areas or while performing radiological work.

- Under topic heading, 4.1, “Minimum Radiological Training”:
  - ***Delete:** training footnote 6 from table 1, “Radiological Training Requirements,” and renumbered the remaining footnotes accordingly.
  - ***Delete:** training footnote 6 for managers responsible for radiological work or radiological workers.
- Under topic heading, 4.3.1, “Generic Training”:
  - ***Add:** requirement to complete the instructor-led version training for Sandia Members of the Workforce who receive radiological worker training for the first time.
  - ***Add:** requirement note that states – In some instances, computerized training records (e.g., TEDS records) may be used to verify qualification immediately following training until new qualification cards can be issued.
  - ***Add:** requirement note that states – Personnel who have completed comparable radiological worker training outside of Sandia may apply for training equivalency (see Section 4.9.2 for specifics). For determination of training equivalency, contact the Radiation Protection and Industrial Hygiene Training Project
- Under topic heading, 4.3.3, “Retraining”:
  - **Add:** guidance that states – A computer-based version of radiological worker training is available for personnel due for their 24-month retraining.
  - **Delete:** guidance that states – Sandia personnel receiving radiological worker training for the first time should complete the instructor-led version of the training. Personnel due for their 24-month training are encouraged to complete the computer-based version of the training.
  - **Delete:** guidance that states – Personnel who have completed comparable radiological worker training outside of Sandia may apply for training equivalency. For determination of training equivalency, contact the Radiation Protection and

Industrial Hygiene Training Project.

- Under topic heading, 4.6, “Training for Managers and Supervisors”:
  - ***Delete:** requirement note that states – Managers are **not** required to take RAD250 if the work their personnel perform requires only RAD102, General Employee Radiological Training (e.g., operation of inherently safe radiation-generating devices [RGDs]).

- Under topic heading, 4.9.2, “Contractors and Visitors”:
  - ***Change:** requirement for contractors and visitors who have completed radiological worker training at another DOE facility.
  - ***Delete:** requirement note that states – Sandia's site-specific radiological worker training includes completion of a self-study training booklet (with exam) and an appropriate applied (hands-on) training exercise.
  - ***Delete:** requirement that states – contractors and visitors shall provide proof of radiological worker training completion at another DOE facility.
  - **Add:** the option to challenge the adequacy of an individuals existing radiological training by requiring the individual to complete a suitable radiological worker training challenge exam, the appropriate hands-on training, and job-specific radiological worker training (Word file/ Acrobat file) for manager’s when considering prior training and experience of non-DOE contractors and visitors.

December 2, 2005

Chapter 1, “Radiological Work Planning and Controls ” was revised to:

Note: An asterisk (*) indicates a substantive change.

- **Replace:** Throughout the entire document and attachments Division ES&H Team with RP Personnel.
- Under topic heading, 2.0, “Scope”:
  - ***Change:** This chapter applies to all radiological work in controlled areas and all work in radiological areas.

- Under topic heading, 3.0, “Responsibilities”:
    - ***Change:** greater than 75% of the requirements in this section have changed, please read in its entirety.
- Under topic heading, 4.0, “Procedure”:
    - ***Change:** greater than 75% of the requirements in this section have changed, please read in its entirety.
- In Attachment 1-3 – “Personal Protective Equipment (PPE) Selection.”
    - ***Change:** Protective clothing (PC) shall be selected based on the contamination level in the work area, the anticipated work activity, worker health considerations, area(s) of the body likely to be exposed to removable contamination, and regard for nonradiological hazards that may be present. Use Table 1 when determining the appropriate protective clothing.

Work Activities	Removable Contamination Levels		
	Low (<10 times Attachment 6-1 values)	**Moderate (10 to 100 times Attachment 6-1 values)**	**High (>100 times Attachment 6-1 values)**
Routine	[1,2] Level I PCs	[2] Level I PCs	[3] Level I PCs, double gloves, double shoe covers
Heavy Work	[2] Level I PCs, work gloves	[2] Level II PCs, work gloves	[3] Level II PCs, work gloves
Work with pressurized or large-volume liquids, closed-system breach	[2] Level I non-permeable PCs	[2] Level II PCs (outer set non-permeable), rubber boots	[3] Level II PCs and non-permeable outer clothing, rubber boots

- [1] Laboratory coats and surgeons gloves may be recommended for low hazard contamination potential situations or whenever work is with liquids or solids to prevent incidental splatter or contact with the material. Laboratory coats should not be used when working with dispersible material such as powders, gases, vapors, mists and pressurized systems.
- [2] Shoe covers and gloves should be taped or otherwise secured at the coverall legs and sleeves when necessary to prevent worker contamination.

- [3] Shoe covers and gloves shall be taped or otherwise secured at the coverall legs and sleeves when removable contamination levels are known or expected to exceed 100 times Attachment 6-1 values or when work activities may result in the spread of contamination to exposed skin.

- In Attachment 1-4 – " Standard Procedure for Donning and Removing Protective Clothing"

  - *Add: Suggested sequence for donning Level I protective clothing. The exact order of donning is not critical so long as all clothing/equipment is donned correctly.

    a. **Don** personal dosimetry as appropriate.

       Technique: TLD should be inside coveralls between the waist and neck on the front portion of the body.

    b. **Don** surgeon gloves and cloth glove liners (optional, for comfort only).

    c. **Don** coveralls, taping coverall seams over surgeon gloves.

       Note: If using coveralls with attached shoe covers and shoes are too big to fit in coveralls or coveralls are not long enough, the attached shoe covers may be removed and separate shoe covers may be donned, taping coverall legs to the shoe covers.

    d. **Don** rubber overshoes.

    e. **Don** outer gloves, pulling gloves over coverall sleeves and taping gloves to coveralls.

       Note: Taping is dependent on situation but is recommended.

    f. **Don** respirator, if applicable, then **don** hood.

       Note: Taping respirator to hood is dependent on situation but is recommended.

    g. **Don** self-reading or electronic dosimetry as required.

       Technique: Place self-reading or electronic dosimeter inside bag and tape to outside of coveralls within three inches of, but not over, the personal TLD.

       Technique: Have partner or RCT check your clothing for proper donning prior to entering the radiologically controlled area.

Technique: Place self-reading or electronic dosimeter inside bag and tape to outside of coveralls within three inches of, but not over, the personal TLD.

Technique: Have partner or RCT check your clothing for proper donning prior to entering the radiologically controlled area.

Glossary:

- ***Add:** Job Coordinator – The person, designated by the manager owning the work, who is most knowledgeable about the work to be performed.

October 24, 2005
Administrative Changes Only

Chapter 12 "Radiation Instrumentation," was revised to:

- **Change:** Section 3.1 heading from “Radiation Protection and Laboratory Services (RPLS)” to “Industrial Hygiene & Instrumentation Department (IH & I/10327).”
- **Change:** References from RPLS to Radiation Protection Instrumentation (RPI) Program throughout the entire document, where applicable.
- **Change:** References from RPLS to Industrial Hygiene & Instrumentation (IH & I) Department throughout the entire document, where applicable.

October 17, 2005
Administrative Changes Only

"TOC ,"was revised to:

- **Change:** The subject matter expert from Kathleen McCaughey to Anthony J. Medina.

September 29, 2005

Chapter 10, "Radiation-Generating Devices (RGDs)," was revised to:

* (Indicates a substantive change)

- Under the topic, “3.1., Device/RGD Registrar”:
  - **Change:** The title of the topic heading from “Managers” to “Device/RGD Registrar.”
  - ***Add:** Responsibilities for the Device Registrar.
- Under the topic, “3.2., Managers”:
  - **Change:** The title of the heading from “RGD Custodians” to “Managers.”
  - ***Add:** Responsibility for the reassignment of RGDs when Members of the Workforce leave their department.
  - ***Add:** Responsibility for an annual inventory of RGDs to be conducted.
- Under the topic, “3.3., RGD Custodians”:
  - **Move:** Responsibilities for RGD Custodians from topic heading number 3.2.
  - ***Add:** Responsibility for performing RGD inventories.
  - **Change:** Reference to section 4.12 to 4.13 for disposal of RGDs.
- Under the topic, “3.4., RGD Operators”:
  - **Move:** Responsibilities for RGD Operators from topic heading number 3.3.
  - ***Add:** Responsibility for notification of changes that affect operation of RGDs.
- Under the topic, “4.11., Inventories”:
  - **Change:** The title of the topic heading from “Dosimetry (ISMS Function: Analyze Hazards)” to “Inventories.”
  - ***Add:** Responsibilities and guidance for RGD Custodians to perform inventories annually.
- Under the topic, “4.12., Dosimetry (ISMS Function: Analyze Hazards)”:
  - **Move:** Requirements for the Whole-body thermoluminescent dosimeter (TLD) from topic heading number 4.11.

- Under the topic, “4.13., Disposal of RGDs (ISMS Function: Analyze Hazards)”:
    - **Move:** Requirements and guidance for RGD custodians to dispose of RGDs from topic heading number 4.12.

August 24, 2005

Chapter 3, "Radiological Training Program," was revised to:

* (Indicates a substantive change)

- Under the topic, “4.0., Procedure”:
    - ***Delete:** Responsibility for first-line supervisors to complete the RAD250 training course, in Table 1, under subtopic “4.1, Minimum Radiological Training.”
    - ***Delete:** Responsibility for first-line supervisors to complete the RAD250 training course, under subtopic “4.6, Training for Managers and Supervisors.”
    - **Add:** Under requirements, a note stating that the current training and qualification for RCTs satisfies the requirements for RAD218 training, under subtopic “4.8, Training for Custodians and Users of Radioactive Sources and Material.”

August 3, 2005
Administrative Changes Only

"Glossary," was revised to:

- **Change:** The word “controlled area” to “radiologically controlled area” in the definition of **radiological area.**

  Note: This change is completed to meet the requirements of corrective action commitment, 2005-I-014-RWP, Issue 1, CA 3.

July 18, 2005

Chapter 8, "Monitoring Areas and Material," was revised to:

- Under the topic, “4.9., Radiological Monitoring”:
    - **Change:** The title of the topic from, “Radiological Monitoring” to “Discrete Particulate Contamination”.
    - **Add:** Requirements for discrete particulate contamination.
    - **Move:** All subtopics previously under 4.9 to 4.10.

Chapter 13, "Feedback And Improvement," was revised to:

* (Indicates a substantive change)

- Under the topic, “2.0., Scope”:
    - ***Change:** The exemptions from the self-assessment process to requirements of this manual.
- Under the topic, “3.0., Responsibilities”:
    - **Change:** Subtopic 3.1 heading from “Division ES&H Coordinators & Line Managers” to “Line Managers.”
    - ***Delete:** Responsibility for reporting nonconformances via the noncompliance tracking system (NTS).
    - ***Add:** Responsibility for causal analyses to be performed for all findings specific to the Line Managers radiological facilities and operations.
    - ***Add:** Note stating that casual analyses must be performed in accordance with the ES&H Manual, Section 22B, “Root Cause Analysis (RCA)” unless it is performed as the result of an ORPS or NTS report.
    - ***Add:** Responsibility for corrective actions to be developed, tracked to completion, and closed.
    - ***Delete:** Responsibility for reporting nonconformances to the PAAA coordinator.
    - **Change:** Subtopic 3.2 heading from “Radiological Protection Safety Committee (RPSC)” to “Members of the Workforce Identifying nonconformances.”

- **Add:** Responsibilities for Members of the Workforce who identify nonconformances.

- **Change:** Subtopic 3.3 heading from “ES&H and Quality Assessments Department” to “Radiological Protection Safety Committee (RPSC).”

- ***Add:** Responsibility to provide feedback and improvement advise to the RP program via the RPSC F&I subcommittee.

- **Change:** Subtopic 3.4 heading from “Price Anderson Amendment Act (PAAA) Program Integration Department (7004)” to “ES&H and Quality Assessments Department).”

- **Change:** Responsibility for conducting and documenting “limited independent assessments” to “independent assessments.”

- **Change:** Subtopic 3.5 heading from”Radiation Protection and Laboratory Services” to “Price Anderson Amendment Act (PAAA) Program Integration Department.”

- **Change:** Responsibility for reviewing the results of “division self-assessments” to “internal and external assessments.”

- **Add:** Subtopic 3.6 heading ”Radiation Protection Program.”

  - **Move:** Responsibilities from subtopic heading 3.5 under 3.6.

  - ***Add:** Responsibility for conferring with the nonconformance owning manager in regards to reporting and assisting with corrective action identification and implementation.

- Under the topic, “4.0., Procedure”:

- Responsibilities under subtopic 4.1 “Radiological Process Improvement Report (RPIR)” have been substantially changed and the section should be read in its entirety.

- **Change:** The period end date for the next Triennial Self-Assessment from December 31, 2004 to December 31, 2007, under subtopic heading 4.3.

- **Change:** IS&S Reporting Feedback & Information Management to ES&H Performance Assurance as the administering department for developing and communicating Lessons Learned.

"Glossary," was revised to:

- **Delete:** The definition of **authorized user** - A person who has been listed on an RWL, which indicates that they have the appropriate training, experience and management concurrence to perform the radiological work authorized by the RWL.
- **Add:** “Note: This definition applies only to this manual” to the definition of **consumer product**.
- **Add:** “Note: This definition applies only to this manual” to the definition of **contractor**.
- **Update:** The definition of **corrective action** - An action identified to correct a finding that, when completed, fixes the problem or prevents recurrence.
- **Add:** “Note: This definition applies only to this manual” to the definition of **engineering controls**.
- **Update:** The definition of **finding** - A statement of fact based on objective evidence documenting an act or condition that does not meet requirements, policies, or procedures required by law, a regulatory agency, DOE, Sandia CPR, or a formally-invoked, site-specific, standard.
- **Update:** The definition of **NTS** - A centralized DOE database that allows Sandia to report noncompliances promptly and take advantage of the mitigation provision outlined in the Price-Anderson Enforcement Program’s enforcement policy. Any potential noncompliance will be reviewed before entering it into the NTS by the PAAA Program Manager, legal staff, the facility/activity owner, and the responsible individual (RI). Input to the NTS reporting system will be managed by the PAAA Program Integration Department.
- **Update:** The definition of **Observation** - A statement of fact based on objective evidence documenting an act or condition that does not violate a requirement but may need improvement.
- **Add: Definition of OP (Operating Procedure)** - An operating procedure (OP) is a document that provides step-by-step instructions for specific operations (normal, postulated abnormal, and emergency operations) to ensure that activities are performed correctly, safely, and consistently. Typically, organizations develop their own OPs for internal use within the organization. OPs may exist as independent documents, unless they describe operations involving hazards which require the development of ES&H SOPs. OPs may not substitute for ES&H SOPs, although they may supplement them.
- **Add: “Note:** This definition applies only to this manual” to the definition of **personal**

protective equipment (PPE).

- **Delete:** Definition of **Principle Authorized User (PAU).**
- **Add:** “Note: This definition applies only to this manual” to the definition of **radioactive material.**
- **Delete:** The definition of **radiological work license** - An Integrated Safety Management System (ISMS) umbrella document that serves as a tool to gather the numerous program elements of radiological work into a single document.
- **Update:** The definition of **technical work document (TWD)** - A formally approved document used to identify activity-level work hazards and their associated work control measures. TWDs are developed as part of implementation of the Integrated Safety Management System (ISMS). TWDs provide an administrative control to communicate to Members of the Workforce the activity-level work hazards and associated work controls during normal activities or foreseeable emergencies. The following are examples of TWDs used at SNL to control hazardous work:
    - ES&H standard operating procedures (ES&H SOPs)
    - Health and safety plans (HASPs)
    - Operating procedures (OPs)
    - Permits, such as safe work permits (SWPs) and radiological work permits (RWPs)
    - Data packages for pressure and vacuum systems
    - Safety and health programs for hazardous waste operations (HAZWOPER)
    - Plans, such as emergency response plans and facility- or building-specific evacuation/emergency plans

  See Chapter 21, "Technical Work Documents (TWDs)," of the *ES&H Manual* for more information on TWDs.
- **Add:** “Note: This definition applies only to this manual” to the definition of **visitor.**

June 29, 2005

Administrative Changes Only

This document was administratively revised to:

- **Change:** Executive Policy Sponsor from Les Shephard to Frank Figueroa

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April 6, 2005

"Glossary," was revised to:

- **Change:** The definition of hot particle to include a specific activity level and examples of common nuclides.
- **Add:** The definition of discrete particle.

April 6, 2005
Administrative Changes Only

MN471016, "Introduction"

This section was changed to:

Under Section 1.1, "Standards, Limits, and Program Requirements":

- **Add:** Paragraph to address quality assurance of radiological operations.

Under Section 3.0, "Ownership":

- **Change:** Paragraph to direct SMEs to the RPSCRS homepage for directions for making changes to the RPPM

  Under Section 4.0, "Assistance/Support":

- **Change:** Division numbers 3127, 3128, and 3129 to 10327, 6328, and 10329 respectively.

March 17, 2005

"Glossary," was revised to:

- **Change:** The definition of RP personnel to include persons qualified and authorized to perform limited scope RP duties.

February 22, 2005

Chapter 12, "Radiation Instrumentation," was revised to:

Under Attachments:

- **Add –** Attachment 12-5, Guidance for Determining if a Radiation-Measuring Instrument is used for Monitoring.

Under Section 1.0, "Purpose":

- **Add –** Applicability statement.

Under Section 2.0, "Scope":

- **Change –** Verbiage from, “this chapter **(does not intend)** to (**does not contain)** a complete set of instructions.”

Under Section 3.1, "Radiation Protection and Laboratory Services Department (RPLS/10323)":

- **Change –** Verbiage from, **“(radiation measurement)** to **(radiation-monitoring).”**

Under Section 3.3, "Managers":

- This section was substantially (greater than 75%) altered and should be read in its entirety.

Under Section 3.4, "Members of the Workforce Who Have Been Issued Radiation-Monitoring Instruments":

- **Change –** Verbiage from, **“(radiation measurement)** to **(radiation-monitoring).”**
- **Change –** Verbiage from **, “(SNL personnel)** to **(Members of the Workforce).”**

Under Section 3.5, "Members of the Workforce Who Use Radiation-Monitoring Instruments":

- **Change –** Verbiage from, **"(radiation measurement)** to **(radiation-monitoring)."**
- **Change –** Verbiage from **, "(SNL personnel)** to **(Members of the Workforce)."**

Under Section 4.1, "Radiation-Monitoring Instrument Training":

- **Change –** Verbiage from **, "(personnel)** to **(Members of the Workforce)."**
- **Add –** Verbiage radiation-monitoring and instrument-related to requirements.

Under Section 4.2, "Radiation-Monitoring Instrument Selection and Procurement":

- **Change –** Verbiage from **, "(SNL personnel)** to **(Members of the Workforce)."**
- **Change –** Verbiage from, **"(radiation measurement)** to **(radiation-monitoring)."**

Under Section 4.3, "Including Radiation-Monitoring Instruments in Technical Work Documents (TWDS)":

- **Change –** Verbiage from, **"(radiation measurement)** to **(radiation-monitoring)."**
- **Change –** Verbiage from **, "(SNL personnel)** to **(Members of the Workforce)."**

Under Section 4.4, "Using Radiation-Monitoring Instruments":

- This section was substantially (greater than 75%) altered and should be read in its entirety.

Under Section 4.5, "Ensuring Valid Readings from Radiation-Monitoring Instruments ":

- **Change –** Verbiage from **, "(SNL personnel)** to **(Members of the Workforce)."**

Under Section 4.6, "Radiation-Monitoring Instrument Operational ":

- **Change –** Verbiage from **, "(SNL personnel)** to **(Members of the Workforce)."**

Under Section 4.7, "Radiation-Monitoring Instrument Calibration and Maintenance ":

- **Change –** Verbiage from, **"(radiation measurement)** to **(radiation-monitoring)."**
- **Change –** Verbiage from **, "(SNL personnel)** to **(Members of the Workforce)."**

Under Section 4.8, "Radiation-Monitoring Instrument Out-of-Tolerance Reports ":

- **Change –** Verbiage from **, “(SNL personnel)** to **(Members of the Workforce).”**
- **Change – Note:** RP personnel are available to help assess the impact of instruments found to be out of tolerance and to implement appropriate corrective actions.

Under Section 4.9, "Radiation-Monitoring Instrument That Are No Longer Needed ":

- **Change –** Verbiage from **, “(SNL personnel)** to **(Members of the Workforce).”**

Under Section 5.0, "Radiation-Monitoring Instrument Records ":

- **Change –** Verbiage from **, “(SNL personnel)** to **(Members of the Workforce).”**
- **Change –** Verbiage from, **“(radiation measurement)** to **(radiation-monitoring).”**

Under Section 6.1, "Requirements Source Documents”:

- **Add –** SNL, CPR001.3.3, *Formality of Operations Manual* , Chapter 2, and “Operating Practices.”

Radiological protection Procedures Manual Glossary:

- **Add:**
  - *Radiation-monitoring instrument(s)
  - *Radiation-measuring instrument(s)

December 7, 2004

Chapter 8, "Monitoring Areas and Material," was revised to:

Under Section 4.9, "Radiological Monitoring":

- **Add.** A new subsection 4.9.1, “Purpose of Monitoring,” that lists the situations from 10 CFR 835 when monitoring is required and Sandia-specific examples.

- **Add.** A new subsection 4.9.2, “Routine Montoring Schedules,” that requires establishment of routine monitoring schedules.

- **Add.** A new subsection 4.9.3, “Deviations from Schedules,” that specifies what is required to get a deviation from an established routine monitoring schedule.

- **Add.** A new subsection 4.9.4, “Review of Monitoring Frequencies,” that requires review of the routine monitoring schedules at least annually or more often if there are significant changes to the work being done.

- **Add.** Attachment 1-8, "Guidance for Establishing Radiological Survey Frequency"

July 12, 2004

Chapter 6, "Control of Radioactive Material" was revised to:

Under Section, 2.1, “Exempted Items”:

- **Add.** Reference to RPO-01-14, *Procedure for the Review and Categorization of Radioactive Materials by the Radioactive Material Controls Committee*.

Under Section, 2.2, “Conditionally Controled Material”:

- **Add.** Activated or volume contaminated material meeting the criteria of the Conditionally Controlled List to the list of example conditionally controlled material.

- **Add.** Reference to RPO-01-14, *Procedure for the Review and Categorization of Radioactive Materials by the Radioactive Material Controls Committee*.

To the topic, “References”:

- **Add** to the subtopic, “Requirements Source Documents,” 10 CFR 30 that pertains to consumer products.

To Attachment 6-2, “Exempted Items List”:

- **Add.** The subtopic, “ES&H Samples.”

To Attachment 6-3, “Conditionally Controlled Material List”:

- **Add.** Rows to the table for:

- Self-luminous products containing tritium.
- Items, sources and materials that have been activated or volume contaminated below the stated limits.

July 7, 2004
Administrative Changes Only

Chapter 7, "Radiological Design and Control and ALARA Application," was revised to:

Under the topic, 4.2, Design and Control,"

- **Change** the driver reference for the third bullet, first sub-bullet from 10 CFR 835.1002 **(b)** to 10 CFR 835.1002 **(a)**.

"Glossary," was revised to:

- **Change.** The term "occupational exposure" to "occupational dose" to agree with the DOE change as reflected in 10 CFR 835, *Occupational Radiation Protection*. The wording of the definition is **not** changed.

May 25, 2004

Chapter 1, "Radiological Work Planning and Controls," was revised to:

- Under the topic, "4.4.1 Conducting Radiological Work":
  - **Change.** Clarify that not smoking, eating, drinking, chewing, or applying cosmetics in soil contamination areas is restricted to periods of intrusive work.
  - **Change.** Clarify the "note" about the activities that may or may not be performed in designated hydration break areas during periods of intrusive work in soil contamination areas.
- Under the topic, "4.4.3 Personnel Contamination Control":
  - **Add.** The requirements that tools, equipment, containers, and personal items (e.g., notebooks, papers and flashlights) being taken from contamination areas, high

contamination areas, and airborne radioactivity areas are to be frisked to the same requirements as the person carrying them.

- **Change**. Clarify the frisking requirements when exiting a radiological buffer area that adjoins a contamination area, high contamination area, or airborne radioactivity area.

- To Attachment 1-5, “Guidelines for Personnel Monitoring with Portable Frisking Instruments”:
  - **Add.** Guidance that special monitoring requirements may be necessary to assure adequate instrument sensitivity relative to the nuclide of concern, background issues or other factors affecting adequacy of the frisk.

Chapter 4, "Radiation Dosimetry," was revised to:

- Under several topics:
  - **Change.** References to “external” and/or “internal” dosimetry to “dosimetry services.”
  - **Change.** To “Radiation Protection Dosimetry Project (RPDP),” from previous references to:
    - Dosimetry Processing Center.
    - Radiation Protection External Dosimetry Project (RPXD).
    - Radiation Protection Internal Dosimetry Project (RPID).
- Under the topic, “2.0 Scope”:
  - **Delete.** The term “minor” from the Scope statement.
  - **Add**. The term “visitor” to the Scope statement.
- Under the topic, “3.1 Personnel Monitoring and Laboratory Services Department (7132),” and throughout the document:
  - **Change.** Organization name and number to “Radiation Protection and Laboratory Services Department (3123).”
- Under the topic, “3.2 Health and Safety Department (8517)”:

- **Change.** Topic title to “SNL/CA Health and Safety Department (8517).”
- **Delete.** Responsibilities related to administering the Radiation Protection Internal Dosimetry Project at SNL/CA.
- **Add.** The responsibility to obtaining internal dosimetry services from Department 3123 as needed for SNL/CA personnel.

- Under the topic, “3.3 Tonopah Test Range (15421)”:
  - **Change.** Department 15421 is responsible for providing external personnel dosimeters at SNL/NV.
  - **Add.** The responsibility to obtaining internal dosimetry services from Department 3123 as needed for SNL/NV personnel.
- Under the topic, “3.4 RP Personnel”:
  - **Add.** To the responsibility for providing personnel air samplers, forwarding corresponding data to Department 3123.
  - **Add.** The responsibility to assist managers in conducting dose investigations for lost or stolen TLDs.
- Under the topic, “3.5 Managers”:
  - **Add.** The responsibility for deleting names of individuals who no longer require dosimetry.
  - **Add.** The responsibility for documenting all occupational exposures received during the current year and how the exposure information was obtained (e.g., pre-employment and/or offsite).
- Under the new topic, “3.7 Sandia Employees”:
  - **Add.** Specific responsibilities for Sandia employees that are in addition to the general responsibilities for all Members of the Workforce regarding submission of previous dose history.
- Under the topic, “4.1.1 Routine Bioassay Program”:
  - **Delete.** From managers’ requirements, the bullet and “note” regarding minors.

- **Delete.** Requirements relating specifically to Members of the Workforce who are assigned to the Nevada Test Site.

- **Change.** Move the conditions under which individuals are expected to provide bioassay samples or submit to a whole body count as requested from “Guidance” to “Requirements,” and clarify and simplify the conditions.

- **Add.** To the list of conditions under which individuals are expected to provide bioassay samples or submit to a whole body count:

  - If a personal air sample result indicates an internal exposure exceeding 10 mrem.

  - As required on a Radiological Work Permit or other technical work document.

  - Upon terminating employment.

- Under the topic, “4.2.1 External Dosimetry Monitoring”:

  - **Delete.** The bullet and “note” regarding minors.

  - **Add.** A requirement that Members of the Workforce shall wear Sandia thermoluminescent dosimeters (TLDs) when entering controlled areas where a TLD requirement is posted.

  - **Change.** Divide the list of requirements for wearing TLDs between those that apply to Members of the Workforce and those that are specific to Sandia employees.

  - **Add.** Requirement for Members of the Workforce to return dosimeters within 2 weeks. This text was moved from “Guidance” under the topic, “4.2.4 Non-Returned, Lost, or Damaged Dosimeters.”

  - **Add.** The “note” indicating that the RPDP has the authority to remove individuals who do not return their dosimeters within 2 weeks of the scheduled return time from the dosimetry issue program. This text was moved from “Guidance” ” under the topic, “4.2.4 Non-Returned, Lost, or Damaged Dosimeters.”

  - **Add.** A “note” stating the authority of the Radiation Protection Dosimetry Project (RPDP) to remove Sandia employees from the dosimetry program if prior dose history forms are not returned to RPDP within the 2-week required time period.

- Under the topic, “4.2.2 Obtaining External Dosimetry”:

- **Change**. Place the responsibility for initiating a request for external dosimetry on the individual, not the manager, and clarify the procedure steps.

- Under the topic, “4.2.3 Use and Care of Dosimeters”:
  - **Add.** Guidance:
    - For emergency response personnel who may consider taking dosimetry home with them for availability if they are called out off-hours.
    - Discouraging the taking of Sandia dosimetry on airplanes, but providing helpful hints for those who decide to take Sandia dosimetry on an airplane.

- Under the topic, “4.2.4 Non-Returned, Lost, or Damaged Dosimeters”:
  - **Add.** A requirement for Members of the Workforce who lose, contaminate, or damage their dosimeters to complete a dosimetry investigation, if requested by RPDP.
  - **Delete.** The guidance and the “note” about returning dosimeters within 2 weeks. This text was moved to topic, “4.2.1 External Dosimetry Monitoring.”

- Under the topic, “4.2.5 Returning Dosimeters”:
  - **Change.** Move the responsibility for Members of the Workforce who host visitors or members of the public to return dosimeters at the end of the visit to the location from which the dosimeters were issued from “Guidance” to a requirement.

- Under the topic, “4.2.6 Deleting Personnel from the Routine Dosimeter Exchange Program”:
  - **Change.** Clarify manager responsibilities for maintaining dosimeter exchange participant lists and returning the lists to RPDP.

- Under the new topic, “4.2.7 Reporting Offsite Doses”:
  - **Add.** Requirements for personnel who are provided dosimetry at offsite locations to have doses received at offsite facilities reported to the Sandia RPDP using the new SF 2001-ODR, Offsite Dose Release Form.

- Under the new topic, “5.0 Records”:
  - **Delete.** Manager responsibilities for maintaining dosimetry records. All dosimetry

records are maintained by the RPDP.

Chapter 8, "Monitoring Areas and Material,"

This chapter was revised to:

- **Add.** A new subsection, "4.2.1, Breathing Zone Air Monitoring," specifying the conditions for which lapel or fixed location breathing zone air sampling devices are required and when alternative monitoring methods are to be used.

Chapter 11, "Radiological Incidents," was revised to:

Under several topics, update organization names and numbers.

- Under the topic, "3.3 Health Services Organizations"
  - **Change.** The topic title from "Medical Organizations" to "Health Services Organizations."
  - **Change.** That health services organizations are responsible for personnel decontamination when there is also an injury or when limited non-intrusive decontamination efforts are unsuccessful.
  - **Add.** A "note" that in California, decontamination services are provided by the Lawrence Livermore National Laboratory (LLNL) Health Services Department.
- Under the topic, "3.5 RP Personnel":
  - **Add.** That RP personnel can perform limited non-abrasive decontamination when there is not also an injury.
  - **Add.** For RP personnel to notify the appropriate health services organization limited non-abrasive decontamination has been performed.
  - **Change.** For RP personnel to assist medical personnel in evaluating and decontaminating individuals who were not successfully decomntaminated by limited non-abrasive techniques.
  - **Add.** For RP personnel to advise the manager and Members of the Workforce of their responsibility to report contamination incidents to the appropriate health services organization for initiation of the injury/illness reporting process.

- Under the topic, 4.2.7 Skin Contamination":
    - **Change**. Members of the Workforce are to perform limited, non-abrasive decontamination in conjunction with RP personnel only when there is no injury.
    - **Change.** Move the information about discrete particles to a "note."
    - **Add.** Members of the Workforce are to notify the appropriate health services organization of efforts that have been taken to remove skin contamination.

April 16, 2004

Chapter 14, "Declared Pregnant Workers," was revised to:

- **Add:**
    - Section 4.1.1, Assistance," that groups several "notes" into a Guidance section.
    - Section title 4.1.2, "Procedure," that contains the procedures for declaring pregnancy.
- **Change:**
    - In Section 2.0, "Scope," text to clarify the scope of this chapter.
    - In Section 3.2, "Managers of Declared Pregnant Workers," that managers are responsible for:
        - Forwarding Form SF 2001-PG, Declaration of Pregnancy for SNL Employees, to the responsible Radiation Protection Line Support Project Leader after signing it.
        - Signing Form SF 2002-WPG, Withdrawal of Pregnancy Declaration, and forwarding it to the responsible Radiation Protection Line Support Project Leader.
    - In Section 3.3, "Radiation Protection (RP) Personnel," the note describing the responsibility for not disclosing status from a note to a bullet.
    - In Section 4.1.2, "Procedure," and Section 4.3, "Withdrawing a Declaration of Pregnancy," signed forms are forwarded to the RP Project Leader on the

appropriate Division ES&H Team instead of directly to the Division ES&H Team.

January 26, 2004

The "Introduction" was revised to:

Change:

- To the Section 5.0, "Exemptions," the process for requesting an exemption.

October 13, 2003
Archived

Chapter 15, "Radiological Work Licenses," was **archived** on October 13, 2003, as approved by vote of the Radiation Protection Safety Committee (RPSC) on October 3, 2002. The use of Chapter 15 to issue radiological work licenses (RWLs) was suspended effective October 13, 2002, but was retained in the *Radiological Protection Procedures Manual* for information purposes. All expiring RWLs were replaced with PHSs during the intervening year. By October 13, 2003, all RWLs will have been replaced with PHSs and the need for Chapter 15 as an information source has elapsed.

October 1, 2003
Administrative Changes Only

The "Glossary" was revised to:

- **Add:** A definition for the term "inaccessible." [RPSC, September 29, 2003]

August 13, 2003

The "Introduction" was revised to:

- **Change:**
  - To the Section 5.0, "Exceptions," the process for requesting an exception.

June 30, 2003

Chapter 13, "Feedback and Improvement" was revised to:

- **Add.** To Section 3.1, “Division ES&H Coordinators & Line Managers,” a responsibility for managers to ensure that their radiological activities are assessed every 3 years per Section 4.3, “The Triennial Self-Assessment.”

- **Change.** In Section 4.3, “The Triennial Self-Assessment, Note,” clarification of the three elements of the triennial assessment process.

- **Change.** In Section 4.3, “The Triennial Self-Assessment,” that division ES&H coordinators shall be responsible for ensuring that:

  - At least 30% or ten (whichever is the larger number) of a division’s Authorization Basis Documents (i.e., PHSs and SARs) for radiological activities are assessed during the triennial period (activities classified as Standard Industrial Hazard (SIH) or exempted items listed in Attachment 6-2, “Exempted Items List,” need not be assessed.).

  - All activities shall be assessed in a division having ten or less applicable activities.

  - Assessments are performed using Attachment 13-1, “Self-Assessment Checklist - 835 - All Radiological Operations.”

  - Activities for which a site visit is not appropriate (examples listed) may be assessed without a site visit as long as the assessment is documented and a justification for not visiting the activities is entered in the “Comments” section of the Attachment 13-1 cover sheet for the assessment.

- **Change.** In Section 4.3, “The Triennial Self-Assessment,” RPSC actions to the RPSC will perform an analysis of Attachment 13-1 results for the current triennial period in accordance with Attachment 13-3.

- **Change.** In Attachment 13-2, "Triennial Information Submittal," that division ES&H coordinators shall ensure that triennial self-assessment reports include:

  - The areas and personnel that were audited.

  - Details of the sampling plan if some radiological operations were not assessed,

including a list of the PHS and SARs sampled.

- Copies of all checklists (Attachment 13-1) completed during the current triennial period (these may be submitted electronically).

- **Change.** In Attachment 13-3, "Evaluation of Triennial Assessment Data,":

  - Move evaluation responsibilities from the RPSC to the Feedback and Improvement Subcommittee.

  - Clarify that the triennial report is a corporate document.

June 18, 2003
Administrative Changes Only

Attachment 6-3, "Conditionally Controlled Material List" was revised to:

- **Change:**

  - Restore the list content to that prior to the December 12, 2002, administrative change. Only the last row prior to the "Notes" is affected. This change was made in violation of the Conditionally Controlled Material List process, and was authorized at an inappropriate level. Following further investigation, the content of this change will be reworded and submitted through the change process. [RPSC Requirements Subcommittee, June 17, 2003]

May 22, 2003
Administrative Changes Only

Chapter 3, "Radiological Training Program," was revised to:

- **Change:**

  - To Section 4.4, "Use of Escorts in Lieu of Training," second bullet, replace "representative RCT" with "designee" to give the Project Leader more flexibility in assigning an alternate.

March 31, 2003

Chapter 6, "Control of Radioactive Material" was revised to:

- **Add.** To the Section 1.0, “Purpose,” that the section now also provides guidance on the decision mechanism for disposing of radioactive or potentially radioactive material.

- **Add.** To the Section 2.0, “Scope,” clarification that radioactive material is defined by the limits in Attachment 6-1.

- **Change.** In the Section 2.1, “Exempted Items,” a new bullet to the list that overrides an exemption for “SNL radiological material is added intentionally or accidently, or if the item/ material has become activated due to SNL activities.”

- **Change**. In Section 2.1, “Exempted Items” and Section 2.2, “Conditionally Controlled Material,” move the statement “If radioactive material becomes dissociated from a conditionally controlled item as a result of storage, use, handling, aging, damage, etc., the contamination shall be controlled in accordance with the requirements of this manual (see Section 4.2.3),” and reword it into a manager requirement in Section 4.2.1, “Control of Radioactive Material.”

- **Add.** To the Section 2.3, “Controlled Material,” add the following bullets to the examples of controlled material:

    - Items, sources, or material that is activated or volume contaminated and a "note" regarding an exclusion for items that were once activated or volume contaminated, but now meet RMMA requirements.

    - Material exceeding the Attachment 6-1 levels to the fourth bullet, clarify that inaccessible radioactive material or radiation sources “(not in excess of Appendix E values).”

- **Change**. In Section 2.3, “Controlled Material,” delete the imbedded definition and add two bullets to the list of criteria that define “controlled material.”

- **Add.** In Section 2.3, “Controlled Material,” add a second “note” about certain SNM inventories being classified and consolidating inventory information may reveal information that would be useful to an adversary and advising that inventory information be reviewed by an Authorized Derivative Classifier (ADC).

- **Change.** In Section 3.1, “Managers,” third bullet, that decontamination … is performed in accordance with “approved technical work documents."

- **Change.** In Section 3.1, “Managers,” move several imbedded manager requirements to Section 4.2.1.

- **Change.** In Section 3.2, “SNL Personnel,” move two imbedded personnel requirements to Section 4.2.1.

- **Change.** In Section 3.3, “Radiation Protection Personnel,” the second bullet that surveys of record are conducted and documented to support line operations.”

- **Add.** To Section 3.3, “Radiation Protection Personnel,” a new fourth bullet that RP personnel are responsible for “providing radiological support for the disposition of facilities…”

- **Change:** In Section 3.4, “Receiving/Mail & Material Movement Department (10263) and Corporate Storage & Shipping (10268),” list both departments (and update organization names and numbers) because the responsibilities that were previously listed have been divided between these departments.

- **Add:** To Section 3.4, “Receiving/Mail & Material Movement Department (10263) and Corporate Storage & Shipping (10268),” a fourth bullet stating that these departments are responsible for “providing guidance to line managers on the requirements for onsite transportation…”

- **Change**. In Section 4.1.3, “Receipt of Radioactive Material, Requirements,” a note that RPPM requirements apply to a limited quantity radioactive material even though current shipping regulations allow it to be shipped without an external radioactive material label.

- **Change.** In Section 4.1.3, “Receipt of Radioactive Material, Requirements,” a simplified statement that “managers shall ensure that facilities under their operational control are properly posted in accordance with the requirements of Chapter 2, ‘Posting and Labeling for Radiological Control."

- **Change**. In Section 4.2.1, “Control of Radioactive Material, Requirements,” include some requirements that were previously obscured in the “Responsibilities” section under the lead-in, “managers shall ensure that…” In addition, the following revisions were made:

- **Change.** In Table 1, "Radioactive Material Controls," delete RAD102 from the first row, last column to be consistent with the official training requirements in Chapter 3, "Radiological Training Program."

- **Change.** When accountable radioactive sources are transferred … the “documentation specified in Chapter 9, ‘Control of Accountable Radioactive Sources,’ is completed within 60 days.”

- **Add.** "In cases where facility ownership is transferred and continued operation of the facility is anticipated, the facility must be remediated to Attachment 6-1 levels or the new owner must be appraised and accept the current radiological conditions."

- **Add.** "In cases of final disposition, facilities must meet the authorized limits appropriate for the disposition path (such as Attachment 6-1 values, interagency agreement values, or waste acceptance criteria) and disposition documentation must be completed prior to transfer of real property to a new owner or final demolition activities commence."

- **Add.** "Written guidance is obtained from the appropriate Division ES&H Team as it relates to a specific line-owned process."

- **Change**. In Section 4.2.1, "Control of Radioactive Material," some requirements for SNL personnel that were previously obscured in the "Responsibilities" section.

- **Add.** To Section 4.2.1, "Control of Radioactive Material," three requirements that were moved from "Responsibilities."

- **Change.** Rename Section 4.2.2 to "Control of Material, Property, and Equipment," and combine with the previous Section 4.2.2, "Storage of Radioactive Material," and Section 4.2.3, "Control of Material and Equipment."

- **Add.** To the renamed Section 4.2.2, "Control of Material, Property, and Equipment," content that covers the scrap metal moratorium, volumetric contamination, and release of material.

- **Change.** To Section 4.2.2, "Control of Material, Property, and Equipment," the first bullet that all of the following sub-bullets must be true.

- **Add.** In Section 4.2.2, "Control of Material, Property, and Equipment," to the first bullet, a sub-bullet that adds to the criteria for material transfer.

- **Add.** In Section 4.2.2, "Control of Material, Property, and Equipment," the requirement that "scrap metal coming from a radiological area is evaluated to ensure that *E&SH Manual*, Chapter 10U, "Scrap Metal from a Radiological Area or Volumetrically Contaminated Metal," disposition restrictions are followed.

- **Change.** To Section 4.2.2, "Control of Material, Property, and Equipment," move the bullet "contamination that results from Attachment 6-2, 'Exempted Items List are handled…" and all sub-bullets from "Guidance" to "Requirements."

- **Change.** To Section 4.2.2, "Control of Material, Property, and Equipment," include as requirements some of the guidance statements previously under the old Section 4.2.3,

"Control of Material and Equipment, Guidance."

- **Change.** To Section 4.2.2, "Control of Material, Property, and Equipment," sub-bullets, refer to RPPM, Chapter 13, and *ES&H Manual*, Chapters 18 and 22 for more information about occurrence reporting

- **Change**. To Section 4.2.2, "Control of Material, Property, and Equipment," sub-bullets, clarification of the criteria for unrestricted release for disposition and a callout to the new Attachment 6-5, "Release/Disposal Decision Flowchart."

- **Change**. To 4.2.2.2, "Control of Radioactive Material Quantities Less Than One-Tenth of the Values Specified in Appendix E, Guidance" clarify the applicability of the guidance.

- **Change**. Renumber the remaining 4.2.2 subsections (e.g., 4.2.2.2 to 4.2.2.1, 4.2.2.3 to 4.2.2.2).

- **Change**. Rename Section 4.2.3, to"Control of Areas."

- **Change.** Combine all of the statements under the first "Guidance" into "Requirements." The second "Guidance" remain as "Guidance." [For some reason, this section had two "guidance" sections.]

- **Add**. To Section 4.2.3, "Control of Areas, Requirements," managers shall ensure that:

    - "The appropriate Division ES&H Team is contacted, in a timely manner, for assistance in determining the potential impact of, and providing…"

    - "Facilities meet the authorized release criteria (Attachment 6-1) and that release surveys are documented prior to transfer of real property to a new owner…"

    - "Radiological buffer areas are established around contamination areas 'and airborne contamination areas' as a secondary boundary to minimize…"

- **Add.** To Section 4.2.3, "Control of Areas, Requirements," a "note" about how to obtain an exemption to step-off pads at access control points of contamination, high contamination, and airborne radioactivity areas to cover areas such as fumehoods.

- **Change**. In Section 4.2.3, "Control of Areas, Guidance," in the third bullet, delete "10 times" the values in Attachment 6-1.

- **Change**. In Attachment 6-1, "Radioactive Contamination Limits," the removable and soil contamination limit for tritium and tritiated compounds to 10,000 to agree with 10 CFR 835, Appendix D.

- **Add**. New Attachment 6-5, “Release/Disposal Decision Flowchart.”

March 13, 2003
Administrative Changes Only

Chapter 1, "Radiological Work Planning and Controls," was revised to:

- **Change:**
  - To Section 3.1.1, “Responsibilities, Managers of Radiological Workers” clarification of responsibilities with regard to RWPs.

March 11, 2003
Administrative Changes Only

Chapter 1, "Radiological Work Planning and Controls," was revised to:

- **Change:**
  - To Section 4.3.3, "Radiological Work Permit (RWP) Types, Guidance," clarify the extension periods for a job-specific RWP.

March 10, 2003
Administrative Changes Only

Chapter 1, "Radiological Work Planning and Controls," was revised to:

- **Add:**
  - To the Section 4.3.2, "Radiological Work Permits (RWPs)," a statement of the RPSC suspension on the use of eTWDs for controlling radiological work.
- **Delete:**
  - From Section 4.3.2, "Radiological Work Permits (RWPs)," in the first bullet, the option of using eTWDs to control rad work.

March 10, 2003
Administrative Changes Only

Chapter 2, "Posting and Labeling for Radiological Control," was revised to:

- **Add:**
  - To the Section 4.1, "General Posting and Labeling, Requirements," a clarification to the general requirement for posting that **radiological postings and labels reflect current conditions in the area**.
- **Add:**
  - To the Section 4.2, "Specific Posting Criteria, Requirements," a restatement to follow the requirement of this chapter and clarification that **field measurement and observations conducted as an element of routine surveys, job coverage, or changes in facility use** are acceptable as verification of postings.

February 26, 2003
Administrative Changes Only

Chapter 3, "Radiological Training Program," was revised to:

Change: To the Section 4.3.3, "Retraining, Guidance":

- Loosening the 12 month retraining limit to "approximately 12 months."
- Linking to the new Radiological Worker Update computer-based course for meeting the retraining requirement.

December 12, 2002
Administrative Changes Only

Chapter 6, "Control of Radioactive Material," was revised to:

- **Add:** To Attachment 6-3, "Conditionally Controlled Material List," items from Section 2.2,

"Conditionally Controlled Material," in the chapter to make both lists agree. The added items are:

- Individual items, including sealed radioactive sources, with activity levels less than one-tenth the applicable limit in Appendix E.
- Generally or specifically licensed commercially available products.
- Exempted items that no longer meet the exclusions listed in Section 2.1.
- Inaccessible radioactive material or radiation sources.

November 14, 2002

Chapter 9, "Control of Accountable Radioactive Sources"

This chapter has been revised to:

- **Add:**
  - To Section 4.1, "Acquisition and Receipt, Requirements" a requirement for source custodians to verify that a PHS is in place, and updated, as appropriate, as well as other required technical work documents, in accordance with RPPM Chapter 1, "Radiological Work Planning and Controls," and ES&H Manual, Chapter 13, "Hazards Identification/Analysis and Risk Management," and Chapter 21, "Technical Work Documents (TWDs)."
  - In Section "4.2.1 Registration, Requirements," Clarification on the custodians responsibilities upon receipt of the "Radioactive Source Information sheet", "Initial Inventory Checklist" and "barcode identification label" from the Source Registrar:
  - To Section 4.6, "Labeling, Requirements," requirements for labeling and barcoding.
  - To Section 4.6, "Labeling," a "Guidance" section that recommends maintaining a binder that includes, at a minimum, a current Radioactive Source Information sheet for each ARS in their possession and that the binder be filed near the ARS storage location.
- **Change:**
  - In Section "4.2.1 Registration, Requirements," move the labeling instructions for

source custodians from “Guidance’ to Section 4.6, “Labeling, “Requirements.”

Chapter 10, "Radiation Generating Devices (RGDs)"

This chapter has been revised to:

- **Add:**
  - To Section “4.5 Pre-Operational and Initial Operating Activities,” a new requirement for RGD custodians to “verify that a PHS is in place, and updated, as appropriate, in accordance with RPPM Chapter 1, “Radiological Work Planning and Controls,” and *ES&H Manual*, Chapter 13, “Hazards Identification/Analysis and Risk Management,” before operating, or permitting the operation of, a newly acquired RGD.

October 24, 2002
Administrative Changes Only

Chapter 15, "Radiological Work Licenses"

This chapter has been revised to:

- **Add:**
  - A statement describing the transition from RWLs to PHSs, including a link to the ISMS Software (PHS) website.
- **Delete:**
  - Inactivate the content of this chapter. The content is being retained until October 13, 2003 for historical purposes only.

October 10, 2002

Chapter 13, "Feedback and Improvement"

This chapter has been revised to:

- **Add:**

- To the new Section 4.1, “Radiological Process Improvement Report (RPIR),” a note clarifying the benefits of using RPIRs.

- New Section 4.4, “Feedback and Improvement, Requirements” that tasks the RPSC Feedback & Improvement (F&I) Subcommittee. This section is based on the F&I Subcommittee charter.

- **Change:**

The most significant change to this chapter is:

- In Section 4.1, “Radiological Process Improvement Report (RPIR), Requirements,” require the manager to use RPIRs for reporting nonconformances to the requirements of the RPPM, but not for issues that are reported through a higher level system (e.g., NTS, ORPS, WebSIMS).

- **Additional changes are:**

- In Section “3.1 Division ES&H Coordinators & Line Managers,” combine division ES&H coordinators (previously 3.1) and managers (previously 3.2) responsibilities. Clarify that the triennial self-assessment is a shared responsibility.

- In Section 3.1, ”Division ES&H Coordinators & Line Managers, “ in the bullet “Submitting…,” clarify that only the triennial report goes the RPSC, not all division self-assessment reports.

- Combine the previous Section 3.2, “Managers,” into the new Section 3.1.

- In new Section 3.2, “Radiological Protection Safety Committee (RPSC),” update responsibilities to be (1) responsible for corporate reports regarding rollup of line implementation and (2) ongoing tracking and trending of radiological performance.

- In new Section 3.3, “ES&H and Quality Assessments Department (12870),” update responsibilities.

- In Section 3.5, “Radiation Protection and Laboratory Services (3123),” update responsibilities.

- Re-order the subsections in Section 4.0, “Procedure,” to 4.1, “Radiological Process Improvement Report (RPIR),” 4.2, “Radiological Protection General Self-Assessments,” 4.3, “The Triennial Self-Assessment,” and 4.4, “Feedback and Improvement.”

- In Section 4.2, “Radiological Protection General Self-Assessments, Requirements,” require personnel (changed from manager) to use Attachment 13-1, “Self-Assessment Checklist - 835 - All Radiological Operations,” when performing self-assessments that are part of the triennial self-assessments of radiological operations.

- In Section 4.2, “Radiological Protection General Self-Assessments, Guidance,” refer personnel to *ES&H Manual*, Section 22A, “ES&H Self-Assessment Activities,” for information regarding general self-assessments.

- In Section 4.3, “The Triennial Self-Assessment, Requirements, Division ES&H Coordinators,” require division ES&H coordinators to ensure that all RPPM functional elements are covered and documented during the triennial assessment period.

- In new Section 4.3, “The Triennial Self-Assessment, Requirements, Note,” revise the date for completion of the next triennial report to December 31, 2004.

- In Section 4.3, “The Triennial Self-Assessment, Requirements, Division ES&H Coordinators,” require that division triennial report be submitted by October 31 of the year in which the 36-month assessment period ends, and indicate that this date is fixed with no extensions.

- In Section 4.3, “The Triennial Self-Assessment, Requirements, RPSC” modify the 2nd bullet to state that the RPSC consolidates the divisions’ self-assessment of RP Program implementation.

- In Section 4.3, “The Triennial Self-Assessment, Requirements, RPSC” modify the 6th bullet to clarify RPSC actions with regard to corporate-wide corrective actions.

- In new Section 4.4, “Feedback and Improvement, Requirements,” move all previous text regarding lessons learned to “Guidance.” All lessons learned are administered and disseminated by the IS&S Reporting, Feedback & Information Management Department (3131).

- In the Section 5.0, “Records, Requirements,” in the 3rd paragraph, change “managers” to” division ES&H coordinators and management” and clarify that maintenance applies to records of the triennial self-assessment only.

- **Delete:**

  - From Section 4.4, “Lessons Learned” all requirements for the RPSC. All lessons learned are administered and disseminated by the Lessons Learned function in the

IS&S Reporting, Feedback & Information Management Department (3131).

July 17, 2002
Administrative Changes Only

Chapter 6, "Control of Radioactive Material"

This chapter has been administratively revised to:

- **Add:**
  - To Attachment 6-3, "Conditionally Controlled Material List," information for "Inline Ionizers containing up to 10 mci of Po-210."

July 1, 2002
Administrative Changes Only

"Introduction" was revised to:

- **Change:**
  - In Section "2.1 Does Not Apply," in the second "Note," clarify guidance for subcontractors who bring their own RGDs or radioactive sources/material onto an SNL site.

April 29, 2002
Administrative Changes Only

Attachment 13-1, "Feedback and Improvement"

This chapter has been administratively revised to:

- **Update:**
  - Attachment 13-1, "Radiological Operations Self-Assessment Checklist" (Word file/ Acrobat file) to incorporate revisions that were suggested following completion of the 2001 triennial self-assessment cycle..

March 11 2002
Administrative Changes Only

Chapter 3, "Control of Radioactive Material"

This chapter has been administratively revised to:

- **Change:**
  - In the last paragraph of Section 4.8, "Training for Custodians and Users of Radioactive Sources and Material, Requirements," clarify that training is for both "primary" and "alternate" source custodians.
  - Repeat the retraining interval (24 months) that is specified in the course description for course RAD218.

March 4, 2002
Administrative Changes Only

Chapter 6, "Control of Radioactive Material"

This chapter has been administratively revised to:

- **Add:**
  - To Attachment 6-3, "Conditionally Controlled Material List," information for "ADAM Mine Parts containing 0.096g DU in an epoxy matrix weighing 417g."

January 29, 2002
Administrative Changes Only

Chapter 6, "Control of Radioactive Material"

This chapter has been administratively revised to:

- **Add:**

- A new Section 4.2.7, "Scrap Metal Recycle," that links to the scrap metal recycling requirements in the *ES&H Manual*, Section 10U, "Scrap Metal From a Radiological Area or Volumetrically Contaminated Metal."

October 30, 2001

Chapter 10, "Radiation-Generating Devices (RGDs)"

This chapter has been revised to:

- **Change:**
  - To Section 5.0, "Records" retaining the results of radiation surveys from "Requirements" to "Guidance" because the Radiation Protection Program retains survey results.

October 25, 2001
Administrative Changes Only

Chapter 15, "Radiological Work Licenses"

This chapter has been administratively revised to:

- **Add:**
  - The links to the term "radiological work license" in the RPPM Glossary.
  - Add the term "radiological work license" to the Glossary

August 6, 2001

Chapter 4, "Radiation Dosimetry"

This chapter has been revised to:

- **Change:**

- Revise the requirements and guidance in Section 4.3, “Foreign Travel.”

July 18, 2001
Administrative Changes Only

Chapter 3, "Radiological Training Program"

This chapter was administratively revised to:

- **Add:**
  - To Section 4.3.3, “Retraining, Guidance” the 30-day grace period to accommodate scheduling needs as allowed by 10 CFR 835, making this chapter consistent with training statements in other chapters.

June 21, 2001
Administrative Changes Only

Chapter 15, "Radiological Work Licenses"

This chapter was administratively revised to:

- **Change:**
  - The title of Section 4.2, "Requesting a Radiological Work License (URL)," to "Requesting and Renewing A Radiological Work License (RWL)," to reflect the change in content.
  - Clarify that the process can be used for requesting a new RWL or renewing an RWL, and that a renewal can be processed prior to the one-year expiration date.

June 11, 2001
Administrative Changes Only

Chapter 12, "Radiation Instrumentation"

This chapter was administratively revised to:

- **Change:**
  - The Personnel Monitoring and Laboratory Services Department (PM LSD/7132) to the Radiation Protection and Laboratory Services Department (RPLS/7132).
- **Delete:**
  - The responsibility section for the SNL/CA Health and Safety Department (HASD/8821) and references to this department in the chapter to reflect the centralization of instrumentation responsibilities in Department 7132.

March 22, 2001
Administrative Changes Only

Chapter 10, "Radiation-Generating Devices (RGDs)," Attachment 10-2, "Installation-Specific Operations"

This chapter was administratively revised to:

- **Change:**
  - Insert the phrase "plus 30-day grace period to accommodate schedule needs after the time period specified on the line "Radiation Surveys, Routine periodic." The "...30-day..." phrase has been moved from the time periods definitions noted below:

Glossary

- **Change:**
  - Add the phrase "A period not to exceed" and remove "plus 30-day grace period to accommodate scheduling needs" from the following definitions:
    - Annual
    - Biennial
    - Semiannual

January 25, 2001

"Introduction"

This chapter was revised to:

- **Add:**
  - In 6.0, "Records," to add a warning about the security of information and a recommendation to consult an Authorized Derivative Classifier when in doubt about the level of security a document should have.

Chapter 6, "Control of Radioactive Material"

This chapter was revised to:

- **Add:**
  - A new Section 4.2.2.1, "Control of Radioactive Material Quantities Less Than One-Tenth of the Values Specified in Appendix E," giving requirements and guidance for control of small quantities of radioactive material.

December 12, 2000
Administrative Changes Only

Chapter 3, "Radiological Training Program"

This chapter was administratively revised to:

- **Add:**
  - New Section 4.8, "Training for Custodians and Users of Radiation-Generating Devices (RGDs)," giving requirements and guidance for custodians that was moved from Section 4.7.
  - In Section 4.8 and Table 1, "Radiological Training Requirements," include the requirement RAD218, "Radioactive Source Control for Source Custodians" This course has been available and required since February 2000. The requirement is being formalized with this revision.

- **Change:**
  - In Section 4.7, "Training for Operators of Radiation-Generating Devices (RGDs), Requirements," delete the term "custodians," making this section for operators of RGDs only.
  - In Table 1, "Radiological Training Requirements," delete the term "custodians" from RAD102, making this row apply to operators of RGDs only.

November 30, 2000

Chapter 15, "Radiological Work Licenses"

This chapter was revised to:

- **Add:**
  - An exemption for training items associated with the Weapons Training Center.

November 3, 2000

Chapter 2, "Posting and Labeling for Radiological Control"

This chapter was revised to:

- **Add:**
  - In Section 4.3, "Radioactive Material Labeling," move to "Requirements," the need for external labeling when the internal label is not clearly visible through the external container. Moved from "Guidance" in Section 4.4, "Exemptions to Radioactive Material Labeling."
  - In Section 4.3, "Radioactive Material Labeling," add the 10 CFR 835 requirement that material or equipment with fixed contamination are clearly labeled to alert personnel of the contaminated status.
  - In Section 4.4, "Exemptions to Radioactive Material Labeling," move to "Requirements" from "Guidance," the need for radioactive material to be properly controlled although it may be exempt from labeling requirements.

Chapter 3, "Radiological Training Program"

This chapter was revised to:

- **Add:**
  - New Section 3.2, "Division ES&H Coordinators," that states that coordinators are responsible for conducting New Manager Radiological Briefings.
  - In Section 4.6, "Training for Managers and Supervisors," add the requirement for division ES&H coordinators to conduct a New Manager Radiological Briefing for new managers of radiological activities within 90 days of the managers' new assignment.
  - In Section 4.6, "Training for Managers and Supervisors," add a link to OS100, an optional tool for use when conducting the New Manager Radiological Briefing.

October 20, 2000

Chapter 1, "Radiological Work Planning and Controls"

This chapter was revised to:

- **Add:**
  - To Section 3.1, "Managers of Radiological Workers," three responsibilities to bring this list in agreement with Section 4.3.5:
    - Ensuring that proposed activities are within the scope of the current Primary Hazard Screening (PHS).
    - Notifying all affected managers and other personnel of proposed work activities.
    - For matrix operations, informing potentially affected managers and other personnel of proposed work activities.
    - In Section 3.1, "Managers of Radiological Workers," the phrase "when approving RWPs" to three bullets to make the wording agree with that of Section 4.3.5, "Approval of Radiological Work Permits (RWPs) or Other

TWDs."

- In Section 4.3.2, "Radiological Work Permits," add the words "or eTWD" to the first bullet under manager responsibilities to make it clear that an eTWD may be used.

- **Change:**

  - In Section 3.2, "Radiological Workers," add "manager" to the notification requirement "Immediately notifying the appropriate manager and Division ES&H Team of any changes to the scope fo work or radiological conditions."

  - Change the title of Section 4.3.5, to include the words "or Other TWDs," to cover all other types of TWDs, including eTWDs.

  - In the first "Note" of Section 4.4.3, "Personnel Contamination Control," change "only radioactive material is tritium" to "radioactive material cannot be detected by frisking (e.g., H-3, Ni-63, and I-125)" for clarification.

  - In several sections, change the specific term "RWP" to the generic term "TWD."

October 12, 2000
Administrative Changes Only

Chapter 6, "Control of Radioactive Material"

This chapter was revised to:

- **Add:**

  - "Radiation deflector housing on Radiation and Physical Pallet (RPIP)" to Attachment 6-3, "Conditionally Controlled Material List.

September 27, 2000

Chapter 15, "Radiological Work Licenses"

This chapter was revised to:

- **Add:**
  - To Section 2.3, "Exemptions," exemptions for out-of-service RGDs; exempt shielded, inherently safe; and exempt, shielded, certified cabinets.
  - To Section 4.2, "Requesting a Radiological Work License (RWL)," the requirement to have an authorized derivative classifier (ADC) review inventory information for classified data.
  - To Section 4.6.1, "Procurement," the phrase "or acquisition."

September 26, 2000
Administrative Changes Only

Chapter 10, "Radiation-Generating Devices (RGDs)"

Section 2.1 of this chapter was revised to:

- **Delete:**
  - The definition of an RGD from the chapter and to link to the Glossary. The definition from the chapter replaced the one previously in the Glossary, removing an inconsistency.

Chapter 13, "Feedback and Improvement"

Section 4.2 of this chapter was revised to:

- **Delete:**
  - The requirement to follow "internal radiation protection procedures" because the guidance procedure has been archived.
  - The requirements for "Division ES&H Teams shall" and move general requirements (UCI and individual names) to "SNL personnel shall" because anyone can initiate an RPIR.

September 21, 2000
Administrative Changes Only

Chapter 9, "Control of Accountable Radioactive Sources"

This chapter was revised to:

- **Add:**
  - A "Guidance" section to Section 4.2.2, "Notification of Change in Status (ISMS Function: Feedback and Improvement)."

August 30, 2000

MN471016, "Introduction"

This section was changed to:

- **Add:**
  - To Section 1.1, "Standards, Limits, and Program Requirements," the text "including, but not limited to entry into controlled, radiological, and radioactive material areas" to the end of the first sentence.
  - To Section 2.2, "Employees," the text "and entry into controlled, radiological, and radioactive material areas" following the word "activities" in the first sentence.
  - To Section 2.3, "Contractors," the text "and entry into controlled, radiological, and radioactive material areas" following the word "activities" in the first sentence.
  - To Section 2.4, "Other Agreements," the text "and entry into controlled, radiological, and radioactive material areas" following the word "activities" in the first sentence.
- **Change:**

  Section 2.9, "Work in Foreign Countries or Territories," has been completely revised from:
  - Replace "…follow the host country's laws and regulations…" unless "…the host country does not have any radiation protection requirements or those requirements are less stringent than those in this manual, SNL personnel shall use this manual [the RPPM]" with "the requirements of this manual do not apply to DOE activities conducted outside the United States on territory under the jurisdiction of a foreign government **if there is an agreement** between the cognizant government and the United States regarding the occupational radiation protection requirements for the

work."

- "DOE activities conducted on foreign soil are to be conducted under the cognizance of the responsible DOE Program Office, e.g. Defense Programs. The cognizant Program Office (CPO) is responsible to determine whether there are agreements in effect before authorizing the conduct of such activities."

- Include instructions on how SNL personnel are to determine if an agreement is in place and they are to do if an agreement is not in place.

Chapter 9, "Control of Accountable Radioactive Sources"

This chapter was revised to:

- **Change:**

  - In Section 4.7.1, "Leak Testing Requirements," "at intervals not to exceed 6 months" to "every 6 months from the month and day the activity (e.g., survey, leak test) was last performed, plus a 30-day grace period to accommodate scheduling needs.

  - In Section 4.8, "Inventory," "at intervals **not** to exceed 6 months" to "every 6 months from the month and day the activity (e.g., survey, leak test) was last performed, plus a 30-day grace period to accommodate scheduling needs.

Chapter 10, "Radiation-Generating Devices (RGDs)"

This chapter was revised to:

- **Change:**

  - In Section 4.10, "Radiation Surveys," "Requirements," incorporate the "Note:" into the first bullet so that the survey frequencies specified in Attachment 10-2 are clearly required. New text is:

    "Managers shall be responsible for ensuring that all RGDs except those classified as "exempt shielded, inherently safe" or "neutron generator operations" receive a routine periodic radiation survey performed by RP personnel as specified in Attachment 10-2."

- In Attachment 10-2, "Installation-Specific Operations," link the terms "annual" and "semiannual" to definitions added to the Glossary.

- **Delete:**
  - In Section 4.9, "Technical Work Documents (TWDs)," under "SNL personnel should see the following," the second bullet (Attachment 10-2 for information about the content of TWDs for neutron generator operations). TWD information is in Attachment 10-3 (the third bullet).

Chapter 11, "Radiological Incidents"

This chapter was revised to:

- **Add:**
  - Section 4.2.8, "Response to Damaged, Unresponsive, or Abnormally-Reading Self-Reading Personnel Dosimeter," listing actions to be taken when a self-reading personnel dosimeter provides an unexpected result, i.e., abnormally high, off-scale, or no reading.

Chapter 15, "Radiological Work Licenses"

This chapter was revised to:

- **Add:**
  - To Section 3.3, "Directors and Managers of Radiological Work," the manager responsibility for reviewing application for radiological work licenses prior to starting radiological work.
  - To Section 3.3, "Directors and Managers of Radiological Work," the director responsibility for reviewing and approving application for Type Red radiological work licenses prior to starting radiological work.
  - To Section 4.3, "Review-and Approval Process," the director responsibility for reviewing and approving Type Red license applications.
  - Director approval signature block for Type Red radiological work licenses to the Radiological Work License (RWL) form.
- **Change:**
  - In Section 2.3, "Exemptions," clarify that sealed sources, while exempted from the definition of an RGD in Chapter 10, require an RWL.

- Include "Directors" in the title of Section 3.3.

- In Section 3.3, "Directors and Managers of Radiological Work," limiting the completion of OARs to "Type Red" RGDs.
- To Section 4.3, "Review-and Approval Process," the manager responsibility for reviewing and approving types white, yellow, and green radiological work license applications; and only reviewing Type Red license applications.
- Attachment 15-1, "Radiological Work License (RWL) Application Process Flowchart," to include the director review and approval of Type Red radiological work license applications.
- Attachment 15-4, "Radiological Work License (RWL) Application Process," to include the director review and approval of Type Red radiological work license applications.

"Glossary"

The glossary was revised to:

- **Add:** the following terms:
  - Annual
  - Biennial
  - Legacy radioactive material
  - Semiannual

August 2, 2000
Administrative Changes Only

Chapter 6, "Control of Radioactive Material"

This chapter was revised to:

- **Change:** the following to attachments to Chapter 6 and adjust attachment links throughout the chapter:

- Exempted Items List to Attachment 6-1.
- Conditionally Controlled Material List to Attachment 6-2.

Attachment 15-3, "Operation Classification"

This attachment was revised to:

- **Change:** wording of the introductory sentence to the section "Radiotoxicity Factor (RTF) to "Table 3 gives examples of RTF by radionuclide divided into four toxicity groups."
- **Add**: clarification as to the criteria that defines which radionuclides fall into which category.
- **Correct:** the following entries:
  - Change the first Po-210 to Pb-210 in Group1
  - Change Th-239 to Th-229 in Group 1
  - Delete Es-254 from Group 2. The correct entry is in Group 1.
  - Delete Cu-65 from Group 3
  - Change Ba-137 to Ba-131 in Group 3
  - Change Ir-193 to Ir-190 in Group 3
  - Change Pt-192 to Pt-191 in Group 3
  - Delete Pu-35 from Group 4
  - Add Depleted Uranium to Group 4

Glossary

The Glossary was revised to:

- **Modify** the definition of RGD to agree with the text of RPPM Chapter 10.

  "Certain devices that produce ionizing radiation, including sealed radioactive sources, particle accelerators, electron generating devices that produce x-rays incidentally, and laser systems that produce ionizing radiation, subject to the

exemptions given in Chapter 10, "Radiation-Generating Devices (RGDs)."

July 17, 2000

Chapter 3, "Radiological Training Program"

This chapter was revised to:

- **Add:**
  - Personnel who transport non-exempt radioactive material in quantities less than, or equal to, Appendix E values are required to complete RAD102.
- **Change:**
  - Section 4.4, clarified the conditions and actions to be taken when managers/hosts choose to use escorts in lieu of training (e.g., for contractors, roving personnel, visitors, and tours).
  - Section 4.8, reference and link to the limits stated in Attachment 6-1.
  - Section 4.9.3, clarified approvals and restrictions for tour groups.

Chapter 13, "Feedback and Improvement"

This chapter was revised to:

- **Add**: Attachment 13-1, "Radiological Operations Self-Assessment Checklist" (Word file/ Acrobat file)

Attachment 15-2, "Quantities of Radionuclides for Type White License"

This attachment was revised to:

- **Change the following wording from:**
  - "Less than 30 mCi ($1x10^6$ Bq)" to "Greater than 30 mCi ($1x10^6$ Bq)"
  - "Less than 3 mCi ($1x10^5$ Bq)" to "Greater than 3 mCi ($1x10^5$ Bq)"

- "Less than 300 nCi ($1x10^4$ Bq)" to "Greater than 300 nCi ($1x10^4$ Bq)"
- "Less than 30 nCi ($1x10^3$ Bq)" to "Greater than 30 nCi ($1x10^3$ Bq)"
- "Less than 3 nCi ($1x10^2$ Bq)" to "Greater than 3 nCi ($1x10^2$ Bq)"
- "Less than 0.3 nCi ($1x10^1$ Bq)" to "Greater than 0.3 nCi ($1x10^1$ Bq)"

July 12, 2000
Administrative Changes Only

Chapter 6, "Control of Radioactive Material"

This chapter was revised to:

- **Change:**
  - update the Exempted Items List and the Conditionally Controlled Material List.

June 8, 2000
Administrative Changes Only

Glossary

The Glossary was changed to:

- **Delete:** the term "Radioactive Exempt Material."

May 31, 2000

Chapter 15 - Radiological Work Licenses

This is a new chapter.

May 10, 2000
Administrative Changes Only

Glossary

The Glossary was revised to update the following definitions, mostly to agree with those in 10 CFR 835:

- Accountable radioactive source (ARS)
- Accountable sealed radioactive source
- Airborne radioactive material or airborne radioactivity
- Airborne radioactivity area
- Background
- Contamination area
- Controlled area
- Cumulative total effective dose equivalent
- DOE activity
- Dose
- Effective dose equivalent (HE)
- High contamination area
- Monitoring
- Occupational exposure
- Quality factor
- Radioactive material area (RMA)
- Radioactive material transportation
- Radioactive source

- Radiological area
- Recommendation
- Respiratory protective device
- Sealed radioactive source
- Total effective dose equivalent (TEDE)
- Week
- Year

March 28, 2000
Administrative Changes Only

Chapter 13 - Feedback and Improvement

This chapter was revised to:

- **Add**:
    - Attachment 13-3, "Evaluation of Assessment Data for Radiological Operations," that provides a procedure to be followed when evaluating the triennial assessment data and data obtained during RPSC's quarterly evaluations.
    - A pointer to Attachment 13-3 from the chapter text in Section 4.1, "Radiological Protection Self-Assessment Process."

January 11, 2000

This list of changes includes only additions, changes, and deletions to requirements. Changes to guidance and general information are not listed. See the RPPM manual to become aware of all changes made to the text and Attachments.

General Changes:

- Reformat chapters 1 through 14 into the Requirements and Guidance format similar to

the *ES&H Manual*.

- Update responsibilities following Centers 7400 and 7500 reorganization and integration to Center 7100.

Introduction

- **Add:**
  - "Exempted Items and Conditionally Controlled Materials" with pointers to list for each.
  - Requirements for "Work in Foreign Countries or Territories."
- **Change:**
  - Wording regarding contractor activities once thought to be excluded from the requirements of the manual. (Section 2.1). Some contractor activities may be subject to certain requirements to ensure no unwarranted exposure to SNL personnel from those activities or to the contractors from SNL operations or activities.
  - Sections on "Consumer products," "Naturally Occurring Radioactive Materials (NORM)," and "Radioactive Materials/Sealed Sources." The requirements in these sections were replaced by the information in "Exempted Items and Conditionally Controlled Materials."
- **Delete:**
  - Listing of line support organizations.

Chapter 1, "Radiological Work Planning and Controls"

- **Add:**
  - PHS and ISMS into the "Planning Radiological Work" section.
- **Change:**
  - Wording of "Technical Work Documents (TWDs)" requirements.
  - Wording for "Planned Special Exposures" to match changes in the new 10 CFR 835.

Chapter 2, "Posting and Labeling for Radiological Control"

- **Add:**

  - "Exceptions to Posting" per new 10 CFR 835.
  - "Supplemental Postings used at SNL" to cover radiological postings that are used at SNL.
  - "Radioactive Material Labeling" per new 10 CFR 835.
  - "Exceptions to Radioactive Material Labeling" per new 10 CFR 835.
  - "Disposal of Radiological Signs and Radioactive Material Labeling" per comments from customers.

- **Change:**
  - Posting requirements for "Controlled Areas."

- **Delete:**
  - The definitions for the radiological areas, and added only the required wording on the posting.
  - Two exceptions that are no longer allowed by 10 CFR 835.

Chapter 3, "Radiological Training Program"

- **Add:**
  - Radiological workers are responsible for having their current qualification cards in their possession (or readily available) at all times while in radiological areas or while performing radiological work.

  - Managers must now verify that individuals responsible for developing and conducting job-specific radiological training (i.e., for personnel in their organizations) have the appropriate education, training, and skills to discharge this responsibility.
  - Managers are responsible for maintaining RAD102 training completion records if their organizations conduct RAD102 via *live* instruction.

- Training requirements for contractors and visitors now apply to unescorted area access and/or the performance of unescorted radiological work. Specific conditions and restrictions apply.

- Minimum radiological training requirements for access to various areas now apply to unescorted access. These areas include controlled areas, radiological buffer areas, radioactive material areas, radiation areas, contamination areas, soil contamination areas, underground radioactive material areas, and fixed contamination areas. In addition, the minimum radiological training requirements for various radiological work activities now apply to the performance of unescorted radiological work. Additional information, including specific requirements and restrictions related to the use of escorts, is detailed in the revised Sections 4.2 (*Training for Nonradiological Workers*) and 4.3 (*Training for Radiological Workers*), and the new Section 4.4 (*Use of Escorts In Lieu of Training*).

- Personnel who transport radioactive material now require RAD210, Radiological Worker I Training (as a minimum) only if transporting material in quantities greater than RPPM Appendix E values.

- Material Balance Area (MBA) custodians now require RAD210, Radiological Worker I Training, as a minimum.

- All unescorted radiological workers are required to complete appropriate job-specific radiological training.

- The 12-month frequency for respiratory protection training and fit-testing to help ensure compliance with 29 CFR 1910.134, *Respiratory Protection*.

- **Change:**

  - Managers are responsible for ensuring that personnel within their organizations receive at least the minimum radiological training, as specified in Table 1. In addition, managers are responsible for ensuring that all training requirements commensurate with the hazard(s) within a posted area are completed before personnel are allowed unescorted access to that area.

  - The retraining frequency for RAD102 (General Employee Radiological Training) and RAD210/230 (Radiological Worker I/II Training), as well as for RAD250 (Management of Radiological Operations Training) has been changed from 2 years to 24 months.

  - Consolidated the training requirements applicable to tour groups with those applicable to roving personnel, contractors, visitors, and members of the public.

- Radiological training requirements for the operation/use of devices (including radiation-generating devices, RGDs), equipment, etc., that contain radioactive material now depend upon how the radioactive material is classified (i.e., "exempt," "conditionally controlled," or "controlled" radioactive material), and whether or not the material is accessible during normal operation/use.

- Under certain conditions and restrictions, constant escort by a suitably trained individual may now be used in lieu of training (e.g., for contractors, visitors, and tours) for access to controlled areas, radioactive material areas, soil contamination areas, underground radioactive material areas, and some radiological areas (radiological buffer areas, radiation areas, and contamination areas), as well as for the performance of some radiological work activities. Such use of escorts requires prior concurrence by the appropriate Division ES&H Team, and written approval by the appropriate line manager.

- **Delete:**

  - The requirement for RAD230, Radiological Worker II Training, for all uses of anti-contamination clothing. Training requirements should be specified in postings and Technical Work Documents.

  - Radiological training requirements specific to custodians and users of sealed and unsealed radioactive sources. Training requirements are now related to the use of radioactive sources or material in general, and are determined by whether the sources/material are classified (per RPPM-06) as "exempt," "conditionally controlled," or "controlled" radioactive material.

  - Specific 10 CFR 835 requirements that apply to the actual conduct of General Employee Radiological Training and Radiological Worker Training because they do not specifically apply to SNL line organizations.

  - The Section entitled, *Industrial Radiographers and Radiographer Assistants*.

Chapter 4, "Radiation Dosimetry"

- **Add:**

  - Extremity dosimeters added to DOELAP

  - DOELAP required for radiobioassay.

  - Nuclear accident dosimetry (NAD) from Chapter 11, "Radiological Incidents."

- **Change:**
  - Minors separated from members of the public. Minors now prohibited from entering radiological areas and performing radiological work by the *ES&H Manual*, Attachment 1D-4, "Management Responsibility for Minors."

Chapter 5, "Entry Control"

- **Add:**
  - Area monitoring for high radiation areas and very high radiation areas.
  - Personnel monitoring in high radiation areas or very high radiation areas.
- **Change:**
  - Entry control for radioactive material, soil contamination, underground radioactive material, and fixed contamination areas.

Chapter 6, "Control of Radioactive Material"

- **Add:**
  - Requirements for "Exempted Items."
  - Requirements for "Conditionally-Controlled Material."
  - Form for requesting exempt or conditionally-controlled designation.
  - Responsibilities for managers and SNL personnel.
  - Requirements for "Control of Material and Equipment."
  - Requirements for "Receipt of Radioactive Material."
  - Requirements for "Storage of Radioactive Material."
  - Requirements for "Radioactive Material Transportation."

Chapter 7, "Radiological Design and Control and ALARA Application"

- **Add:**

- "Environmental ALARA" requirements and guidance.

- **Change:**
  - ALARA review thresholds simplified.
  - Pre-job review checklist is now an optional method of performing ALARA review.
  - Top-level ALARA reviews have been delegated by the RPSC to its ALARA Subcommittee or similar committee, such as the RCSC.
  - Simplified the performance goal process.

- **Delete:**
  - Requirements for in-process and post-job reviews. Recommendations on performing reviews are included as part of the ALARA process.

Chapter 8, "Monitoring Areas and Material"

- **Add:**
  - Responsibility of Shipping, Receiving and Mail Services Dept. for monitoring incoming packages containing radioactive material in compliance with 10 CFR 835.405.
  - Requirement that during access to high and very high radiation areas, area monitoring is required as necessary to determine exposure rates.
  - Responsibility of managers for ensuring that materials and equipment to be released from contamination areas, high contamination areas, and airborne radioactivity areas are surveyed by RP personnel.
  - Monitoring requirement for nonradiological areas containing total contamination exceeding the values in Attachment 6-1.
  - Responsibility of source custodians for ensuring that leak tests are performed for accountable radioactive sources.
  - Responsibility of managers for ensuring that RGDs are surveyed by RP personnel.

- **Change:**

- Requirement for monitoring airborne radioactivity changed to "potential exposure of 40 derived air concentration (DAC) - hours in a year, or as necessary, to characterize the airborne radioactivity hazard where respiratory protective devices have been prescribed."

- Requirement for real-time monitoring changed to "as necessary to detect and provide warning of airborne radioactivity concentrations that warrant immediate action to bring about terminate of inhalation of airborne radioactive material."

Chapter 9, "Control of Accountable Radioactive Sources"

- **Change:**

  - Incorporated new (and generally much higher) radioactive source accountability thresholds from Appendix E to 10 CFR 835. Total number of accountable radioactive sources at SNL drops by roughly 75%. Appendix E provides specific accountability limits for most commonly encountered radionuclides, plus general accountability limits for non-listed radionuclides.

  - Incorporated from Appendix E the "sum of fractions" rule for multiple-radionuclide sources into the definition of Accountable Radioactive Source (ARS) in glossary.

  - Expanded definitions of Radioactive Source, Accountable Radioactive Source, Sealed Radioactive Source, and Accountable Sealed Radioactive Source in glossary. Certain exemptions previously covered in the chapter now appear in these glossary definitions.

- **Delete:**

  - None. Some requirements given in the previous version of the chapter do not appear in the new version since they are stated in other chapters, principally RPPM 06, "Control of Radioactive Material," and RPPM 03, "Radiological Training Program." These include:

    - Training
    - Receipt
    - Inaccessible sources
    - TWDs
    - Offsite/onsite movement

        - Disposal

Chapter 10, "Radiation-Generating Devices (RGDs)"

- **Add:**
    - Expand the definition of RGD to include two kinds of devices previously exempted or not addressed:
        - Medical devices:
            - Previously exempted.
            - New device class created for these.
        - High intensity laser devices:
            - Previously not addressed.
            - Exempted below 10^15 W/cm^2 intensity.
            - Expect most to qualify in existing exempt shielded-inherently safe class.
- **Change:**
    - Clarified the requirements for neutron generator devices to allow exemption of both functional parts of the device (i.e., neutron source and energy source).
- **Delete:**
    - For exempt shielded installation class, deleted dose limits for shallow dose and eye dose.

Chapter 11, "Radiological Incidents"

- **Change:**
    - Updated responsibilities to be consistent with other SNL requirements documents.
    - Incorporated incident commander (IC) notifications that are tied to specific radiological conditions for emergencies and reportable occurrences.
    - Consolidated the previously-stated immediate and supplementary actions into

"required initial actions" to be consistent with other SNL requirements documents.

- Updated "return to work" required actions, notifications, and approvals to new 10 CFR 835 and SNL requirements.

- **Delete:**

- Emergency exposure requirements because only the senior management representative (SMR) approves emergency exposures as described in emergency plans.

- Moved nuclear accident dosimetry requirements to Chapter 4, "Radiation Dosimetry."

- Post-incident critique because it was as redundant with the required activities, such as a post-incident investigation or a root cause analysis.

Chapter 12, "Radiation Instrumentation"

No significant changes.

Chapter 13, "Feedback and Improvement"

- **Add:**

- Findings, issues and corrective actions shall be entered into WebSIMS.

- **Change:**

- Line must perform triennial self-assessment using a standard checklist.

- Line's report to the RPSC must follow a standard format, use standard audit terms and include certain statistics.

- **Delete:**

- Explicit requirements for Dept. 12870.

Chapter 14, "Declared Pregnant Workers"

- **Change:**

- Revised the forms to be used by SNL employees only.

- Contractors who want to declare pregnancy must submit their declaration of pregnancy to their employer (i.e., the contracting company). The contracting company will furnish a copy of the signed and dated declaration to its SNL point of contact.

- Contractors who want to withdraw a declaration of pregnancy must submit their withdrawal of declaration of pregnancy to their employer (i.e., the contracting company). The contracting company will furnish a copy of the signed and dated withdrawal to its SNL point of contact.

Glossary

- **Add:**

  - Accelerator
  - Accountable radioactive source (ARS)
  - Consumer product
  - Corrective action
  - Finding
  - Generally licensed
  - Integrity test
  - Leak test
  - Lessons learned
  - LLT - Laboratory Leadership Team
  - Member of the Public
  - Noncompliance Tracking System (NTS)
  - NORM
  - Observation

- Occurrence Reporting and Processing System (ORPS) [DOE]
- Out of Service (for a radiation-generating device)
- Primary Hazard Screening (PHS)
- Radiological Process Improvement Report (RPIR)
- Radioactive material management area (RMMA)
- Recommendation
- Root cause
- Roving personnel
- Specifically licensed

- **Delete:**
  - SQLC
  - TIDBITS

Appendices:

N/A

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Radiological Protection Procedures Manual

LIST OF EFFECTIVE CHAPTERS

Subject Matter Expert: M. Keith Matzen; CA Counterpart: Albert Lau
MN471016, Issue BC
Revision Date: June 15, 2007; Replaces Document Dated: March 24, 2007
Review Date: October 11, 2006

*Indicates a substantive change

CHAPTER	ISSUE	ISSUE DATE
List of Effective Chapters	BC	June 15, 2007
Introduction	J (I not used)	January 21, 2006
Chapter 1 - Radiological Work Planning and Controls	N	March 6, 2007
Chapter 2 - Posting and Labeling for Radiological Controls	F	September 22, 2006
Chapter 3 - Radiological Training Program	M	April 26, 2006
Chapter 4 - Radiation Dosimetry	E	May 25, 2004
Chapter 5 - Entry Control	D	January 11, 2000
Chapter 6 - Control of Radioactive Material	H	September 22, 2006
Chapter 7 - Radiological Design and Control and ALARA Application	D	March 31, 2006
Chapter 8 - Monitoring Areas and Material	G	November 27, 2006
Chapter 9 - Control of Accountable Sealed Radioactive Sources	G	May 24, 2007

*Chapter 10 - Radiation-Generating Devices (RGDs)	J (I not used)	June 15, 2007
Chapter 11 - Radiological Incidents	F	May 25, 2004
Chapter 12 - Radiation Instrumentation	E	November 27, 2006
Chapter 13 - Feedback and Improvement	G	March 31, 2006
Chapter 14 - Declared Pregnant Workers	D	April 16, 2004
Chapter 15 - Radiological Work Licenses	E	**Archived** October 13, 2003
*Glossary	S	May 24, 2007
Appendix A - Derived Air Concentrations (DAC) for Controlling Radiation Exposure to Workers at DOE Facilities	C	January 11, 2000
Appendix B - Alternative Absorption Factors and Lung Retention Classes for Specific Compounds	--	RESERVED
Appendix C - Derived Air Concentration (DAC) for Workers From External Exposure During Immersion in a Contaminated Atmospheric Cloud	C	January 11, 2000
Appendix D - Surface Radioactivity Values;[1] in DPM/100 CM^2	C	January 11, 2000
Appendix E - Values for Establishing Sealed Radioactive Source Accountability and Radioactive Material Posting and Labeling Requirements	C	January 11, 2000

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Corporate Process Requirement No: CPR400.1.1.32
Sponsor: Dori Ellis, 4000, Acting

Revision Date: June 21, 2006

Radiological Protection Procedures Manual

INTRODUCTION

Subject Matter Experts: Ross Miller
MN471016, Issue J (I Not Used)
Effective Date: June 21, 2006; Replaces Document Dated: January 26, 2004

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* Indicates a substantive change

1.0 PURPOSE

1.1 Standards, Limits, and Program Requirements

This manual describes the SNL radiological safety standards applicable to SNL and

contractor facilities, locations, or activities involved in the use of radioactive materials or radiation-generating devices (RGDs), including but not limited to entry into controlled, radiological, and radioactive material areas. This manual is the mechanism used to communicate the requirements of 10 CFR 835 and to describe the portions of the SNL Radiation Protection Program that are applicable to line organizations. Activities involving the use of radioactive materials or RGDs are to be conducted in compliance with the requirements in this manual.

Nothing in this manual shall be construed as limiting actions that may be necessary to protect health and safety.

This manual does not contain requirements on managing radioactive waste. See CPR400.1.1, MN471001, *ES&H Manual*, Section 19B, "Low-Level Radioactive Waste Management," for radioactive waste management requirements. Likewise, radiological operations are subject to quality assurance requirements as outlined in SNL's Corporate implementation of 10 CFR Part 830.120 (CPR001.3.2, *Corporate Quality Assurance Program*; CPR400.1.3, *Price-Anderson Amendments Act (PAAA) and Nuclear Safety Requirements*; CPR400.1.1/MN471001, *ES&H Manual*, Section 18G, "Identifying, Reporting, and Correcting Nuclear Safety Nonconformances"; PG470208, *Price-Anderson Amendments Act (PAAA) Program Plan*; (AOP) 2004-01, *Administrative Operating Procedure 2004-01*, Title 10 CFR 830, Subpart A, *Quality Assurance Requirements Applicability*; and, DOE O 414.1B, *Quality Assurance*).

1.2 Format of this Manual

The RPPM chapters and sections are formatted with "Requirements" and "Guidance" headings. Requirements include the word "shall"; guidance includes words such as "should" or "may." To minimize redundancy and inconsistencies between sections of this manual, the format includes a number of links between different portions of the manual. Review all linked items to ensure that you are aware of all applicable requirements and guidance.

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*2.0 APPLICABILITY

*2.1 Does Not Apply

The requirements of this manual do **not** apply to:

- Radiological activities performed by SNL employees or SNL contractors or members of the public who perform work for DOE or use DOE facilities that are subject to any one of the following:
    - U.S. Nuclear Regulatory Commission (NRC) licensing or certification.
    - An NRC Agreement State radiation control regulation.
    - Any documented DOE-approved radiation protection program.

      Example: An SNL employee performing a radiological activity at Los Alamos National Laboratory (LANL) may perform that activity in accordance with LANL's DOE-approved radiation protection program.

      Note 1: Consult RP personnel for assistance in determining the applicability of NRC licensing or certification, state radiation control regulations, or any DOE-approved radiation protection program to SNL or SNL contractor activities.

      Note 2: Even if certain activities conducted by contractors or members of the public are excluded from this manual because of any of the three exclusions listed above, SNL may require the contractors or members of the public to comply with specific provisions of this manual (e.g., site specific training) in order to protect SNL employees, operations, contractors and members of the public.
- Activities conducted under the authority of the Director, Naval Nuclear Propulsion Program, as described in Public Law 98-525.
- Activities conducted under the Nuclear Explosives and Weapons Surety Program relating to the prevention of accidental or unauthorized nuclear detonations.
- Background radiation, doses received as a patient for the purposes of medical diagnosis or therapy, or radiation doses received from participation as a subject in medical research programs.

2.2 Employees

This manual applies to SNL employees when performing radiological activities and entry into controlled, radiological, and radioactive material areas, regardless of where the employees are working (i.e., even if not working on Sandia-controlled premises). However, if an SNL employee is performing work that is subject to any of the conditions listed in Section 2.1, "Does Not Apply," the employee's activities are not subject to this manual.

Note: The U.S. Nuclear Regulatory Commission (NRC) and the State of New Mexico (an Agreement State) do not regulate any material or equipment owned and being used, stored, or transported for the DOE by SNL (a DOE prime contractor). Therefore, SNL employees performing radiological activities in New Mexico cannot meet either of the first two conditions listed in Section 2.1, "Does Not Apply." This may also be true in other Agreement States where SNL employees are working. Consult the Legal Division; ES&H, Corporate & International Law Center for assistance in determining the applicability of NRC or state law to SNL activities in states other than New Mexico.

2.3 Contractors

This manual applies to SNL contractors who conduct DOE-funded radiological activities and entry into controlled, radiological, and radioactive material areas, regardless of where the contractors are working (i.e., even if not working on Sandia-controlled premises) and even if contractors are using their own material or equipment. If any contractor's work, including construction, maintenance, or repair work, is subject to one of the conditions listed in Section 2.1, "Does Not Apply," the contractor's activities are not subject to this manual, unless otherwise specifically required by SNL.

Contractors subject to this manual who are performing SNL-directed work are required to follow the SNL processes exactly as described in this manual.

Consult the Sandia Designated Representative (SDR), the Sandia Contracting Representative (SCR), or the Legal Division; ES&H, Corporate & International Law Center for assistance in determining whether a contractor is performing SNL-directed work or contractor-directed work, or for assistance in determining the applicability of any condition listed in Section 2.1, "Does Not Apply."

The SDR is responsible for ensuring that all applicable requirements of this manual are referenced or included in the terms and conditions of contracts. The SDR or the SCR can assist in providing this manual to the contracting company, if necessary.

2.4 Other Agreements

The requirements of this manual apply to SNL employees and contractors performing radiological activities and entry into controlled, radiological, and radioactive material areas, pursuant to other types of agreements, such as cooperative research and development agreements (CRADAs), work-for-others agreements (WFOs), memoranda of understanding (MOUs), user facility agreements (UFAs), etc., unless the work is subject to one of the conditions listed in Section 2.1, "Does Not Apply."

The requirements of this manual apply to other parties performing radiological activities pursuant to other types of agreements, such as CRADAs, WFOs, MOUs, UFAs, etc., if the other party's work is DOE-funded. However, even when DOE-funded, if the other party's work is subject to one of the conditions listed in Section 2.1, "Does Not Apply," that work is not subject to this manual unless otherwise specifically required by SNL.

2.5 Roving Personnel and Members of the Public

Roving personnel and members of the public shall meet all requirements of the space to be visited and activities to be performed.

For assistance in determining training equivalency, consult the Radiation Protection and Industrial Hygiene Training Project Leader in the Information Systems and Technology Department (3133) and see Chapter 3, Section 4.8, "Training for Custodians and Operators of Radiation-Generating Devices (RGDs)."

2.6 Minors

Managers who direct the work of SNL personnel who are under 18 years of age (i.e., minors) shall prohibit those minors from entering radiological areas.

2.7 Use of SNL Material or Equipment

2.7.1 Sandia-Controlled Premises (Onsite)

Radiological activities performed by SNL employees or contractors on Sandia-controlled premises using SNL material or equipment (purchased, leased, rented, or borrowed by SNL, or designated by DOE for use by SNL) are subject to the requirements of this

manual. However, if those activities are subject to any of the conditions listed in Section 2.1, "Does Not Apply," they are not subject to this manual.

2.7.2 Non-Sandia-Controlled Premises (Offsite)

Radiological activities performed by SNL employees or contractors at non-Sandia-controlled premises using SNL material or equipment (purchased, leased, rented, or borrowed by SNL, or designated by DOE for use by SNL) are subject to the requirements of this manual. However, if those activities are subject to any of the conditions listed in Section 2.1, "Does Not Apply," they are not subject to this manual.

2.8 Use of Non-SNL Material or Equipment

2.8.1 Sandia-Controlled Premises (Onsite)

Radiological activities performed by SNL employees or contractors on Sandia-controlled premises using material or equipment owned or controlled by another entity (not DOE or SNL) are subject to the requirements of this manual. However, if those activities are subject to any of the conditions listed in Section 2.1, "Does Not Apply," they are not subject to this manual.

2.8.2 Non-Sandia-Controlled Premises (Offsite)

Radiological activities performed by SNL employees or contractors at non-Sandia-controlled premises using material or equipment owned or controlled by another entity (not DOE or SNL) are subject to the requirements of this manual. However, if those activities are subject to any of the conditions listed in Section 2.1, "Does Not Apply," they are not subject to this manual.

2.9 Work in Foreign Countries or Territories

The requirements of this manual do not apply to DOE activities conducted outside the United States on territory under the jurisdiction of a foreign government if there is an agreement between the cognizant government and the United States regarding the occupational radiation protection requirements for the work. **[835.a(b)(5)]**

DOE activities conducted on foreign soil are to be conducted under the cognizance of the responsible DOE Program Office, e.g., Defense Programs. The cognizant Program

Office (CPO) is responsible to determine whether there are agreements in effect before authorizing the conduct of such activities. SNL personnel shall:

- Verify whether applicable agreements exist regarding radiation protection requirements prior to conducting the work, by contacting the CPO sponsoring the activity.
- If no agreement exists, the requirements in the SNL RPPM apply.
- If there is no agreement in place and requirements of the SNL RPPM are not suitable for customers' needs or not accepted by the host, negotiate an agreement on protective and acceptable requirements.

2.10 Exempted Items and Conditionally Controlled Materials

2.10.1 Exempted Items

RP personnel maintain a list of items that are exempt from the requirements of this manual. For more information on exempted items, see Chapter 6, Section 2.1, "Exempted Items."

2.10.2 Conditionally Controlled Materials

RP personnel maintain a list of items and materials that may not be subject to all of the requirements of this manual. For more information on conditionally controlled materials, see Chapter 6, Section 2.2, "Conditionally Controlled Material."

3.0 OWNERSHIP

The Radiation Protection Safety Committee (RPSC) administers and manages this manual and is responsible for its development and update. Submit suggestions for revisions, updates, or changes to the RPPM using the RPSC Requirements Subcommittee (RPSCRS) change process (refer to RPSCRS homepage for details).

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*4.0 ASSISTANCE/SUPPORT

In cases where a subcontractor or member of the public is bringing RGDs or radioactive sources/material on-site, the sponsoring SNL Line Organization shall inform the appropriate Radiation Protection Line Support organization in a timely manner to assist in undertaking potential impact evaluations and providing other essential guidance.

Persons with questions regarding radiation protection may consult their Division ES&H Team.

Except as noted, the terms "radiation protection" and "RP" refer to the radiation protection representatives on the Division ES&H Teams and the personnel of departments 10327, 10328, 10329, and 8517.

Radiation protection organizations at SNL/CA provide services and oversight to that site. Radiation protection organizations at SNL/NM provide services and oversight to all other Sandia-controlled premises.

The radiation protection organizations are the sole authorized providers of certain services needed to implement the requirements contained in this manual. These services include, but are not limited to, the following:

- Recommending radiological control practices.
- Releasing material from radiologically controlled areas.
- Performing sample analysis for occupational radiation protection.
- Performing radiation surveys for a legal record.
- Training and qualifying employees and radiological control technicians (RCTs) in DOE-required radiological safety programs.
- Calibrating radiation detection equipment used for radiological safety.
- Assessing, assigning, and recording internal and external exposures.

5.0 EXEMPTIONS

The manager of the Radiation Protection Program shall authorize exceptions to requirements in this manual. Exceptions require strong justification showing equivalent or superior controls. Exceptions cannot be granted to regulatory requirements or for corrective actions to which Sandia has committed. If the justification is inadequate or inappropriate, such requests shall be rejected. The RPSC shall be informed of exception requests.

6.0 RECORDS

Records are generated for various actions, e.g., workplace surveys, instrument performance checks, dosimetry results, and radiological work permits (RWPs). These records enable SNL to demonstrate compliance with the requirements of 10 CFR 835 and the SNL *Radiation Protection Program (RPP)*. These records are to be maintained in accordance with the *Corporate Records Retention and Disposition Schedule* by the Recorded Information Management Department (4912).

Unless otherwise specified, the quantities used in the required records shall be clearly indicated in special units of curie, rad, or rem, including multiples and subdivisions of these units. The SI units, bequerel (Bq), gray (Gy), and sievert (Sv), are only provided parenthetically for reference with scientific standards. These SI units are not authorized for use in required records.

While most Radiological Protection Procedures Manual information in reports and records such as workplace surveys, instrument performance checks, dosimetry results is generally unclassified, it is necessary to ensure that information that would meaningfully aid in adversary is either not contained in the report or records, cannot be inferred from its detailed contents, or is classified appropriately. If you are unsure or have any questions, contact an Authorized Derivative Classifier.

7.0 REFERENCES

7.1 Requirements Source Documents

10 CFR 835, *Occupational Radiation Protection*.

DOE N 441.1, *Radiation Protection for DOE Activities*.

7.2 Related Documents

DOE G 441.1-1, *Management and Administration of Radiation Protection Programs Guide*.

DOE-STD-1098-99, *Radiological Control*.

SNL, PG470193, *SNL Radiation Protection Program.*

10 CFR 835*, Occupational Radiation Protection*, September 30, 1996.

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Corporate Process Requirement No: CPR400.1.1.32
Sponsor: Dori Ellis, 4000, Acting

Revision Date: March 6, 2007

Radiological Protection Procedures Manual

CHAPTER 1 – RADIOLOGICAL WORK PLANNING AND CONTROLS

Subject Matter Expert: Brian D. Hunt
MN471016, Issue N
Effective Date: March 6, 2007; Replaces Document Dated: November 3, 2006
Review Date: October 11, 2006

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*Indicates a substantive change

- 1-7- Template for Radiological TWD

- Forms
  - SF 2001 - WPR, "Radiological Work Permit Request." (Word File/Acrobat File)
  - SF 2001 - ARA, "General RWP Task Analysis for Added Radiological Activities." (Word File/Acrobat File)

1.0 PURPOSE

This chapter presents the requirements for the planning and control of all radiological work conducted at Sandia.

For purposes of this document, Members of the Workforce are:

- Sandia employees.
- Sandia contractors as specified in CPR400.1.1/MN471001, *ES&H Manual*, Section 1B, "What Is the Scope."

2.0 SCOPE

Note: Full implementation of the changes outlined in Issue N (TWD disengagement from RWPs) is expected by April 30, 2007. TWDs shall be in place for all radiological work performed as of that date. The intent of this deadline is to allow for the replacement of RWPs by TWDs as they come due – no new RWPs will be written for which there is not an active TWD in place.

This chapter applies to all radiological work in controlled areas and all work in radiological areas.

At Sandia, radiological work controls are implemented through the use of technical work documents (TWDs) (see CPR400.1.1/MN471001, *ES&H Manual*, Chapter 21, Technical

Work Documents [TWDs]) and, if required, authorized using Radiological Work Permits (RWPs). Consult the following for assistance with TWDs:

- For RWPs at Sandia/NM, the appropriate RP Personnel.
- For safe work permits (SWPs) at Sandia/CA, the appropriate RP Personnel or OP471382.

3.0 RESPONSIBILITIES [S-]

3.1 Managers of Radiological Workers

Managers of radiological workers are responsible for:

- Ensuring the radiological safety of individuals under their supervision.
- Ensuring that radiological workers are adequately trained and familiar with tasks to be performed (see Chapter 3, "Radiological Training Program").
- Designating job coordinators from their organization, as appropriate.

  Note: The manager assumes the responsibilities of a job coordinator if one is not designated.

- Ensuring that work planning is performed prior to job commencement.

  Note: Planning includes specific description of job scope, radiological hazard identification and communication to radiological workers, preparation of a technical work document (TWD), a pre-job briefing (as appropriate), and an ALARA review, if required.

- Ensuring that proposed activities are within the scope of a current Primary Hazard Screening (PHS).
- Approving TWDs that accurately describe the scope of work and provide the necessary controls to ensure the safety of the individuals and compliance with this

document.

- Obtaining concurrence of the appropriate Radiation Protection Project Leader on TWDs for radiological work.
- Ensuring that RWPs are initiated for all applicable radiological work using SF 2001-WPR *Radiological Work Permit Request*. (Word File/Acrobat File)
- Ensuring that an approved RWP is in place prior to performing any work, which requires an RWP.
- Ensuring that a *General RWP Task Analysis for Added Radiological Activities*, (Word File/Acrobat File), is completed and reviewed for all new radiological work to determine the adequacy of current RWP(s) if a new RWP is not desired.
- Notifying all applicable managers of proposed work activities for all radiological work affecting other organizations or facilities.

3.2 Radiological Workers

Radiological workers are responsible for:

- Completing all required radiological training (see Chapter 3, "Radiological Training Program").
- Complying with all TWDs and RWPs, as applicable.
- Conducting only those activities identified within the scope of work.
- Standing down work activities, immediately, when directed to do so by a concerned Member of the Workforce.
- Terminating any activity deemed unsafe or outside the scope of the planned radiological work.
- Notifying the appropriate manager and RP Personnel, immediately, of any changes to the scope of work or radiological conditions.

3.3 RP Personnel

RP Personnel are responsible for:

- Providing guidance in the area of radiological work practices.
- Specifying the radiological work controls, appropriate for the defined job scope, to include in TWDs.
- Reviewing TWDs for radiological work.
- Preparing RWPs based on the description of work provided by the line, when applicable.
- Reviewing *General RWP Task Analysis for Added Radiological Activities*, (Word File/Acrobat File), for all new Radiological Work to determine the adequacy of current RWP(s) when requested by the line.
- Participating in pre-job and post-job briefings and reviews, as requested.
- Performing pre-job, work-in-progress, and post-job surveys, as applicable (see Chapter 8, "Monitoring Areas and Material").
- Notifying management of any activity that causes, or threatens to cause, an adverse impact on radiological controls or radiological conditions.
- Discontinuing any activity deemed unsafe or outside the scope of planned radiological work.

3.4 Environmental ALARA Coordinator

The Environmental ALARA Coordinator is responsible for:

- Providing assistance to the line organizations and the appropriate RP Personnel, as requested, for compliance with this chapter.
- Conducting dose assessments, for the record, to determine actual or potential doses to members of the public.
- Preparing and submitting the Annual Site Environmental Report (ASER) to the

Department of Energy (DOE), in accordance with DOE O 231.1, *Environment, Safety and Health Reporting*, including the results from environmental surveillances, effluent monitoring, and measured or estimated radiological doses to offsite members of the public.

3.5 Job Coordinator

The Job Coordinator is responsible for:

- Planning the work.
- Developing a detailed description of the work used in TWDs.
- Identifying the radiological hazards.
- Preparing and submitting a SF 2001-WPR, *Radiological Work Permit Request (Word File/Acrobat File)* when required.
- Ensuring that job briefings occur at the required frequency.
- Notifying RP Personnel and management when the scope of work changes or there are violations to the TWD.

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*4.0 PROCEDURE [S-]

4.1 Exposure Limits

4.1.1 Exposure Limits for Radiological Workers

Requirements

Managers of radiological workers shall ensure that:

- The occupational dose received by general Members of the Workforce is controlled such that the limits in Attachment 1-1 are not exceeded in a calendar year, except for planned special exposures conducted and consistent with 10 CFR

835.204 and emergency exposures authorized in accordance with 10 CFR 835.1302. **[10 CFR 835.202(a)]**

- Each individual's total effective dose equivalent (TEDE), at Sandia, is limited to 100 mrem per calendar year unless the member's health hazard case file contains a signed SF 2001-ACL, ACL Approval Form (Word file/Acrobat file).

- With regard to administrative control limits (ACLs):

  - ACLs are reviewed and approved annually or when individual exposure levels require a change to an ACL.

  - Each SF 2001-ACL, ACL Approval Form (Word file/Acrobat file), is signed by the affected individual and the proper approving authority.

    Note: ACLs and their required approvals are summarized on SF 2001-ACL, ACL Approval Form (Word file/Acrobat file).

  - When submitting an ACL request or change, alternative measures that were considered and deemed not feasible are included in the request and the reason(s) they were deemed not feasible are explained.

  - Following review and approval, originals of SF 2001-ACL, ACL Approval Form (Word file/Acrobat file), are forwarded to the Dosimetry Records Center (MS 0651) for retention in the individual's health hazard case file.

  - Individuals who begin work at Sandia with a current-year TEDE greater than or equal to 100 mrem have signed originals of SF 2001-ACL, ACL Approval Form ([Word file/Acrobat file]), before receiving any additional occupational exposure at Sandia.

  - A program is implemented to prevent personnel exposures from exceeding a cumulative total effective dose equivalent (CTEDE) ACL of 1 rem TEDE per year of age.

  - If a radiological worker's CTEDE exceeds 1 rem TEDE per year of age, special ACLs are established during ensuing years as necessary to cause that individual's CTEDE to return to and, if possible, fall below 1 rem per year of age.

4.1.2 Basic Dose Limit for Members of the Public

Requirements

Managers shall ensure that:

- The exposure of members of the public to radiation sources as a consequence of all routine DOE activities does not cause, in a year, an effective dose equivalent greater than 100 mrem (1 mSv). **[DOE 5400.5, II.1.a.]**

  Note: Dose evaluations should reflect realistic exposure conditions. See Attachment 1-2 for requirements on what sources of exposure are to be included in evaluations of dose to members of the public.

- All reasonable efforts are made to maintain the annual dose to any individual offsite member of the public to less than 10 mrem.

Members of the Workforce shall report off-normal occurrences in accordance with CPR 400.1.1/MN471001, *ES&H Manual*, Section 18C, "Occurrence Reporting," in the event of an actual or potential offsite exposure of members of the public, from Sandia sources, that could result in an effective dose equivalent greater than 10 mrem (0.1 mSv) in a year.

4.1.3 Pathway-Specific Dose Limits for Members of the Public

4.1.3.1 Airborne Pathway

Requirements

Managers shall ensure that the exposure of members of the public to radioactive materials released to the atmosphere, as a consequence of routine DOE activities, does not cause members of the public to receive, in a year, an effective dose equivalent greater than 10 mrem (0.1 mSv). **[DOE 5400.5, II.1.b.]**

Note: Airborne emissions are regulated by 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities," (*re* NESHAP). Sandia has established a program for compliance with NESHAP. For details, see CPR 400.1.1/MN471001, *ES&H Manual*, Section 17E, "Radionuclide National Emissions Standards for Hazardous Air Pollutants (NESHAP)."

Consult the appropriate RP Personnel or the Radiological NESHAP contact for assistance.

4.1.3.2 Drinking Water Pathway and Liquid Effluents

Requirements

Managers shall ensure that radioactive liquid effluents are controlled in accordance with state and local restrictions. (See CPR 400.1.1/MN471001, *ES&H Manual*, Section 10H, "Discharges to the Sanitary Sewer System," and Section 10T, "Surface and Storm Water Discharges," for Sandia-specific requirements for control of radioactive liquid effluents. Consult the appropriate RP Personnel or the Water Quality contact for assistance.)

*4.2 Planning Radiological Work

Requirements

Managers shall:

- Develop and implement written procedures as necessary to ensure compliance with the RPPM and commensurate with the radiological hazards created by the activity and consistent with the education, training, and skills of the individuals exposed to those hazards. **[10 CFR 835.104]**

- Ensure radiological work is planned and controlled in accordance with the Integrated Safety Management System (ISMS) process.

- Ensure that a Primary Hazard Screening (PHS) is developed and maintained for all radiological work in controlled areas or radiological areas.

- Ensure that radiological work is performed using an approved TWD.

- Ensure that TWDs and RWPs as applicable, are developed and implemented as specified in the PHS and CPR 400.1.1/MN471001, *ES&H Manual*, Chapter 21, "Technical Work Documents (TWDs)," as necessary, to ensure compliance with the requirements of this manual.

Ensure that TWDs used as the sole administrative control for radiological work include:

- Detail and content commensurate with the radiological hazards created by the activity and be consistent with the education, training, and skills of the individuals exposed to those hazards.
- Sufficient description of the work to be performed to allow for planning of radiological controls.
- Specific training requirements, including a pre-job briefing if the task is complex.
- Description of current radiological conditions.
- Requirements for radiological monitoring and dosimetry.
- Requirements for personal protective equipment (PPE) for radiological controls.
- Other radiological work controls as applicable.
- Radiological hold points or work controls.
- Correct authorized user lists, when applicable.

- Ensure that all TWDs for radiological work include concurrence of the appropriate Radiation Protection Project Leader.
- Ensure that a *General RWP Task Analysis for Added Radiological Activities*, (Word File/Acrobat File), is completed and reviewed for all new Radiological Work to determine the adequacy of current RWP(s) if a new RWP is not desired.
- Initiate, review, and retain copies of the following forms for radiological workers whom they supervise:
  - SF 2001-ACL, Administrative Control Level (ACL) Approval Form (Word file/ Acrobat file).
  - SF 2001-RWR, Radiological Work Restriction (Word file/Acrobat file).

- Approve implementation of the radiological work covered by the TWD and RWPs, as applicable.

Job coordinators shall ensure that:

- Pre-job briefings and special training are attended by any individuals assigned to participate in a job that requires either a pre-job briefing and/or special training.

  Note: Pre-job briefings should be given by Members of the Workforce who understand the level of radiological risk, the complexity of the task, and the level of coordination between the assigned work participants and the planned activities.

- All work is performed in compliance with the requirements of the TWDs and RWPs, as applicable, (consult the appropriate RP Personnel, as necessary for assistance).

- All TWDs and RWPs, as applicable, for a planned job activity are consistent.

- The Environmental ALARA Coordinator is consulted directly, or through the appropriate RP Personnel, for assistance in estimating, measuring, and/or mitigating radiological releases and public doses, as applicable.

- Steps are included in TWDs and RWPs, as applicable, as necessary to provide radiological protection of the public and the environment (consult the Environmental ALARA Coordinator for assistance).

- The appropriate RP Personnel are notified of:

  - Any changes in work scope and radiological conditions.

  - Violations by anyone of radiological controls imposed by a TWD or RWPs, as applicable.

- TWDs and RWPs, as applicable, are terminated when the work is completed or changes in work scope require the generation of a new document.

4.3 Radiological Work Permits (RWPs)

Requirements

RWPs are an authorization to conduct work involving exposure to radiation or radioactive materials that identify radiological conditions, establish worker protection and monitoring requirement and contain specific approvals. RWPs shall be used to establish radiological controls for the following radiological activities:

- Work in any Radiological Area.
- Intrusive work in soil contamination areas, underground radioactive material areas, or fixed contamination areas.
- Work involving direct contact with radioactive material that could result in contamination to the worker or property.

  Note 1: If an RWP is used, radiological controls specified in the TWDs shall be consistent with the RWP.

  Note 2: For radiological controls, RWPs take precedence over any TWDs.

  Note 3: RWP preparation is initiated by submitting a Radiological Work Permit Request (SF 2001-WPR) to the appropriate RP Personnel.

4.3.1 Radiological Work Permit (RWP) Requests

Requirements

The Job Coordinator shall:

- Complete SF 2001-WPR, Radiological Work Permit Request (Word File/Acrobat File), as indicated in the instructions attached to the form.
- Submit SF 2001-WPR, Radiological Work Permit Request, to the appropriate Radiation Protection Line Support Project Leader.
- Consult the appropriate RP Personnel for assistance in completing and submitting the form.
- Allow sufficient time for pre-job surveys and RWP processing to be completed

prior to the anticipated start of the job.

4.3.2 General RWP Task Analysis for Added Radiological Activities

This form is to be used to evaluate the applicability of a current RWP for new work to ensure that all work performed using a general RWP is within the scope of the existing RWP and that the hazards introduced by the proposed activity are adequately controlled.

Requirements

The Job Coordinator shall:

- Complete a *General RWP Task Analysis for Added Radiological Activities*, (Word File/Acrobat File), for all new Radiological Work to determine the adequacy of current RWP(s) if a new RWP is not desired.
- Submit a *General RWP Task Analysis for Added Radiological Activities*, (Word File/Acrobat File), to the appropriate Radiation Protection Line Support Project Leader when completed.

4.3.3 Approval of RWPs

Three signatures are required for completion of an RWP:

- Job Coordinator – approves the description of work.
- Responsible RP Project leader (or designee) – approves the radiological controls specified for the scope of work stated in the job description portion of the RWP.
- Line Manager – approves the implementation of all RWPs used in conjunction with radiological work performed by their organization before work is initiated.

4.3.4 Revising/Replacing RWPs

Requirements

Conditions that require revising/replacing an RWP include the following:

- Change in job site.
- Change in the scope of work.
- Change in estimated personnel doses and/or radiological conditions to such an extent that ALARA trigger levels may be exceeded (see Chapter 7, "Radiological Design and Control and ALARA Application").
- Change in radiological conditions that would result in a change to posting, personal protective equipment (PPE), or work controls.
- Need for additional special instructions.

Note: A stand down of operations may be necessary to revise an RWP. The appropriate RP Personnel will make this determination based on the nature and scope of the needed revision.

4.3.5 Radiological Work Permit (RWP) Types

There are two types of RWPs used at Sandia:

- A job-specific RWP is a work authorization issued for performance of a specific job in a specific area where the work may affect or change the radiological conditions, as well as any work or task that does not meet the requirements for a general RWP. Job-specific RWPs are issued for a maximum, initial, valid period of 3 months, but may be extended up to a maximum duration of 1 year.
- A general RWP is a work authorization issued for work of a routine nature, such as sampling, surveys, calibrations, tours, inspections, or other repetitive tasks that do not change the radiological protection requirements for a system or area or do not result in significant radiation exposure. General RWPs should be issued for an extended period of time, with a maximum period of 1 year.

4.3.6 RWP Termination

Managers shall ensure that:

- Appropriate RP Personnel are notified when work under an RWP is completed. This will initiate the RWP termination process.

4.4 Radiological Work Implementation

4.4.1 Conducting Radiological Work

Requirements

Members of the Workforce shall (prior to commencing work):

- Attend pre-job briefings when such briefings are cited as mandatory in relevant TWDs and RWPs if applicable.
- Read any associated TWDs and RWPs if applicable:
    - Verify scope of work reflects the work that the Member of the Workforce intends on performing.
    - Resolve any questions concerning TWDs.
- Sign any associated TWDs and RWPs if applicable:
    - At specified frequencies (i.e., per the requirements of the individual TWDs).
    - After any revision that affects existing radiological controls or the scope of the radiological work.

Note 1: When signing an RWP, a signature indicates that the individual meets the requirements of the RWP, understands the content of the RWP, has received any necessary briefings, and will comply with all the requirements of the RWP.

Note 2: For higher hazard jobs, a formal ALARA pre-job review and a pre-job briefing may be required (see Chapter 7, "Radiological Design and Control and ALARA Application," for ALARA review and briefing requirements).

While conducting radiological work:

- Perform only activities described in the scope of the applicable TWD.

Note: Should actions be required that extend beyond the scope; create a conflict with TWD requirements; or should radiological conditions deviate from the values

specified in the TWD:

  - Immediately stand down the work.
  - Notify the responsible manager and appropriate RP Personnel (see Section 4.7, "Standing Down Operations").

- Document changes in equipment, techniques, and procedures used to monitor radiological conditions in the workplace.
- Work in the lowest dose rate area practical.
- Wear dosimetry according to instructions in Chapter 4, "Radiation Dosimetry."
- **NOT** move or modify postings, barricades, shielding, boundaries, or reach across radiological boundaries unless authorized to do so by the appropriate RP Personnel or an approved TWD.
- **NOT** smoke, eat, drink, chew, or apply cosmetics while in:
  - Airborne radioactivity areas.
  - Radiological areas established for contamination control.
  - Radiological buffer areas established for contamination control.
  - Radioactive material areas.
  - Soil contamination areas (SCAs) during performance of intrusive work.

    Note: When performing intrusive work in soil contamination areas, drinking and applying skin/lip sunscreens are allowed in designated hydration break areas. Prior to drinking, hand washing is encouraged. Eating, smoking, and chewing (tobacco products or gum) is discouraged. Consult the appropriate RP Personnel for assistance in establishing hydration break areas.

Guidance

Managers should:

- Routinely observe work in progress to ensure that TWDs are being implemented.
- Include surveys and other supporting data with TWDs that are posted at radiological work areas.
- Consider providing pre-job briefings for all work performed under TWDs, including discussions of work to be performed, reviews of the anticipated radiological conditions, and protective measures specified in relevant TWDs.

4.4.2 Personal Protective Equipment (PPE)

Members of the Workforce shall:

- Comply with approved TWD requirements for using PPE.
- Inspect PPE for integrity prior to donning.
- Wear PPE when entering areas where removable contamination exists at levels exceeding those specified in Attachment 6-1, "Radioactive Contamination Limits."
- Use Attachment 1-3, "Personal Protective Equipment (PPE) Selection," to select PPE that is appropriate for: the contamination level in the work area, the anticipated work activity, worker health conditions, if applicable, and with regard for nonradiological hazards that may be present.
- Don and remove PPE in accordance with instructions specified in Attachment 1-4, "Standard Procedure for Donning and Removing Protective Clothing," or per the relevant TWD.
- Immediately exit the work area and consult appropriate RP Personnel, if the integrity of PPE is compromised.

Guidance

Donning and removing instructions should be available in the work area for reference.

4.4.3 Personnel Contamination Control

Note: The following requirements do not apply to areas where the radioactive material

present cannot be detected by frisking (e.g., H-3, Ni-63, I-125).

Requirements

Managers shall ensure that:

- Frisking instructions are posted at frisking instrument and automatic monitor locations, unless a radiological control technician (RCT) conducts or observes the frisking operations.

Members of the Workforce shall:

- When exiting contamination areas, high contamination areas, and airborne radioactivity areas:
    - Perform a whole-body frisk as soon as possible following exit from the area, but prior to washing, showering, or exiting controlled areas.
    - Frisk any personal items carried into the area. Personal items include papers, pens, jewelry, security badges, dosimeters, and other items commonly used within the area.
    - **NOT** remove tools or other material and equipment. These items may be released only after surveyed by trained RP Personnel.

    Note: Attachment 1-5, "Guidelines for Personnel Monitoring with Portable Frisking Instruments," presents guidelines for using portable frisking instruments.

- If a contamination frisk cannot be performed at the exit from a contamination area, high contamination area, or airborne radioactivity area because of high background radiation levels:
    - Remove all protective clothing and equipment at the exit point.
    - Proceed directly to the nearest designated frisking station.
    - Conduct a whole-body frisk.

      Note: The nearest frisking station should be located inside the

radiological buffer area that adjoins the contamination area, high contamination area, or airborne radioactivity area from which personnel are exiting.

- When exiting a Radiological Buffer Area that adjoins a contamination area, high contamination area, or airborne radioactivity area, perform, at a minimum a hand and foot frisk (this requirement applies even if no entry was made to the contamination area, high contamination area, or airborne radioactivity) Any items removed from a radiological buffer area, including hand-held items that may have been directly or indirectly in contact with surfaces in this area, are subject to the frisking requirement as well.

  Note 1: Frisking is not required in areas where only low-energy-beta emitting radionuclides (e.g., H-3 and Ni-63) are expected. If such contamination is expected, notify RP Personnel so that proper monitoring can be performed.

  Note 2: Performing this frisk is optional in cases where the exit from the radiological buffer area is located immediately adjacent to the place where the person performed a whole-body frisk.

- When exiting a soil contamination area (SCA) where intrusive work was performed, perform a hand and foot frisk.

- When contamination is indicated during the frisk, stay at the frisking station and consult the appropriate RP Personnel for assistance.

Guidance

Members of the Workforce may conduct a frisk using either portable frisking instruments (see Attachment 1-5) or automatic monitors.

4.4.4 Respiratory Protection

Requirements

Managers shall ensure that:

- Members of the Workforce who may potentially be exposed to airborne radioactivity with the likelihood of causing the worker to receive a committed

effective dose equivalent (CEDE) in excess of 100 mrem per year are monitored. Monitoring can be accomplished by:

  - Tracking the derived air concentration (DAC) value or,
  - Performing internal dosimetry(bioassay).

    Note: The preferred monitoring method is bioassay.

- Respirators are provided to control worker intake of airborne radioactive material.

When respiratory protection is required by the TWD, Members of the Workforce shall:

- Be medically approved, fit tested, and trained within the past 6 or 12 months, as appropriate, and be able to demonstrate proof of compliance upon request.
- Possess a current qualification for the type of respirator specified.
- Ensure that the respirator's sealing surface is not compromised.
- If corrective lenses are required, use only lenses that are approved for use with the respirator.
- Qualitatively check the respirator for proper fit prior to entering areas that require a respirator.

RP Personnel shall:

- Evaluate the work conditions to determine the need for and type of respiratory protection required for an activity;
- Monitor the work place or worker during work performance; and
- Monitor the respirator at the conclusion of use.

4.5 Radiological Work Restrictions

Requirements

Managers shall ensure the following when a radiological work restriction is issued:

- SF 2001-RWR, Radiological Work Restriction (Word file/Acrobat file), is signed by the affected individual and the responsible manager or the appropriate RP Project Leader (to indicate concurrence).

  Note: Radiological work restrictions may be issued by either the responsible manager or the appropriate RP Project Leader.

- The completed form is forwarded to the appropriate RP Project Leader, with a copy sent to the individual's organization manager.

  Note: A copy of the completed SF 2001-RWR, Radiological Work Restriction (Word file/Acrobat file) is maintained by RP personnel until the restriction has expired or is removed. The appropriate RP Project Leader (SNL/NM) or HASD manager (SNL/CA) signs the restriction to indicate concurrence with the expiration or removal of the radiological work restriction.

- Radiological work restrictions for declared pregnant radiological workers are developed in accordance with Chapter 14, "Declared Pregnant Workers."

Guidance

A radiological work restriction (see SF 2001-RWR, Radiological Work Restriction [Word file/Acrobat file]) may be issued for reasons such as the following:

- Declared pregnancy.
- Repeated poor radiological work practices or procedure violations.
- Exceeding an administrative control level (ACL) without authorization.
- Unknown external or internal dose status.
- Suspected or positive internal deposition of radioactive material.
- Participation in a nuclear medical procedure.
- Loss of issued dosimetry.

- Involvement in a radiological incident or potential overexposure.
- A responsible manager's request.
- A request by the appropriate Sandia health services organization.
- Refusal to comply with external or internal dosimetry requirements as described in Chapter 4, "Radiation Dosimetry."

4.6 Planned Special Exposures

Requirements

Managers shall ensure that:

- Each of the following conditions is satisfied before planned special exposures are authorized for radiological workers to receive doses in addition to the dose received under the limits specified in 10 CFR 835.202(a) (see Attachment 1-1):
    - The planned special exposure is considered only in an exceptional situation when alternatives that might prevent a radiological worker from exceeding the limit in 10 CFR 835.202(a) are unavailable or impractical.
    - Management (and the radiological worker's employer, if the worker is not a Sandia employee) specifically requests the planned special exposure, in writing.
    - Joint written approval is received from the appropriate Department of Energy/ Headquarters (DOE/HQ) program office and the Secretarial Officer responsible for environment, safety, and health matters.
- Prior to requesting that radiological workers participate in an authorized planned special exposure, each worker's dose from all previous planned special exposures and all doses in excess of the occupational dose limits are determined.
- Radiological workers do not receive a planned special exposure that, in addition to the doses determined in 10 CFR 835.204(b), would result in a dose exceeding the following:

- The numerical values of the dose limits established in 10 CFR 835.202(a) (see Attachment 1-1), within in a one year period.
- Five times the numerical values of the dose limits established at 10 CFR 835.202(a) (see Attachment 1-1), over a workers lifetime.

- Written consent is obtained from each worker involved, prior to a planned special exposure, to include:
  - The purpose of the planned operation and the procedures to be used.
  - The estimated dose associated with the potential risks, specific radiological conditions, and other hazards that might be involved in performing the task.
  - Instructions on the measures to be taken to keep the dose as low as reasonably achievable (ALARA), considering other risks that may be present.
- Records of planned special exposures are maintained and written reports are submitted to the approving organizations identified in 10 CFR 835.204(a)(3) within 30 days after the planned special exposure.

- The dose from planned special exposures:
  - Is not considered in controlling future occupational dose of the 10 CFR 835.202(a) (see Attachment 1-1).
  - Is included in records and reports required under 10 CFR 835(a)-(f).

Members of the Workforce shall follow the requirements in Attachment 1-6 for conducting planned special exposures.

4.7 Voluntary Stand Down of Operations

Members of the Workforce shall voluntarily stand down operations when radiological controls or hold points are deemed inadequate or are not being implemented.

Managers shall ensure that radiological work does not resume following a voluntary stand down of operations until:

- Proper radiological control has been re-established.
- Written approval has been:
  - Obtained from responsible managers and the appropriate RP Personnel.

    Note: Consult the appropriate RP Personnel for assistance.
  - Documented in a technical work document (TWD) at Sandia/NM or safe work permit (SWP) at Sandia/CA.

5.0 RECORDS

Requirements

Managers shall ensure that records are maintained:

- To document compliance with Sandia's radiation protection record-keeping requirements as implemented in the *Sandia Records Retention and Disposition Schedule* by the Recorded Information Management Department. **[10 CFR 835.701(a)]**
- Until final disposition is authorized by the National Archives and Records Administration (NARA) through DOE. **[10 CFR 835.701(b)]**

Managers shall ensure that work planning and control-related record copies (i.e., originals) of the following documents are sent to the the appropriate RP Personnel:

- SF 2001-ACL, ACL Approval Form (Word file/Acrobat file).
- SF 2001-RWR, Radiological Work Restriction (Word file/Acrobat file).
- Radiological work permits (RWPs) and associated attachments (e.g., briefing forms, sign-in sheets, revisions, etc.).
- Documentation related to planned special exposures

Members of the Workforce who generate occupational radiation protection related records shall use the specific units of curie, roentgen, rad, and rem for activity, exposure, dose and dose equivalent respectively. Multiples and subdivisions of these units are allowed. SI units (becquerel [Bq], gray [Gy], and sievert [Sv]) may be included in parenthesis after the specific units. **[10 CFR 835.4]**

Guidance

Managers should retain copies of the above records in their department files.

6.0 REFERENCES

6.1 Requirements Source Documents

10 CFR 835, *Occupational Radiation Protection*.

6.2 Implementing Documents

SNL, CPR 400.1.1.1/GN470098, *Developing ES&H Procedures*.

SNL, CPR 400.1.1/MN471001, *ES&H Manual*, Chapter 21, "Technical Work Documents (TWDs)."

SNL, RPGD-05-001, *Control of Soil Contamination Areas (SCAs)*.

SNL/CA, OP471382, *Administrative Procedure for the Development of Safe Work Permits*.

6.3 Related Documents

DOE G 441.1-1, *Management and Administration of Radiation Protection Programs Guide*.

DOE-STD-1098-99, *Radiological Control*.

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Corporate Process Requirement No: CPR400.1.1.32
Sponsor: Dori Ellis, 4000, Acting

Revision Date: September 22, 2006

Radiological Protection Procedures Manual

CHAPTER 2 – POSTING AND LABELING FOR RADIOLOGICAL CONTROL

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MN471016, Issue F
Effective Date: September 22, 2006; Replaces Document Dated: November 3, 2000
Review Date: September 6, 2006

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* Indicates a substantive change

1.0 PURPOSE

This chapter presents requirements and guidance for radiological posting and labeling at

SNL.

2.0 SCOPE

This chapter applies to all radiological posting and labeling practices at SNL.

3.0 RESPONSIBILITIES

3.1 Managers

Managers are responsible for ensuring that:

- Controlled areas, radiological areas, and radioactive material areas are posted, and individual items and containers are labeled in accordance with the requirements of this chapter.
- Postings accurately reflect radiological conditions.
- Postings are legible and easy to understand, and remain unaltered.

3.2 RP Personnel

RP personnel are responsible for providing:

- Radiological signs and labels that meet specified requirements.
- Guidance in determining posting and labeling requirements.
- Guidance with regard to placement of temporary and permanent fixtures for the purpose of posting.
- Guidance with regard to disposal of contaminated and non-contaminated radiological signs and labels.

*4.0 PROCEDURE

4.1 General Posting and Labeling

Requirements

Managers shall ensure that:

- Radiological postings and labels reflect current conditions in the area.

  Note: Postings **and labels** may need to be upgraded or downgraded to be current. Postings that reflect the conditions during intermittent operations fulfill this requirement.

- All signs and labels required by this procedure bear the standard radiation trefoil in magenta or black imposed upon a yellow background. **[10 CFR 835.601(a)]**

- All signs required by this procedure are clearly and conspicuously posted. **[10 CFR 835.601(b)]**

- If more than one radiological condition exists in an area and requires posting, each radiological condition is identified. **[10 CFR 835.603]**

- If other hazardous conditions exists (e.g., chemical, electrical, etc.), the condition (s) are posted separately in accordance with the requirements of the appropriate chapter(s) of CPR400.1.1, MN471001, *ES&H Manual*.

Guidance

Managers may use the following information to assist with posting:

- Required signs may include radiological protection instructions such as dosimetry requirements, training requirements, PPE requirements, etc. **[10 CFR 835.601(b)]**

- Postings that indicate intermittent radiological conditions may include statements specifying when the condition exists, such as in the examples provided below.

CAUTION: RADIATION AREA
WHEN RED LIGHT IS ON

GRAVE DANGER
VERY HIGH RADIATION AREA
WHEN ACCELERATOR FIRES

- Rope, tape, chain, or similar barrier material used to designate radiological areas should be yellow and magenta.
- Physical barriers should be placed so that they are clearly visible from all accessible directions and elevations (if more than one elevation is affected).
- Postings at doorways should be positioned so that they are always visible whether doors are open or closed.
- Postings and barriers should not be moved or altered without prior notification to the appropriate Division ES&H Team.
- Multiple radiological conditions should be posted using one of the following practices:
    - Posting each radiological condition on a separate sign with any appropriate supplemental wording.
    - Posting all radiological conditions on one or more signs (e.g., user-changeable signs using inserts)

      using the most stringent heading and listing the radiological areas in decreasing order of importance. (Consult the appropriate Division ES&H for guidance on posting hierarchy.) Any supplemental information should follow the radiological area designations.

  Note: The second method is preferred because it reduces clutter and is more efficient.
- Very high radiation area postings should be established on an exclusive sign without other radiological area designations. **[DOE G 441.1-10]**
- Signs used for training should be clearly marked, such as "For Training Purposes

Only." **[DOE-STD-1098-99]**

*4.2 Specific Posting Criteria

Requirements

Managers shall be responsible for ensuring that:

- Proper posting is maintained in accordance with the following sections of this procedure.
- Postings are verified by field measurement and observations conducted as an element of any of the following:
  - Routine surveys.
  - Job coverage.
  - Changes in facility use.

*4.2.1 Controlled Areas

Requirements

Managers shall be responsible for ensuring that:

- Each access point to controlled areas is posted, whenever radiological areas or radioactive material areas exist in the area. Individuals who enter only controlled areas without entering radiological areas or radioactive material areas are not expected to receive a total effective dose equivalent of more than 0.1 rem (0.001 sievert) in a year. **[10 CFR 835.602(a)]**
- All access points are posted with the words "Caution, Controlled Area." **[DOE G 441.1-10]**
- Controlled area boundaries are established and completely surround radiological or radioactive material areas. **[DOE-STD-1098-99]**

Guidance

Managers may post controlled areas with signs that do not meet the requirements as to color and design to avoid conflict with local security requirements. **[10 CFR 835.602(b)]** However, the yellow and magenta color scheme, and the standard radiological hazard warnings are preferred. **[DOE G 441.1-10]**

Note: Controlled area boundaries may be contiguous with but should be larger than the boundaries of radiological or radioactive material areas.

4.2.2 Radiological Areas and Radioactive Material Areas

Requirements

Managers shall ensure that all access points to radiological areas or radioactive material areas are posted with conspicuous signs bearing the wording specified in the following table. **[10 CFR 835.603]**

Type of Area	Required Wording
Radiation Area	"Caution, Radiation Area" **[10 CFR 835.603(a)]**
High Radiation Area	One of the following: • "Caution, High Radiation Area" • "Danger, High Radiation Area" **[10 CFR 835.603(b)]**
Very High Radiation Area	"Grave Danger, Very High Radiation Area" **[10 CFR 835.603(c)]**
Airborne Radioactivity Area	One of the following: • "Caution, Airborne Radioactivity Area" • "Danger, Airborne Radioactivity Area" **[10 CFR 835.603(d)]**

Contamination Area	"Caution, Contamination Area" **[10 CFR 835.603(e)]**
High Contamination Area	One of the following: • "Caution, High Contamination Area" • "Danger, High Contamination Area" **[10 CFR 835.603(f)]**
Radioactive Material Area	"Caution, Radioactive Material(s)" **[10 CFR 835.603(g)]**

4.2.3 Exceptions to Posting

Guidance

Managers are allowed the following exceptions to postings:

Radiological Areas and Radioactive Material Areas

Areas may be excepted from the above posting requirements for periods of less than 8 continuous hours when placed under continuous observation and control of an individual knowledgeable of and empowered to implement required access and exposure control measures. **[10 CFR 835.604(a)]**

Radioactive Material Areas

Areas may be excepted from the radioactive material area posting requirements when:

- Posted as radiological areas (i.e., Radiation Area, High Radiation Area, Very High Radiation Area, Contamination Area, High Contamination Area, or Airborne Radioactivity Area) in accordance with Section 4.2.2. **[10 CFR 835.604(b)1]**
- Each item or container of radioactive material is labeled in accordance with Section 4.3 such that individuals entering the areas are made aware of existing/ potential hazards. **[10 CFR 835.604(b)2]**

- The radioactive materials of concern consist solely of structures or installed components that have been activated, such as by being exposed to neutron radiation or particles produced by an accelerator. **[10 CFR 835.604(b)3]**

Areas intended for receipt only (e.g., Shipping and Receiving) of packages received from offsite need not be posted in accordance with Section 4.2.2 until the packages are monitored, provided that both of the following criteria are met:

- The packages are labeled in accordance with DOT regulations.
- The packages are in non-degraded condition (e.g., not damaged, wet). **[10 CFR 835.604(c)]**

See Chapter 6, "Control of Radioactive Material," for monitoring requirements.

Although certain areas may be excepted from posting, appropriate controls should be established over these areas to limit exposures consistent with ALARA and the Integrated Safety Management System (ISMS). **[DOE G 441.1-10]**

The exceptions discussed above apply only to area posting requirements and do not apply to entry control requirements (e.g., access control, personal protective equipment [PPE], dosimetry) or to radiation safety training requirements. Decisions regarding omission of postings should be documented in appropriate technical work documents (TWDs). **[DOE G 441.1-10]**

For areas that will be unposted for less than 8 continuous hours (using an individual to control access), the observing/controlling individual should be stationed to provide both of the following:

- Line-of-sight surveillance of the access points and area boundaries, if possible.
- Verbal warnings.

4.2.4 Supplemental Postings

Requirements

Managers shall ensure that:

- When areas are established (see Chapter 6, "Control of Radioactive Material ," for establishment criteria), all access points are posted with conspicuous signs bearing the wording specified in the following table.

Type of Area	Required Wording
Radiological Buffer Area	"Caution, Radiological Buffer Area"
Soil Contamination Area	"Caution, Soil Contamination Area"
Underground Radioactive Material Area	"Caution, Underground Radioactive Material Area"
Radioactive Material Management Area (RMMA)	One of the following: ○ "Caution, Radioactive Material Management Area" ○ A sign insert using the initialism "RMMA" **Note:**RMMAs are established for waste management not radiation protection. See CPR400.1.1, MN471001, *ES&H Manual*, Section 19D, "Radioactive Material Management Areas (RMMAs)," for specific establishment criteria.
Fixed Contamination Area	"Caution, Fixed Contamination Area"

- Soil contamination areas are located within posted controlled areas if access to soil contamination areas is likely to result in individual total effective dose equivalent (TEDE) doses greater than 100 mrem in 1 year from the radioactive material in the soil.

- Soil contamination areas are posted and controlled as posted contamination areas (or high contamination areas) when monitoring shows that radioactive material can be transferred from soil contamination areas at levels greater than those specified for removable contamination in Appendix D.

- Underground radioactive material areas are located within posted controlled areas

if access to such areas is likely to result in individual TEDE doses greater than 100 mrem in 1 year from the underground radioactive material.

- Fixed contamination areas are located within posted controlled areas if access to the fixed contamination areas is likely to result in individual TEDE doses greater than 100 mrem in 1 year from the fixed contamination.

- Individual locations identified as having fixed contamination equal to or above the levels specified in column 1 of Appendix D are posted or labeled identifying the locations as having fixed contamination.

[DOE-STD-1098-99]

Guidance

Managers may use the following information to assist with posting:

- Postings for soil contamination areas and underground radioactive material areas should include instructions or special warnings to workers regarding intrusive work.

- It is not necessary to place physical barriers around the boundaries of soil contamination areas and/or underground radioactive material areas if appropriate signs are placed at normal access points and along the boundaries.

- Large remote areas (e.g., test sites) should use fencing or other means to identify boundaries, when practical. At a minimum, normal access routes should be marked to identify such areas.

- A program to inspect and replace all outdoor postings for worn/faded/missing postings should be implemented.

- If several areas of fixed contamination exist throughout a room, the entrance may be posted rather than each surface. In this case, it is recommended that supplemental instructions be included on the posting to provide workers with precautions or controls imposed for working in the area.

- Installed temporary shielding should be posted or labeled with the following or equivalent wording: "Temporary Shielding – Do Not Remove Without Permission from the Division ES&H Team."

4.3 Radioactive Material Labeling

Requirements

Managers shall ensure that:

- Except as provided in Section 4.4, all items and containers of radioactive material are labeled (this includes devices such as gas chromatographs, x-ray diffraction units, radiography units, equipment, etc. containing radioactive material).
- Labels are durable and contain the standard radiation warning trefoil and the words "Caution, Radioactive Material" or "Danger, Radioactive Material."
- Labels provide sufficient information to permit individuals handling or using the containers, or working in the vicinity of the containers to take precautions to avoid or minimize exposures.
- Labels are clearly visible on items or containers.

  [10 CFR 835.605]

- If labels applied to items are not clearly visible through a container (e.g., plastic bags, lead pigs, boxes, etc), then an additional label is placed on the exterior of the container holding the radioactive material. **[DOE G 441.1-10] [Corrective Action #5 to Occurrence Report ALO-KO-SNL-7000-2000-0003, Radioactively Contaminated Lead in Uncontrolled Area]**
- Material and equipment with fixed contamination are clearly labeled to alert personnel of the contaminated status. **[10 CFR 835.1101 (c)]**

4.4 Exceptions to Radioactive Material Labeling

Requirements

Although items and containers of radioactive material may be excepted from labeling, SNL personnel shall establish appropriate controls over the storage, movement, and use of unlabeled items and containers as necessary to limit exposures consistent with the ALARA principle and to identify and control hazards in accordance with the Integrated

Safety Management System (ISMS) principle. **[DOE G 441.1-10]**

Guidance

Managers are allowed the following exceptions to labeling:

- Items or containers may be excepted from radioactive material labeling if:
    - The items or containers are used, handled, or stored in areas posted in accordance with Section 4.2.2, and controlled such that sufficient information is provided to permit individuals to take precautions to avoid or control exposures. **[10 CFR 835.606(a) 1]**
    - The quantity of radioactive material is less than one-tenth of the values specified in Appendix E (Word file/Acrobat file). **[10 CFR 835.606(a) 2]**
    - The items or containers are packaged, labeled, and marked in accordance with the regulations of DOT or the requirements of DOE orders governing radioactive material transportation. **[10 CFR 835.606(a) 3]**
    - The items or containers are inaccessible or are accessible only to individuals authorized (i.e., through an approved technical work document [TWD]) to handle or use them, or to work in the vicinity. **[10 CFR 835.606(a) 4]**
    - The items or containers are installed in manufacturing, process, or other equipment, such as reactor components, piping, and tanks. **[10 CFR 835.606 (a) 5]**
    - The radioactive material consists solely of nuclear weapons or their components. **[10 CFR 835.606(a) 6]**
- Radioactive material labels applied to sealed radioactive sources may be excepted from the color specifications of Section 4.1. **[10 CFR 835.606(b)]**

Managers may use the following information to assist with labeling:

- For containers with numerous items of radioactive material, the determination of the need for labeling the container should be based upon the sum of the activities

of the individual items. **[DOE G 441.1-10]**

- When DOT labels are used as an alternative to the above requirements (see Section 4.2.2), measures should be implemented to ensure that affected individuals are familiar with the labels and the hazards and precautions associated with the labeled material. **[DOE G 441.1-10]**

- Although items and containers of radioactive material may be excepted from labeling when the material is stored in an area already posted in accordance with Section 4.2.2, caution should be exercised in applying this exception. The area radiological posting and required controls may not be sufficient to protect the individual if the hazard created by working with or in the vicinity of the item or container is different than the general area hazard. For example, the required postings and controls for a "Contamination Area" may not be sufficient if the item or container stored within creates a radiation exposure hazard if opened or used. **[DOE G 441.1-10]**

- Supplemental labels should be used in conjunction with the labeling required in Section 4.3. Examples of supplemental labels include but are not limited to the following:

    - "Contaminated"
    - "Potentially Contaminated"
    - "Internally Contaminated"
    - "Potentially Internally Contaminated" **[DOE-STD-1098-99]**

- For consistency, consult the appropriate Division ES&H Team for labels currently used at SNL.

4.5 Disposal of Radiological Signs and Radioactive Material Labels

Requirements

Managers shall be responsible for ensuring that:

- Radiological signs and radioactive material labels that are not contaminated are not disposed of in clean trash, unless they have been destroyed (by cutting, shredding, or otherwise tearing) to a point that the radiological warnings (pictorial and verbiage) are unrecognizable.

- Contaminated radiological signs and radioactive material labels are disposed of as radioactive waste; no destruction of these is necessary.

Guidance

Managers should consult the appropriate Division ES&H Team for assistance and guidance regarding disposal of larger signs and labels.

5.0 RECORDS

Requirements

SNL personnel who generate occupational radiation protection related records shall use the special units of curie, roentgen, rad, and rem for activity, exposure, dose and dose equivalent respectively. Multiples and subdivisions of these units are allowed. SI units (becquerel [Bq], gray [Gy], and sievert [Sv])may be included in parenthesis after the special units. **[10 CFR 835.4]**

Managers shall be responsible for ensuring that records are maintained:

- To document compliance with SNL's radiation protection record-keeping requirements as implemented in the *Sandia Records Retention and Disposition Schedule* by the Recorded Information Management Department (4912). **[10 CFR 835.701(a)]**

- Until final disposition is authorized by the National Archives and Records Administration (NARA) through DOE. **[10 CFR 835.701(b)]**

6.0 REFERENCES

6.1 Requirements Source Documents

10 CFR 835, *Occupational Radiation Protection*.

DOE-STD-1098-99, *Radiological Control.*

6.2 Implementing Document

SNL, CPR400.1.1, MN471001, *ES&H Manual*:

- Chapter 12, "Packaging and Transportation of Hazardous Material."
- Section 19D, "Radioactive Material Management Areas (RMMAs)."

6.3 Related Documents

DOE G 441.1-1, *Management and Administration of Radiation Protection Programs Guide*.

DOE G 441.1-10, *Posting and Labeling for Radiological Control Guide.*

DOE-STD-1098-99, *Radiological Control*.

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Corporate Process Requirement No: CPR400.1.1.32
Sponsor: Dori Ellis, 4000, Acting

Revision Date: April 26, 2006

Radiological Protection Procedures Manual

CHAPTER 3 – RADIOLOGICAL TRAINING PROGRAM

Subject Matter Expert: Brian C. Thomson
MN471016, Issue M
Revision Date: April 26, 2006; Replaces Document Dated: December 13, 2005
Administrative Changes: July 5, 2006

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*Indicates a substantive change

1.0 PURPOSE

This chapter describes the Sandia Radiological Training Program, which implements the requirements of 10 CFR 835.901 and .704(a).

2.0 SCOPE

This chapter applies to all personnel entering Sandia-controlled premises that are posted in accordance with Chapter 2, "Posting and Labeling for Radiological Control."

3.0 RESPONSIBILITIES

3.1 Managers

Managers are responsible for ensuring that personnel within their organizations are appropriately trained in accordance with Table 1, and that:

- Personnel complete radiological worker training either prior to assignment as radiological workers, or concurrent with assignment as radiological worker if the workers are accompanied by and under the direct supervision of a trained radiological worker.
- Radiological workers receive appropriate job-specific radiological training.
- Nonradiological workers complete RAD102, General Employee Radiological Training, as applicable.

3.2 Division ES&H Coordinators

Division ES&H Coordinators shall be responsible for providing managers that are new to an organization that has radiological work and/or facilities with a New Manager Radiological Briefing within 90 days of the managers' new assignment.

3.3 Nonradiological Workers

Nonradiological workers (Sandia personnel and DOE personnel) are responsible for completing RAD102, General Employee Radiological Training, as applicable (see Table

1 and Section 4.2).

3.4 Radiological Workers

Radiological workers are responsible for:

- Completing required radiological training (see Table 1, and Sections 4.3, 4.7, 4.8, and 4.9).
- Having their current qualification cards in their possession (or readily available) at all times while in radiological areas or while performing radiological work.
- **Note:** In some instances, computerized training records (e.g., TEDS records) may be used to verify qualification immediately following training until new qualification cards can be issued.

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*4.0 PROCEDURE

4.1 Minimum Radiological Training

Requirements

Members of the Workforce shall complete radiation safety training before being permitted unescorted access to controlled areas.

Managers shall be responsible for ensuring that:

- Personnel within their organizations receive at least the minimum radiological training requirements as specified in Table 1.
- All training requirements commensurate with the hazard(s) within posted areas are completed before personnel are allowed unescorted access to the areas.
- **Note:** All unescorted radiological workers are required to complete appropriate job-specific radiological training. Additional information on job-specific radiological training may be found in Section 4.3.2.

Table 1. Radiological Training Requirements

Affected Personnel/Activity	Minimum Training Required[1]
Unescorted access to controlled areas	RAD102[2]
Unescorted access to radiological buffer areas	RAD102[2]
Unescorted access to radioactive material areas (RMAs)	RAD102[2]
Unescorted access to radiation areas	RAD210[3]
Access to high radiation and very high radiation areas	RAD230[4]
Unescorted access to contamination areas	RAD230[3]
Access to high contamination areas	RAD230[4]
Access to airborne radioactivity areas	RAD230[4,5]
Unescorted access to soil contamination areas, underground radioactive material areas, and fixed contamination areas: • To perform non-intrusive work • To perform intrusive work	RAD102[2] RAD230[3]
Managers responsible for radiological work or radiological workers	RAD250
Sandia radiological emergency response team members	RAD230[4]

Members of the Workforce who use radioactive sources or material: • Conditionally Controlled radioactive material. • Accessible Controlled radioactive material. • Inaccessible Controlled radioactive material.	RAD102[6,7] RAD210[3,7] RAD102[2,7]
Radioactive source custodians	RAD218[7]
Material Balance Area (MBA) custodians	RAD210[8]
Members of the Workforce who transport non-exempt radioactive material: • In quantities greater than Appendix E values. • In quantities less than, or equal to, Appendix E values.	RAD210[4] RAD102[6,10]
Custodians and Operators of radiation-generating devices (RGDs): 1. Unattended, Inherently Safe, or Certified Cabinet 2. Emitting only electronically generated x-rays 3. Containing accessible Controlled radioactive material 4. Containing inaccessible Controlled radioactive material 5. High-energy particle accelerators	RAD102[6,9] RAD214[3,9] or RAD210[3,9] RAD210[3,9] RAD102[2,9] RAD210[3,9]
Custodians of radiation-generating devices	RAD219[9]

[1] Radiological workers are also required to complete training on procedures specific to their job assignments (see Section 4.3.2).

[2] See Section 4.2.1. Escorts may be used in lieu of training; however, specific restrictions and requirements apply (see Section 4.4).

[3] See Section 4.3.1. Escorts may be used in lieu of training; however, specific restrictions and requirements apply (see Section 4.4).

[4] See Section 4.3.

[5] See Section 4.5.

[6] See Section 4.2.2.

[7] See Section 4.8.

[8] RAD210 is the minimum level of radiological training required for personnel who transport radioactive material in quantities greater than Appendix E values. Also see CPR400.1.1/MN471001, *ES&H Manual*, Chapter 12, "Packaging and Transportation of Hazardous Material," and the packaging and transportation process manuals for Sandia/NM and Sandia/CA for additional requirements (e.g., training) related to the transport of radioactive material.

[9] See Section 4.7.

[10] Transport of exempt radioactive material does not require RAD102 training.

4.2 Training for Nonradiological Workers

4.2.1 Generic Training

Requirements

Nonradiological workers who require unescorted access to controlled areas shall complete RAD102, "General Employee Radiological Training."

Nonradiological workers shall complete radiation safety retraining (e.g., RAD102, “General Employee Radiological Training”) at intervals not to exceed 24 months and when there are significant changes to radiation protection policies and procedures that may affect the individual.

Guidance

Managers may authorize nonradiological workers who have completed RAD102, General Employee Radiological Training, unescorted access to radiological buffer areas, radioactive material areas, fixed contamination areas, soil contamination areas, and underground radioactive material areas if the following conditions are met (as applicable):

- Recent radiological surveys have demonstrated that contamination levels in the area are less than the limits specified in Chapter 6, Attachment 6-1, "Radioactive Contamination Limits."
- No intrusive work will be performed.
- RAD102-trained personnel requiring access to the area will **not**:
  - Handle Controlled radioactive material.
  - Operate a radiation-generating device (RGD) that requires a higher level of radiological training (see Section 4.7).
  - Receive more than 100 mrem in a year.

Managers may authorize nonradiological workers who have full-time escort by radiological worker-trained personnel, access to radiation areas. See Section 4.4 for specific provisions and restrictions regarding the use of escorts in lieu of training.

4.2.2 Activities Authorization

Guidance

Nonradiological workers who have completed RAD102, "General Employee Radiological Training," may be authorized to:

- Operate "unattended" radiation-generating devices (RGDs), as well as "Exempt Shielded" radiation-generating devices that are classified as either "Inherently Safe" or "Certified Cabinet."

- Operate/use devices, equipment, etc., that contain inaccessible controlled radioactive material.

- **Note:** Sandia personnel directly involved with the modification of, or invasive maintenance on, equipment containing normally inaccessible controlled or conditionally controlled radioactive material shall complete RAD210, Radiological Worker I Training, as a minimum.

- Use, or work with, some conditionally controlled radioactive material. See the conditionally controlled material list (Attachment 6-3) for specific restrictions and requirements that may apply.

- **Note:** See Section 4.9 for additional requirements for roving personnel, contractors, visitors, tours, members of the public, and minors.

- Transport non-exempt radioactive material in quantities less than, or equal to, Appendix E values.

Personnel who are current in RAD210, Radiological Worker I Training; RAD230, Radiological Worker II Training; RAD214, Radiation-Generating Device Safety Training; or Radiological Control Technician Training satisfy the requirements for RAD102, General Employee Radiological Training.

4.3 Training for Radiological Workers

4.3.1 Generic Training

Requirements

Radiological workers shall complete the appropriate level of radiological worker training prior to:

- Unescorted access to radiological areas.

- Occupational exposure to ionizing radiation.

- Performing unescorted assignments as radiological workers.

- **Note:** The level of radiological worker training required (i.e., Radiological Worker I or Radiological Worker II), as well as job-specific radiological training, depends upon the type(s) of radiological hazard(s) or radiological area(s) that individuals may encounter while performing assigned activities.

RAD210, Radiological Worker I Training, is required for:

- Use of, or work with, Controlled radioactive material.

- Operation or use of devices, equipment, etc., that contain accessible Controlled radioactive material (see also Section 4.8).

- Operation of radiation-generating devices (RGDs) that require a level of radiological training higher than RAD102, General Employee Radiological Training (see also Section 4.7).

- Personnel whose job assignments involve the transport of radioactive material in quantities greater than Appendix E (Word file/Acrobat file) values.

- Material Balance Area (MBA) custodians (see also Section 4.8).

- Personnel whose job assignments require receiving more than 100 mrem in a year from occupational exposure.

- Personnel directly involved with the modification of, or invasive maintenance on, equipment containing normally inaccessible Controlled or Conditionally Controlled radioactive material (see also Section 4.8).

- Personnel whose job assignments require unescorted access to radiation areas in order to perform radiological work.

RAD230, Radiological Worker II Training, is required for:

- Work involving direct contact with non-exempt radioactive material that could result in contamination of the worker or property in excess of Attachment 6-1 limits.

- Intrusive work in soil contamination areas, underground radioactive material areas, and fixed contamination areas.
- Personnel who have access to high radiation areas, very high radiation areas, high contamination areas, or airborne radioactivity areas.
- Personnel who require unescorted access to contamination areas (see also Section 4.4).
- Sandia radiological emergency response team members.

Sandia Members of the Workforce receiving radiological worker training for the first time shall complete the instructor-led version of the training.

Radiological worker-trained personnel shall have their current qualification cards in their possession (or readily available) at all times while in radiological areas or while performing radiological work.

Note 1: In some instances, computerized training records (e.g., TEDS records) may be used to verify qualification immediately following training until new qualification cards can be issued.

Note 2: Personnel are issued radiological worker qualification cards that indicate the level of training completed and the date of expiration.

Note 3: Personnel who have completed comparable radiological worker training outside of Sandia may apply for training equivalency (see Section 4.9.2 for specifics). For determination of training equivalency, contact the Radiation Protection and Industrial Hygiene Training Project.

4.3.2 Job-Specific Training

Requirements

Radiological workers shall complete appropriate job-specific radiological training. This training shall include, as a minimum, reading all technical work documents applicable to work assignments. This training should also include appropriate on-the-job training (OJT), such as mentoring and/or vendor-provided training. Based upon the complexity of the task(s) and/or the experience of the worker, managers may exempt an individual

worker from formal OJT.

Managers shall be responsible for providing training on job-specific technical work documents (e.g., OPs, ES&H SOPs, and operating instructions), and for providing any additional training (e.g., equipment manufacturers' training, specialized radiological training), as necessary, to qualify their personnel for assigned radiological work. Managers shall be responsible for the following for each radiological worker in their organization:

- Determining appropriate job-specific radiological training.
- Providing job-specific radiological training to be completed by the individual.
- Documenting completion of job-specific radiological training.

Note 1: A Job-Specific Radiological Training Matrix (Word file/Acrobat file) has been developed and is available for use in documenting job-specific radiological training provided for personnel.

Note 2: Various elective courses are available to assist managers in providing additional job-specific radiological training for their personnel (e.g., RAD216, Portable Survey Instrument Training).

Managers shall verify that individuals responsible for developing and conducting job-specific radiological training have the appropriate education, training, and skills to discharge this responsibility. See CPR400.1.1/MN471001, *ES&H Manual*, Chapter 11, "ES&H Training" for instructor qualification requirements.

4.3.3 Retraining

Requirements

Radiological workers shall complete radiation safety retraining (e.g., Radiological Worker Training) at intervals not to exceed 24 months and when there are significant changes to radiation protection policies and procedures that may affect them.

Note: Should significant changes take place in radiation protection policies and practices, the Radiation Protection and Industrial Hygiene Training Project shall notify personnel of any additional retraining requirements.

Guidance

A computer-based version of radiological worker training is available for personnel due for their 24-month retraining.

Radiological workers are strongly encouraged to review the Radiological Worker Update approximately 12 months after their initial training, and subsequently every alternate year during which radiological worker retraining is not completed.

Managers should ensure that the levels of radiological worker training required for particular areas or activities are specified in radiological postings, applicable technical work documents (TWDs), and primary hazard screening (PHS) documentation.

The 24-month retraining interval for radiological workers may be extended, on a case-by-case basis, by a period not to exceed 30 days to accommodate scheduling needs (10CFR835.2). Any such extension should be documented by the appropriate manager.

Note: Current training and qualification for radiological control technicians (RCTs) satisfy the requirements for RAD230, Radiological Worker II Training.

*4.4 Use of Escorts in Lieu of Training

Under certain conditions and restrictions, constant escort and direct supervision by a suitably trained individual may be used in lieu of training (e.g., for contractors, roving personnel, visitors, and tours) for access to controlled areas, radioactive material areas, soil contamination areas, underground radioactive material areas, radiological buffer areas, and some radiological areas and non-radiological areas as well as for the performance of some limited radiological work activities.

Requirements

Sandia managers/hosts may choose to use escorts in lieu of training for contractors, roving personnel, visitors, and tours if the following conditions are met:

- For escort into Radiation Areas and Contamination Areas, as well as Soil Contamination Areas and Underground Radioactive Material Areas where invasive activities are being (or will be) performed during the escorting activity:
    - Prior knowledge and approval of the escorting activity by the appropriate

facility manager (or designee).

- Prior knowledge and approval of the escorting activity by the appropriate Radiation Protection Project Leader (or designee).

  Note: Facility manager and Radiation Protection approval of the escorting activity shall be documented. This documentation shall include: name of the escorted individual; name of the escort; date(s) of the escorting activity; specific details of the escorting activity; and identification of the RWP(s) associated with the area(s) to be entered and/or work to be performed/observed.

- Appropriate monitoring of the escorted individual is performed (see *Radiological Protection Procedures Manual,* Chapter 4).

- Signature on the appropriate RWP(s) of the escort and the escorted individual.

- For escort into Controlled Areas, Radioactive Material Areas, and Radiological Buffer Areas, as well as Soil Contamination Areas and Underground Radioactive Material Areas where invasive activities are not being (or will not be) performed during the escorting activity:

  - Prior knowledge and approval of the escorting activity by the appropriate facility manager (or designee).

  Note: Facility manager approval of the escorting activity shall be documented. This documentation shall include: name of the escorted individual; name of the escort; date(s) of the escorting activity; and specific details of the escorting activity [e.g., area(s) to be entered and/or work to be performed/observed].

Whenever an escort is used in lieu of training, the escort shall:

- Be knowledgeable of the facility/area(s) to be entered during the escorting activity.

- Complete all radiological training requirements applicable to the area(s) to be entered and the work to be performed.

- Ensure that all escorted individuals comply with CPR400.1.1.32, MN471016,

Radiological Protection Procedures Manual.

Escort in lieu of training shall be allowed only if:

- Escorted individuals will enter the areas for a short period of time (i.e., a few hours).
- There is no potential for the escorted individual to exceed the annual effective dose equivalent limit for the general public (see Chapter 1, Section 4.1.2).
- Presence of an escort will provide for an adequate level of safety.
- Presence of the escort and escorted individual will not change or affect the radiological conditions in the area(s) being entered.
- Presence and use of an escort will be consistent with the ALARA philosophy. This determination should be based upon consideration of the resources (including collective dose) that must be expended to escort the individual versus those necessary to provide the appropriate training for the escorted individual.
- Reliance on the escort provision does not become a routine occurrence.

No escorting shall be allowed for High Radiation Areas, Very High Radiation Areas, High Contamination Areas, or Airborne Radioactivity Areas.

4.5 Respiratory Protection Training

Requirements

Radiological workers who are required to use respiratory protection devices for protection against airborne radiological hazards shall:

- Be trained, fitted, and medically qualified to wear respiratory protection devices prior to use.
- Complete respiratory protection training and fit-testing every 12 months.

Guidance

Any individual who has completed comparable respiratory protection training outside of Sandia may apply for training equivalency. For determination of training equivalency, contact the Radiation Protection and Industrial Hygiene Training Project.

*4.6 Training for Managers and Supervisors

Requirements

Managers who are responsible for radiological work or radiological workers at Sandia shall complete RAD250, Management of Radiological Operations Training.

Managers whose departments own, or are responsible for, radioactive sources (regardless of activity) and/or radiation-generating devices (regardless of classification) shall complete RAD250, “Management of Radiological Operations Training.”

Note: The retraining interval for RAD250 is 24 months.

Managers who require unescorted access to controlled areas shall complete RAD102, “General Employee Radiological Training.”

Note: The retraining interval for RAD102 is 24 months.

Division ES&H Coordinators shall be responsible for providing managers that are new to an organization that has radiological work and/or facilities with a New Manager Radiological Briefing within 90 days of the manager's new assignment.

Note: This requirement applies to Members of the Workforce that are new to management positions, as well as to existing managers that are new to departments with radiological activities at Sandia. This also pertains to existing managers whose organizations add radiological work and/or facilities.

Guidance

Managers of radiological workers should complete RAD210, Radiological Worker I Training, or RAD230, Radiological Worker II Training, as appropriate, if any portion of their duties requires them to train or direct their personnel in job duties categorized as radiological work.

For guidance on how to perform a New Manager Radiological Briefing, see OS100, an optional tool for use when conducting the briefing.

*4.7 Training for Operators and Custodians of Radiation-Generating Devices (RGDs)

Requirements

Operators of "unattended" RGDs or "exempt shielded" RGDs classified as either "inherently safe" or "certified cabinet," shall complete RAD102, General Employee Radiological Training, as a minimum.

Operators of other RGDs that emit only electronically generated x-rays shall complete RAD214, Radiation-Generating Device Safety Training, as a minimum.

Note: RAD214, Radiation-Generating Device Safety Training, does not qualify personnel to access high or very high radiation areas.

Note: RAD210, Radiological Worker I Training, or RAD230, Radiological Worker II Training, may be substituted for RAD214.

Operators of RGDs that contain accessible Controlled radioactive material shall complete RAD210, Radiological Worker I Training, or RAD230, Radiological Worker II Training, as appropriate (see Section 4.3).

Operators of RGDs that contain inaccessible Controlled radioactive material shall complete RAD102, General Employee Radiological Training, as a minimum (see Section 4.2.2 for restrictions).

Operators of high-energy particle accelerators shall complete RAD210, Radiological Worker I Training or RAD230, Radiological Worker II Training, as appropriate (see Section 4.3).

Note: See Chapter 10, "Radiation-Generating Devices," for additional information on the classification and control of RGDs, as well as information on required device-specific training.

Operators of RGDs shall complete radiation safety retraining (e.g., RAD210, RAD214, or <RAD230) at intervals **not** to exceed 24 months.

RGD Custodians (primary and alternate) shall complete RAD219, Radiation-Generating Device Custodian Training. RGD Custodians (primary and secondary) shall complete Radiation-Generating Device Custodian retraining at intervals not to exceed 24 months.

RGD Custodians (primary and alternate) shall also complete radiation safety training (e.g., RAD102, RAD210, RAD230, or RAD214, as appropriate) if any part of their job responsibilities requires them to operate radiation-generating devices. This training shall be completed at intervals **not** to exceed 24 months.

4.8 Training for Custodians and Users of Radioactive Sources and Material

Requirements

Users of Conditionally Controlled radioactive material and inaccessible controlled radioactive material shall complete RAD102, General Employee Radiological Training, as a minimum.

Note: See the Conditionally Controlled Material List (Attachment 6-1) for specific restrictions and additional requirements (including training) that may apply to the use of Conditionally Controlled radioactive material.

Sandia personnel directly involved with the modification of, or invasive maintenance on, equipment containing normally inaccessible Controlled or Conditionally Controlled radioactive material shall complete RAD210, Radiological Worker I Training, as a minimum.

Users of accessible Controlled radioactive material shall complete RAD210, Radiological Worker I Training, as a minimum.

Material Balance Area (MBA) custodians shall complete RAD210, Radiological Worker I Training, as a minimum.

Sandia personnel performing any work with radioactive sources with removable surface contamination or material with removable surface contamination above Attachment 6-1

limits shall complete RAD230, Radiological Worker II Training, as a minimum.

Source Custodians (primary and secondary) shall complete RAD218, Radioactive Source Control for Source Custodians. Source Custodians (primary and secondary) shall complete radioactive source control retraining at intervals not to exceed 24 months.

Note: Current training and qualification for radiological control technicians (RCTs) satisfy the requirements for RAD218, Radioactive Source Control for Source Custodians.

4.9 Training for Roving Personnel, Contractors, Visitors, Tours, Members of the Public, and Minors

4.9.1 Roving Personnel

Requirements

Managers shall verify that any of their personnel who are considered "roving personnel" have satisfied all radiological training requirements specified for the area(s) to be accessed and the activities to be performed (see Table 1).

4.9.2 Contractors and Visitors

Requirements

Contractors and visitors shall successfully complete the appropriate level of radiological worker training (academic and hands-on portions) before being qualified to perform unescorted radiological work at Sandia (see Section 4.3 and Section 4.4).

On a case-by-case basis, contractors and visitors who have completed radiological worker training at another DOE site may be allowed to complete the academic portion of their training via computer-based training. Evidence of proof of previous training (e.g., certification document containing the individual's name, training date, and specific course completed) shall be provided to, and approved by, the RP&IH Training Project Leader in order for this option to be allowed.

Note: Radiological worker training received at another DOE site or facility must have been received within the past 24 months.

Contractors and visitors who require unescorted access to controlled areas shall complete RAD102, "General Employee Radiological Training," as a minimum (see Section 4.2).

Managers shall be responsible for determining and documenting the adequacy of prior radiological training possessed by non-DOE contractors and visitors, taking into account licenses possessed (if applicable), the scope and nature of work to be performed, and the radiological hazards in the area(s) to which access will be granted.

Guidance

Managers may, at their discretion, choose one of the following options when considering the prior training and experience of non-DOE contractors and visitors:

- Accept an individual's existing radiological training as is.
- Augment an individual's existing radiological training by assigning a full-time escort. See Section 4.4 for specific requirements and restrictions regarding the use of escorts.
- Challenge the adequacy of an individuals existing radiological training by requiring the individual to complete a suitable radiological worker training challenge exam, the appropriate hands-on training, and job-specific radiological worker training (Word file/Acrobat file)
- Require the individual to complete the appropriate Sandia radiological worker training, in its entirety.

Managers should ensure that visitors who will be escorted into controlled areas for periods exceeding 10 consecutive work days have completed RAD102, General Employee Radiological Training.

4.9.3 Tours

Requirements

Managers who are responsible for tours shall be responsible for:

- Obtaining prior approval from the appropriate facility manager(s).

- Being familiar with the current radiological conditions of the facilities or areas to be visited.

- Working with the facility manager(s) to establish processes or tour rules that will prevent tour participants from being exposed to ionizing radiation in excess of the limits specified in Chapter 1, Attachment 1-1, "10 CFR 835 Exposure Limits," while accessing the facilities.

  Note: If the facility manager has authorized a facility tour, full-time escort by RAD102-trained personnel may permit untrained tour participants to access controlled areas, radioactive material areas (RMAs), and radiological buffer areas provided that all of the conditions specified in Section 4.2.1 are met.

- Ensuring that tour participants are not allowed to perform any radiological work.

Note: Section 4.4 contains specific requirements and restrictions regarding the use of escorts.

4.9.4 Members of the Public and Minors

Requirements

The responsible manager shall ensure that members of the public and minors are not allowed to perform any radiological work.

5.0 RECORDS

Requirements

Managers shall be responsible for ensuring that records are maintained:

- To document compliance with Sandia's radiation protection record-keeping requirements as implemented in the *Sandia Records Retention & Disposition Schedule* by the Recorded Information Management Department (4912).

- Until final disposition is authorized by the National Archives and Records Administration (NARA) through DOE.

Managers shall be responsible for maintaining RAD102 training completion records if their organizations conduct RAD102 via live instruction (e.g., for off-site contractor personnel).

Note: The Technical and Compliance Training Department (3521) at Sandia/NM and the CA Site Human Resources Department (8522) at Sandia/CA maintain course records for RAD210, Radiological Worker I Training, RAD230, Radiological Worker II Training, and RAD214, Radiation-Generating Device Safety Training.

Note: For retention information regarding job-specific radiological training records, consult the records management contact.

Guidance

Consult the *Records Management Manual* for additional guidance regarding records management.

6.0 REFERENCES

Requirements Source Documents

10 CFR 835, *Occupational Radiation Protection*.

29 CFR 1920.134, *Respiratory Protection*.

DOE N 441.1, *Radiological Protection for DOE Activities*.

Implementing Documents

Sandia, CPR400.1.1/MN471001, *ES&H Manual*, Chapter 12, "Packaging and Transportation of Hazardous Material."

Related Documents

DOE, *Office of Worker Protection Programs and Hazards Management*, "Job-Specific Radiological Worker Training," Radiological Control Technical Position RCTP 95-06.

DOE G 441.1-1, *Management and Administration of Radiation Protection Programs Guide*.

DOE G 441.1-12, *Radiation Safety Training Guide for Use With Title 10, Code of Federal Regulations, Part 835, Occupational Radiation Protection*.

DOE-STD-1098-99, *Radiological Control*.

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Corporate Process Requirement No: CPR400.1.1.32
Sponsor: Dori Ellis, 4000, Acting

Revision Date: May 25, 2004

Radiological Protection Procedures Manual

CHAPTER 4 – RADIATION DOSIMETRY

Subject Matter Expert: Gus Potter
MN471016, Issue E
Effective Date: May 25, 2004; Replaces Document Dated: August 6, 2001
Administrative Changes: June 29, 2005, March 16, 2006, and July 5, 2006

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* Indicates a substantive change

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*1.0 PURPOSE

This chapter describes the processes used to obtain dosimetry services.

*2.0 SCOPE

This chapter includes requirements and implementation guidance regarding internal and external dosimetry. It applies to all Members of the Workforce, visitors, and members of the public at Sandia who use radioactive material or radiation-generating devices, or who enter controlled or radiological areas.

*3.0 RESPONSIBILITIES

*3.1 Radiation Protection and Laboratory Services Department (3123)

Department 3123 is responsible for internal and external dosimetry at all Sandia sites. Specific responsibilities include:

- Providing dosimetry services where needed.
- Maintaining dosimetry records.
- Reporting of internal and external doses.

*3.2 SNL/CA Health and Safety Department (8517)

Department 8517 is responsible for:

- Providing external personnel dosimeters at SNL/CA.
- Obtaining internal dosimetry services from Department 3123, as needed, for SNL/CA personnel.

*3.3 Tonopah Test Range Department (15421)

Department 15421 is responsible for:

- Providing external personnel dosimeters at SNL/NV.
- Obtaining internal dosimetry services from Department 3123, as needed, for SNL/NV personnel.

*3.4 RP Personnel

RP personnel are responsible for:

- Providing guidance to Sandia organizations regarding the need for dosimetry.
- Assisting in dosimetry investigations.
- Providing pocket and electronic dosimeters.
- Providing personal air samplers and forwarding corresponding data to Department 3123.
- Assisting managers in conducting dose investigations for lost or stolen thermoluminescent dosimeters (TLDs).

*3.5 Managers

Managers of organizations with personnel who have the potential to exceed the regulatory monitoring requirements are responsible for:

- Identifying individuals in their organizations who require dosimetry or personal air sampling (see sections 4.1.1 and 4.2.1).
- Ensuring that individuals comply with the requirements of this chapter.
- Ensuring that individuals do **not** perform radiological work without required dosimetry or personal air samplers or while on work restriction.
- Obtaining and providing personnel TLDs for all workers under their control who require monitoring.
- Completing dosimetry investigations for lost dosimeters or unusual dosimetry

results.

- Ensuring that all personnel under their supervision who require radiation monitoring wear their dosimeters or personal air samplers, as required.
- Deleting names of individuals who no longer require dosimetry (see Section 4.2.6).
- Documenting all occupational exposures received during the current year and how the exposure information was obtained (see Sections 4.2.1 and 4.2.7).
- Correlating pocket or electronic dosimeter data with job-specific Sandia TLD data.

*3.6 Members of the Workforce, Visitors, and Members of the Public

Members of the Workforce, visitors and members of the public who are required to have dosimetry are responsible for:

- Complying with dosimetry requirements.
- Informing Radiation Protection Dosimetry Project (RPDP) personnel of scheduling difficulties that affect bioassays, whole-body counts, etc.
- Properly wearing their assigned dosimetry and personal air samplers, as required.
- Immediately reporting the loss, damage, or contamination of their dosimeters to the RPDP within Department 3123 or Department 8517, as appropriate.
- Notifying their Division ES&H Team before undergoing a medical procedure involving radionuclides.
- Notifying RPDP personnel personnel if dosimetry (other than a Sandia thermoluminescent dosimeter [TLD]) is worn while at another site or facility.

Note: See CPR 400.1.1/MN471001, *ES&H Manual*, Section 1D, "Who Does What" for additional information about visitors and minors at Sandia.

*3.7 Sandia Employees

In addition to the responsibilities listed in Section 3.6, “Members of the Workforce, Visitors, and Members of the Public,” Sandia employees are responsible for:

- Returning signed Affidavit of Occupational Radiation Dose History and Authorization for Release of Information to RPDP at the address shown on the form in a timely manner.
- Cooperating with attempts to obtain their current year and previous dose history as necessary.

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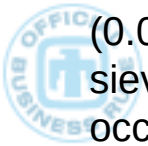
*4.0 PROCEDURE

*4.1 Internal Dosimetry

*4.1.1 Routine Bioassay Program

Requirements

Managers shall be responsible for ensuring that internal dose evaluation programs (including routine bioassay programs) are conducted for:



- Radiological workers who, under typical conditions, are likely to receive 0.1 rem (0.001 sieverts) or more committed effective dose equivalent, or 5 rems (0.05 sieverts) or more committed dose equivalent to any organ or tissue, from all occupational radionuclide intakes in a year. **[10 CFR 835.402(c)(1)]**
- Declared pregnant workers who are likely to receive an intake resulting in a dose equivalent to the embryo/fetus in excess of 10 percent of the limit stated in 10 CFR 835.206, which is 0.5 rem (0.005 sieverts). See Chapter 14, "Declared Pregnant Workers," for additional information. **[10 CFR 835.402(c)(2)]**
- Members of the Public who are likely to receive in 1 year an intake resulting in a committed effective dose equivalent in excess of 50 percent of the limit stated in 10 CFR 835.207 and 10 CFR 835.208, which is 0.1 rem (0.001 sieverts) total effective dose equivalent (TEDE) in a year. **[10 CFR 835.402(c)(3)]**

Members of the Workforce shall provide bioassay samples or submit to a whole-body count as requested under any of the following conditions: **[S]**

- The affidavit on SF 2001-RDR, Radiation Dosimeter Request Form (Word file/ Acrobat file) indicates previous internal exposure.
- Unintentional internal exposure occurs or conditions indicate the possibility of a radiological intake.
- A personal air sample result indicates an internal exposure exceeding 10 mrem.
- As required on a Radiological Work Permit or other technical work document (TWD).
- Upon terminating employment.

Individuals who require bioassay shall agree to have a whole-body count, urinalyses, or both. **[S}**

Note: Urinalysis consists of submission of a single-void sample or up to two 24-hour samples, depending on the radionuclides for which the sample is being conducted. Baseline sampling is performed only for those radionuclides to which the individual has been exposed. Individuals scheduled for bioassay will be required to be away from their job for a short time.

Guidance

The Radiation Protection and Laboratory Services Department (3123) manager is responsible for ensuring that the RPDP bioassay services provided to Sandia conform to the requirements of the DOE Laboratory Accreditation Program (DOELAP) for radiobioassay. **[10 CFR 835.402(d)]**

4.1.2 Personal Air Sampling

Requirements

Managers shall be responsible for ensuring that all TWD requirements are followed, including those related to wearing personal air samplers. (See Chapter 1, " Radiological Work Planning and Controls," and CPR 400.1.1/MN471001, *ES&H Manual*, Chapter 21,

"Technical Work Documents (TWDs)." **[S]**

Guidance

For non-routine operations (which is often the case at Sandia), the need for bioassay (i. e., urinalysis and/or whole-body counting) is indicated by personal air sampling except in the case of tritium. The need for personal air sampling are determined by Radiation Protection personnel and indicated on radiological work permits (RWPs) or TWDs. For more information, consult RPDP personnel.

*4.2 External Dosimetry

*4.2.1 External Dosimetry Monitoring

Requirements

Managers shall be responsible for ensuring that:

- Personnel dosimetry is provided to and used by:
  - Radiological workers who, under typical conditions, are likely to receive one or more of the following:
    - An effective dose equivalent to the whole body of 0.1 rem (0.001 sieverts) or more in a year. **[10 CFR 835.402(a)(1)(i)]**
    - A shallow dose equivalent to the skin or to any extremity of 5 rems (0.05 sieverts) or more in a year. **[10 CFR 835.402(a)(1)(ii)]**
    - A lens of the eye dose equivalent of 1.5 rems (0.015 sieverts) or more in a year. **[10 CFR 835.402(a)(1)(iii)]**
  - Declared pregnant workers who are likely to receive from external sources a dose equivalent to the embryo/fetus in excess of 10 percent of the applicable limit in 10 CFR 835.206, which is 0.5 rem (0.005 sieverts). See Chapter 14, "Declared Pregnant Workers," for additional information. **[10 CFR 835.402(a)(2)]**
  - Members of the public likely to receive in 1 year from external sources a

dose in excess of 50 percent of the applicable limit in 10 CFR 835.207 and 10 CFR 835.208, which is 0.1 rem (0.001 sieverts) total effective dose (TEDE) in a year. **[10 CFR 835.402(a)(4)]**

- Nuclear accident dosimetry is worn by individuals who work with or around quantities of fissile material that could constitute a critical mass such that excessive radiation exposure is possible. This dosimetry includes: **[10 CFR 835.1304]**

  - A method to conduct initial screening of individuals involved in a nuclear accident to determine whether significant exposures to radiation occurred. **[10 CFR 835.1304(b)(1)]**

  - Methods and equipment for analysis of biological materials. **[10 CFR 835.1304(b)(2)]**

  - A system of fixed nuclear accident dosimeter units. **[10 CFR 835.1304 (b)(3)]**

Members of the Workforce shall: **[S]**

- Wear Sandia thermoluminescent dosimeters (TLDs) when entering:

  - Radiation areas at Sandia-controlled premises.

  - Controlled areas where a TLD requirement is posted.

- Use only Sandia TLDs or Sandia-supplied supplemental dosimeters at Sandia sites, unless exempt from the requirements of 10 CFR 835 as stated in the RPPM "Introduction."

- When visiting other nuclear facilities, wear dosimeters provided by the facility and **not** a Sandia dosimeter if required.

Sandia employees, in addition to the requirements for Members of the Workforce, shall: **[S]**

- Upon entering the routine dosimeter exchange program, supply Sandia with prior radiation dose histories to ensure compliance with the requirements of 10 CFR 835.702(d)-(e). After an individual enters the program, RPDP will send an Affidavit

of Occupational Radiation Dose History to the individual. **[R-10 CFR 835.702 (d)-(e)]**

- If they have previous dose histories, sign Authorization for Release of Information forms and return them to RPDP within 2 weeks.

  Note: The RPDP has the authority to remove individuals who do not return the Affidavit of Occupational Radiation Dose History or the Authorization for Release of Information forms to RPDP within the 2-week required time period from dosimetry issue or exchange until the situation is rectified.

Guidance

The Radiation Protection and Laboratory Services Department (3123) manager is responsible for ensuring that external dosimetry services and associated equipment used at Sandia conform to the requirements of the DOE Laboratory Accreditation Program (DOELAP) for personnel dosimetry as stated in 10 CFR 835.402(b).

*4.2.2 Obtaining External Dosimetry

Requirements [S]

Members of the Workforce who require external dosimetry shall complete SF 2001-RDR, Radiation Dosimeter Request Form (Word file/Acrobat file), using the following criteria to determine the "issue period" to be indicated for the dosimeter being requested (declared pregnant workers may be placed on a monthly or quarterly issue period):

- One Time. Individual does **not** need to be on the Routine Dosimeter Exchange Program.
- Quarterly or monthly: Individual is on the Routine Dosimeter Exchange Program. Quarterly is adequate for most individuals; however, monthly exchange should be considered for individuals with an ACL greater than 500 mrem.
- Submit their SF 2001-RDR to their manager for approval.
- Forward the manager-approved SF 2001-RDR to the RPDP or to Department 8517 (MS 9221) to acquire an external dosimeter.

Guidance

Certain personnel monitoring situations may require supplemental dosimeters, as determined by RP personnel. Supplemental dosimeters are provided on an as-needed basis.

*4.2.3 Use and Care of Dosimeters

Requirements [S]

Members of the Workforce who use dosimeters shall:

- Obtain and read the dosimeter use and care instruction sheet provided with SF 2001-RDR, Radiation Dosimeter Request Form (Word file/Acrobat file).
- Follow all relevant instructions listed on the dosimeter use and care instruction sheet.
- Wear dosimeters properly.
- Follow directions from RPDP personnel regarding use of multi-dosimeter kits, extremity dosimeters, or relocation of single dosimeters for specific radiological work requirements.

Guidance

Members of the Workforce should store dosimeters at their work sites, but outside any area where radiation levels are above natural background levels.

Contrary to the Use and Care of the Personnel Radiation Dosimeter information, emergency response personnel may consider taking their dosimetry home with them for availability if called out off-hours. However, in all cases dosimetry should be kept away from all possible sources of exposure when not worn, including family members that may have had diagnostic or therapeutic medical administrations.

Individuals traveling on airplanes should not take dosimeters with them unless they are to be used at the destination. When dosimeters are taken on an airplane, place them in carry-on bags, not in checked baggage.

*4.2.4 Non-Returned, Lost, or Damaged Dosimeters

Requirements[S –]

Members of the Workforce who lose, contaminate, or damage their dosimeters shall:

- Report the event to their supervisors and RPDP personnel.
- Submit a SF 2001-RDR, Radiation Dosimeter Request Form (Word file/Acrobat file), to obtain a replacement dosimeter, marking the "Replace Lost Dosimeter" block in Part II of the form.
- Complete a dosimetry investigation, if provided by RPDP.

Guidance

Members of the Workforce should return dosimeters within 2 weeks of the scheduled return time.

When a dosimeter is not returned within 2 weeks of the scheduled return time, the RPDP will send a "Non-Returned Dosimeter Notice" to the responsible department manager. If the initial notice is **not** completed and returned within 2 weeks, the individual will be removed from dosimetry issue and another dosimeter will **not** be issued to that individual until the situation is rectified.

*4.2.5 Returning Dosimeters

Requirements [S]

Managers shall be responsible for ensuring that routine dosimeter exchanges are completed within 2 weeks after a new supply of dosimeters is received.

Members of the Workforce who host visitors or members of the public shall be responsible for ensuring that guests return their dosimeters at the end of the visit to the location from which the dosimeters were issued.

Guidance

The following organizations accept dosimeters that are no longer needed:

- At SNL/NM, the RPDP in Department 3123.
- At SNL/CA, Department 8517.
- At SNL/NV, the Tonopah Test Range Site Management Department (15421).

4.2.6 Deleting Personnel From the Routine Dosimeter Exchange Program

Note: The Dosimetry Processing Center uses the information from Routine Exchange Program participant lists returned by organizations to prepare the next dosimeter exchange.

Requirements

When managers receive dosimetry exchange participant lists three to four weeks before a scheduled dosimeter exchange, they shall be responsible for ensuring that:

- The names of individuals who no longer need a dosimeter are crossed off the list.
- Information about personnel who have a continuing need to be on the Routine Exchange Program is corrected.
- Lists are returned to the RPDP, even if there are no changes.

*4.2.7 Reporting Offsite Doses [S]

Requirements

Personnel who are provided dosimetry at offsite locations shall:

- Nonemployees. Consult their employer companies to determine dose-reporting requirements when they are provided dosimetry at offsite locations.
- Students who are not employed by Sandia. Consult college/university to determine dose-reporting requirements when they are provided dosimetry at offsite locations.
- Sandia employees. Ensure that results are forwarded to RPDP for inclusion in dosimetry records by:

- Printing a copy of SA 2003-ODR, Offsite Dose Release Form.
- Taking the copy of the SA 2003-ODR with them to the offsite location.
- Submitting the SA 2003-ODR to the offsite issuing organization.
- Informing the dosimetry offsite issuing organization that the SA 2003-ODR must be sent to the Radiation Protection Dosimetry Program, MS0651.

Guidance

Note: RPDP automatically reports dose information to all contractor and visitor employers and student colleges/universities.

4.3 Foreign Travel

The Sandia RPPM does not normally apply to DOE activities performed outside of the United States. "Introduction," Section 2.9, “Work in Foreign Countries or Territories,” describes when the RPPM does apply.

Requirements

[10 CFR 835.a(b)(5)]

- Employees who are traveling shall determine the applicability of the RPPM to their travel as indicated in "Introduction," Section 2.9, “Work in Foreign Countries or Territories.”
- If the RPPM is applicable to the travel circumstances, the employee shall obtain dosimetry services (external and internal as required) as indicated in this chapter.

Guidance

Sandia thermoluminescent dosimeters (TLDs), electronic dosimeters, and bioassay are provided to Sandia employees on foreign travel as a service when the Sandia RPPM does not apply to the travel. Dosimetry personnel can assist in determining if dosimetry services are advisable for the travel. In general, Sandia employees should consider using dosimetry services on foreign travel when:

- Visiting a nuclear facility (i.e., weapons research or production, nuclear power reactor)
- Performing radiological work
- Visiting an area with known high amounts of contamination (i.e., Chernobyl)
- Visiting an area where unknown radiological conditions may exist

Contact the RPDP to obtain more information or to obtain dosimetry services for foreign travel.

International agreements and local laws may prohibit use of a Sandia dosimeter in other countries. Your safety is more important than the return of a dosimeter. If directed to surrender a badge to a foreign entity, do so.

5.0 RECORDS

Requirements

Members of the Workforce who generate occupational radiation protection related records shall use the special units of curie, roentgen, rad, and rem for activity, exposure, dose and dose equivalent respectively. Multiples and subdivisions of these units are allowed. SI units (becquerel [Bq], gray [Gy], and sievert [Sv])may be included in parenthesis after the special units. **[10 CFR 835.4]**

Managers shall be responsible for ensuring that records are maintained:

- To document compliance with Sandia's radiation protection record-keeping requirements as implemented in the *Sandia Records Retention and Disposition Schedule* by the Recorded Information Management Department (9612). **[10 CFR 835.701(a)]**
- Until final disposition is authorized by the National Archives and Records Administration (NARA) through DOE. **[10 CFR 835.701(b)]**

Members of the Workforce shall submit special requests in writing for dosimetry records

or reports to the Dosimetry Records Center within Department 3123.

Guidance

Department 3123 maintains all required dosimetry records. Reports containing both internal and external dose are generated periodically and submitted to individuals, department managers, and DOE as required by DOE orders and 10 CFR 835.

Sandia retains the responsibility for maintaining dose records for employees. Maintaining dose records for contractors is the responsibility of their company under Nuclear Regulatory Commission (NRC) or DOE regulations. Maintaining dosimetry records for students who are not employed by Sandia is the responsibility of their college or university under NRC regulations.

6.0 REFERENCES

6.1 Requirements Source Document

10 CFR 835, *Occupational Radiation Protection*.

6.2 Related Documents

DOE G 441.1-1, *Management and Administration of Radiation Protection Programs Guide*.

DOE-STD-1098-99, *Radiological Control*.

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Corporate Process Requirement No: CPR400.1.1.32
Sponsor: Dori Ellis, 4000, Acting

Revision Date: January 11, 2000

Radiological Protection Procedures Manual

CHAPTER 5 – ENTRY CONTROL

Subject Matter Expert: Tom Laiche
MN471016, Issue D
Effective Date: January 11, 2000, Replaces Document Dated: January 21, 1999
Administrative Changes: June 29, 2005

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* Indicates a substantive change

1.0 PURPOSE

This chapter presents requirements and guidance for controlling entry to Sandia-controlled premises that are posted in accordance with Chapter 2, "Posting and Labeling for Radiological Control."

2.0 SCOPE

This chapter applies to all personnel entering Sandia-controlled premises that are posted in accordance with Chapter 2, "Posting and Labeling for Radiological Control."

3.0 RESPONSIBILITIES

3.1 Managers

Managers are responsible for:

- Ensuring that appropriate entry controls are installed in their facilities.
- Ensuring that entry controls comply with the requirements of this chapter.
- Maintaining records to document compliance with the requirements of this chapter.
- Ensuring procedures and administrative controls that are used to control entry are kept current.
- Ensuring that entry control requirements are described in approved technical work documents, per CPR400.1.1, MN471001, *ES&H Manual*, Chapter 21, "Technical Work Documents (TWDs)."
- Ensuring that minors and members of the public do not have access to radiological areas. See CPR400.1.1, MN471001, *ES&H Manual*, Section 1D, Attachment 1D-4, "Management Responsibility for Minors," for more information.

3.2 RP Personnel

RP personnel are responsible for providing guidance regarding entry control requirements.

4.0 PROCEDURE

4.1 Radiological Areas

Requirements

Managers shall ensure that:

- Personnel entry control is maintained for each radiological area. **[10 CFR 835.501 (a)]**
- The degree of control is commensurate with existing and potential radiological hazards within the area. **[10 CFR 835.501(b)]**
- One or more of the following methods is used to ensure control:
    - Signs and barricades
    - Control devices on entrances
    - Conspicuous visual and/or audible alarms
    - Locked entranceways
    - Administrative controls **[10 CFR 835.501(c)]**
- Written authorizations are implemented to:
    - Control entry into and work within radiological areas.
    - Specify radiation protection measures commensurate with existing and potential hazards. **[10 CFR 835.501(d)]**
- No controls are installed at any radiological area exit that would prevent rapid evacuation of personnel under emergency conditions. **[10 CFR 835.501(e)]**

4.2 High and Very High Radiation Areas

Requirements

Managers shall ensure that in addition to the requirements of Section 4.1:

- The following measures are implemented for each entry into a high radiation area:
    - The area is monitored as necessary during access to determine the exposure rates to which individuals are exposed.
    - All individuals are monitored by supplemental dosimetry devices or other means capable of providing immediate estimates of an individual's integrated deep dose equivalent during the entry. **[10 CFR 835.502(a)]**
- One or more of the following features is used for each entrance or access point to a high radiation area where radiation levels exist such that an individual could exceed a deep dose equivalent to the whole body of 1 rem (0.01 sievert) in any 1 hour at 30 centimeters from the source or from any surface that the radiation penetrates:
    - A control device that prevents entry to the area when high radiation levels exist or upon entry causes the radiation level to be reduced below the level that defines a high radiation area.
    - A device that functions automatically to prevent use or operation of the radiation source or device while individuals are in the area.
    - A control device that energizes a conspicuous visible or audible alarm signal so that individuals entering the high radiation area and the supervisor of the activity are made aware of the entry.
    - Entryways that are locked and, during periods when access to the area is required, positive control over each entry is maintained.
    - Continuous direct or electronic surveillance that is capable of preventing unauthorized entry.
    - A control device that will automatically generate audible and visual alarm signals to alert personnel in the area before use or operation of the radiation source in sufficient time to permit evacuation of the area or activation of a

secondary control device that will prevent use or operation of the source. **[10 CFR 835.502(b)]**

- In addition to using one or more of the above requirements, additional measures are implemented to ensure individuals are not able to gain unauthorized or inadvertent entry to very high radiation areas. **[10 CFR 835.502(c)]**

  Note: Additional measures that prevent unauthorized or inadvertent entry into a very high radiation area may include actions such as a locked door with key control and a full-time guard posted during times the very high radiation exists, or a barrier such as a chain link fence surrounding the very high radiation area that requires the use of tools to gain entry.

- No controls are established in a high or very high radiation area that would prevent rapid evacuation of personnel. **[10 CFR 835.502(d)]**

Guidance

Managers should provide:

- Written procedures to ensure the effectiveness and operability of barricades, devices, alarms, and locks. **[DOE-STD-1098-99]**

- Documented inspections of the physical entry controls to high and very high radiation areas to verify controls are adequate to prevent unauthorized or inadvertent entry. **[DOE-STD-1098-99]**

- Administrative controls for issuance and return of keys that are used for entry to high and very high radiation areas. **[DOE-STD-1098-99]**

4.3 Other Areas Requiring Entry Control

Requirements

Managers shall ensure that unescorted individuals have the following prior to accessing or performing work (intrusive or otherwise) in radioactive material areas (RMAs), soil contamination areas, underground radioactive material areas, or fixed contamination areas:

- Authorization to enter or perform work in the area, as required by the applicable technical work document (see CPR400.1.1, MN471001, *ES&H Manual*, Chapter 21, "Technical Work Documents [TWDs]").

- Training, as required in Chapter 3, "Radiological Training Program," and any site specific training required by the TWD.

- Dosimetry, if individual doses are likely to exceed 100 mrem total effective dose equivalent (TEDE) in 1 year, or as required by the TWD.

5.0 RECORDS

Requirements

SNL personnel who generate occupational radiation protection related records shall use the special units of curie, roentgen, rad, and rem for activity, exposure, dose and dose equivalent respectively. Multiples and subdivisions of these units are allowed. SI units (becquerel [Bq], gray [Gy], and sievert [Sv])may be included in parenthesis after the special units. **[10 CFR 835.4]**

Managers shall be responsible for ensuring that records are maintained:

- To document compliance with SNL's radiation protection record-keeping requirements as implemented in the *Sandia Records Retention and Disposition Schedule* by the Recorded Information Management Department (4912). **[10 CFR 835.701(a)]**

- Until final disposition is authorized by the National Archives and Records Administration (NARA) through DOE. **[10 CFR 835.701(b)]**

Managers shall ensure that the following entry-specific records are created and maintained:

- Technical work documents (TWDs) used to administratively control entry to areas are kept current in accordance with the revision cycle specified in the TWD.

- Original signature sheets for authorized workers are maintained and filed in accordance with applicable SNL procedures.

- Procedures used to ensure effectiveness and operability of barricades, devices, alarms, and locks are maintained and kept current in accordance with the revision cycle specified in the procedure.

- Inspection logs of the physical entry controls to high and very high radiation areas are maintained and filed in accordance with applicable SNL procedures.

6.0 REFERENCES

6.1 Requirements Source Documents

10 CFR 835, *Occupational Radiation Protection*.

DOE-STD-1098-99, *Radiological Control*.

6.2 Implementing Documents

DOE G 441.1-10*, Posting and Labeling for Radiological Control Guide.*

6.3 Related Documents

DOE G 441.1-1, *Management and Administation of Radiation Protection Programs Guide*.

DOE-STD-1098-99, *Radiological Control*.

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Corporate Process Requirement No: CPR400.1.1.32
Sponsor: Dori Ellis, 4000, Acting

Revision Date: September 22, 2006

Radiological Protection Procedures Manual

CHAPTER 6 – CONTROL OF RADIOACTIVE MATERIAL

Subject Matter Expert: Tom Laiche, Bob Miltenberger
MN471016, Issue H
Effective Date: September 22, 2006; Replaces Document Dated: June 21, 2006
Review Date: September 13, 2006
Administrative Changes: June 6, 2007

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* Indicates a substantive change

1.0 PURPOSE

The purpose of this chapter is to provide the controls for acquiring, receiving, using, handling, storing, and transporting radioactive material. It also provides guidance on the decision mechanism for disposing of radioactive or potentially radioactive material.

2.0 SCOPE

For purposes of this document, Members of the Workforce are:

- Sandia employees.
- Sandia contractors as specified in CPR400.1.1/MN471001, *ES&H Manual*, Section 1B, "What Is the Scope."

This chapter describes the requirements for control of radioactive material used in activities conducted by Members of the Workforce. The controls are based on a graded approach and are dependent upon the category and quantity of radioactive material. There are three categories of radioactive material:

- Exempted Items.
- Conditionally Controlled Material.
- Controlled Material.

Note: The controls that correspond to each category are listed in Table 4.1, "Radioactive Material Controls."

In all cases, it is important for anyone working with radioactive material (see Attachment 6-1, "Radioactive Contamination Limits") to be able to answer the following questions:

- What do I have?

- How much material or how many sources do I have?
- Where do I use it or store it?
- What are the controls that apply to it?
- How do I dispose of it?

2.1 Exempted Items

The Radiation Protection and Laboratory Services Department (10323) maintains a list (see Attachment 6-2, "Exempted Items List") of items that are exempt from the requirements of this manual (see SF 2001-RFC, Request for Categorization as Exempt or Conditionally Controlled [Word file/Acrobat file]). Such exemptions remain in effect unless one or more of the following occurs:

- The dose to an individual from the item is likely to result in 100 mrem total effective dose equivalent (TEDE) in a year.
- The item has been modified or altered (e.g., Sandia radiological material is added intentionally or accidentally, or if the item has become activated due to Sandia activities) in a way prohibited or otherwise not intended by the manufacturer of the item.
- The radioactive material in the item is known to have been modified, technologically enhanced, concentrated, or isotopically altered.

Attachment 6-2, "Exempted Items List" consists primarily of consumer products, naturally occurring radioactive material (NORM), and products containing no radioactive material other than NORM.

The Radiation Protection and Laboratory Services Department (10323) has established a process (RPO-01-14, *Procedure for the Review and Categorization of Radioactive Materials by the Radioactive Material Controls Committee*) for determining which items and material may be placed on Attachment 6-2, "Exempted Items List." Consult the appropriate Division ES&H Team for assistance in determining whether an item is on or may be added to Attachment 6-2.

Note: Items on Attachment 6-2, "Exempted Items List," may require disposal as radioactive waste. See CPR400.1.1/MN471001, *ES&H Manual*, Section 19B, "Radioactive Waste Management," and Section 19C, "Mixed Waste Management," for information regarding waste determination and disposal.

2.2 Conditionally Controlled Material

The Radiation Protection and Laboratory Services Department (10323) maintains a list of conditionally controlled material (see Attachment 6-3, "Conditionally Controlled Material List") such items, materials and sources may include, but are not limited to, the following:

- Individual items, including sealed radioactive sources, with activity levels less than one-tenth the applicable limit in Appendix E, "Values for Establishing Sealed Radioactive Source Accountability and Radioactive Material Posting and Labeling Requirements" (Word file/Acrobat file).
- Generally or specifically licensed commercially available products.
- Exempted items that no longer meet the exclusions listed in Section 2.1.
- Inaccessible radioactive material or radiation sources.
- Activated or volume contaminated material that meets the criteria of conditionally controlled material.

Conditionally controlled material is subject to a minimum set of controls as described in Section 4.2. Attachment 6-3, "Conditionally Controlled Materials List" will include the required controls for the items or materials.

The Radiation Protection and Laboratory Services Department (10323) has established a process (RPO-01-14, *Procedure for the Review and Categorization of Radioactive Materials by the Radioactive Material Controls Committee*) for determining which items and material may be placed on Attachment 6-3, "Conditionally Controlled Materials List." Submit requests for additions, changes, or deletions from the Conditionally Controlled Material List using SF 2001-RFC, Request for Categorization as Exempt or Conditionally Controlled (Word file/Acrobat file).

Note: Conditionally controlled material may require disposal as radioactive waste. See CPR400.1.1/MN471001, *ES&H Manual*, Section 19B, "Radioactive Waste Management," and Section 19C, "Mixed Waste Management," for information regarding waste determination and disposal.

2.3 Controlled Material

Use, handle, and store controlled material in accordance with the requirements of this chapter. Controlled material is material that meets one or more of the following criteria:

- Radioactive items, materials, and sources that are not in Attachment 6-3, "Conditionally Controlled Materials List."

- Items or material that are activated or volume contaminated and do not meet the criteria of conditionally controlled material.

  Note: Items and material that were once activated or volume contaminated, but now meet radioactive material management area (RMMA) requirements, are excluded from control. See Section 19D, "Radioactive Material Management Areas (RMMAs)."

- Material exceeding the Attachment 6-1 levels.

Radioactive sources with activities equal to or greater than the values in Appendix E are also subject to the requirements of Chapter 9, "Control of Accountable Radioactive Sources."

Notes:

- The term accountable radioactive sources relates to the inventory and leak test requirements of radioactive sources that exceed Appendix E values. The term accountable nuclear material (SNM) applies to special nuclear material and the inventory/control program associated with this type of radioactive material. For more information on the requirements for accountable nuclear material see CPR400.3.14, *Management of Accountable Nuclear Material*.

- Certain SNM inventories are classified. Consolidating inventory information may reveal information that would be useful to an adversary for the purpose of sabotage or theft. Having inventory information reviewed by a Derivative Classifier

(DC) will minimize the potential for information to be available that could be combined into information that could compromise security considerations.

Controlled material requires disposal as radioactive material. See CPR400.1.1/ MN471001, *ES&H Manual*, Section 19B, "Radioactive Waste Management," and Section 19C, "Mixed Waste Management," for information regarding waste determination and disposal. Additional requirements apply for the procurement, receipt, storage, or movement of nuclear material. See the following related documents for more information:

- CPR 400.3.14, *Management of Accountable Nuclear Material*.
- CPR400.1.1/MN471001/*ES&H Manual*:
  - Chapter 12, "Packaging and Transportation of Hazardous Material."
  - Chapter 13, "Hazards Identification/Analysis, and Risk Management."

3.0 RESPONSIBILITIES

3.1 Managers

Managers are responsible for ensuring that:

- Personnel under their supervision control radioactive material in accordance with this manual.
- Procedures and training (see Chapter 3, "Radiological Training Program") are provided to personnel under their supervision, prior to assigning them to work with radioactive material.
- Decontamination of material or areas contaminated with radioactive material, due to the operations of their organizations, is performed in accordance with approved technical work documents.
- Their facilities are properly categorized in accordance with CPR400.1.1/

MN471001, *ES&H Manual*, Chapter 13, " Hazards Identification/Analysis and Risk Management," based upon the quantities of radioactive material in use or storage.

3.2 Members of the Workforce

Members of the Workforce are responsible for:

- Controlling radioactive material in accordance with this manual.
- Obtaining necessary assistance from RP personnel to ensure proper radiological posting and labeling (see Chapter 2, "Posting and Labeling for Radiological Control").
- Ensuring that they have received training to work with radioactive material (see Chapter 3, "Radiological Training Program").
- Obtaining and following approved technical work documents (TWDs) as required by Chapter 1, "Radiological Work Planning and Controls."

3.3 Radiation Protection Personnel

RP personnel are responsible for:

- Assisting line organizations with the control of radioactive material in accordance with this manual.
- Conducting and documenting radiological surveys of record, as required, to support line operations.
- Providing radiological advice for decontamination activities.
- Providing radiological support for the disposition of facilities in accordance with formally established internal procedures; CPR200.2.2, *Baseline Directives Management*, which implements DOE Order 5400.5, *Radiation Protection of the Public & the Environment*, and implementation guidance; and the authorized limits listed in Attachment 6.1.
- Recommending for approval technical work documents (TWDs), as required by

Chapter 1, "Radiological Work Planning and Controls."

- Establishing and maintaining a process for placing radioactive material and items on Attachment 6-2, "Exempted Items List" and Attachment 6-3, "Conditionally Controlled Material List."

- Maintaining Attachment 6-2, "Exempted Items List" and Attachment 6-3, "Conditionally Controlled Material List."

3.4 Receiving/Mail & Material Movement Department (10263) and Corporate Storage & Shipping (10268)

These departments are responsible for:

- Ensuring packages containing radioactive material are received in accordance with this chapter.

- Notifying the appropriate Division ES&H Team and arranging for timely receipt surveys.

- Transporting radioactive material in accordance with the requirements stated in CPR400.1.1/MN471001, *ES&H Manual*, Chapter 12, "Packaging and Transportation of Hazardous Material."

- Providing guidance to line managers on the requirements for onsite transportation of radioactive material that is consistent with CPR400.1.1/MN471001/*ES&H Manual*, Chapter 12, "Packaging and Transportation of Hazardous Material."

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*4.0 PROCEDURE

4.1 Planning Work with Radioactive Material (ISMS Function: Plan Work)

4.1.1 Preparation

Requirements

Members of the Workforce shall:

- Prepare the appropriate documentation for working with radioactive material (e.g., primary hazard screening [PHS], hazards analysis [HA], technical work document [TWD]), in accordance with Chapter 1, "Radiological Work Planning and Control," and CPR400.1.1/MN471001, *ES&H Manual*, Chapter 21, "Technical Work Documents."

- Ensure that the total radioactive material inventory anticipated for a facility, operation, or process is entered into a PHS to account for material potentially received or transferred during operations and to ensure proper facility hazard categorizations in accordance with DOE-STD-1027-92.

4.1.2 Radioactive Material Procurement

Requirements

Members of the Workforce shall:

- Ensure that the appropriate box is checked on the purchase requisition (i.e., "Radioactive" or "Nuclear") when purchasing either radioactive or nuclear material.

- Notify the Radiation Protection Line Support Project Leader at SNL/NM or the Health and Safety Department at SNL/CA before radioactive material is procured and provide the following information:

    - Radioactive isotope.

    - Quantity of material.

    - Location of use/storage.

    - Intended use of the material.

Note: Procurement of radioactive material is a quality-significant activity.

4.1.3 Receipt of Radioactive Material (ISMS Function: Perform Work)

Note: Current shipping regulations allow a limited quantity of radioactive material to be shipped without external labeling noting the radioactive content. When these containers are opened, all surveying, registering, posting, handling, etc. requirements of the RPPM are in force.

Requirements

Managers shall ensure that:

- Facilities under their operational control are properly posted in accordance with the requirements of Chapter 2, "Posting and Labeling for Radiological Control."
- Upon receipt of accountable radioactive sources:
  - The Source Registrar is notified.
  - Personnel within their organization comply with the requirements specified in Chapter 9, "Control of Accountable Radioactive Sources."
- Arrangements are made to satisfy one of the following criteria if packages containing quantities of radioactive material in excess of a Type A quantity are expected to be received from an offsite shipment:
  - Take possession of the package when the carrier offers it for delivery.
  - Receive notification as soon as practicable after arrival of the package at the carrier's terminal (if not delivered directly to Sandia) and take possession of the package within 8 hours after the beginning of the following working day.
- Upon receipt of an offsite shipment, the external surfaces of packages known to contain radioactive material are monitored if the package meets any of the following criteria:
  - Is labeled with a Radioactive White I, Yellow II, or Yellow III label (as specified in 49 CFR 172.436-440).
  - Has been transported as low specific activity material (as defined in 10 CFR 71.4) or an exclusive use vehicle (as defined in 10 CFR 71.4).

- Has evidence of degradation (e.g., packages that are crushed, wet, or damaged).

- The required monitoring includes both of the following:
  - Measurements of removable contamination levels, unless the package contains only special form (as defined in 10 CFR 71.4) or gaseous radioactive material.
  - Measurements of the radiation levels, unless the package contains less than Type A quantity of radioactive material (as defined in 10 CFR 71.4).
- The required monitoring be completed as soon as practicable following receipt of the package, but not later than 8 hours after the beginning of the working day following receipt of the package.
- Monitoring of any other package of radioactive material shall be performed as soon as practicable after receipt of the package.
- All Department of Transportation (DOT) shipping papers, source certificates, and any special form certificates (e.g., ANSI and NIST) are maintained in accordance with Section 5.0 Records of this chapter and that copies are forwarded to the Device and Source Registrar.

Guidance

Managers should consider that:

- RP personnel are present to perform surveys when packages known to contain radioactive material are initially opened.
- The appropriate Division ES&H Team is notified prior to receiving Controlled and Conditionally Controlled radioactive material from an offsite shipment, transfer, or movement.

Managers should maintain DOT shipping paper, source certificates, and any special form or ANSI N43.6 certifications that are shipped with the radioactive material and that copies of any special form or ANSI N43.6 certifications are forwarded to the Source Registrar.

*4.2 Work with Radioactive Material (ISMS Function: Perform Work)

*4.2.1 Control of Radioactive Material

Requirements

Managers shall:

- Control radioactive material in accordance with the requirements summarized in Table 4.1 and in compliance with the requirements stated in applicable technical work documents (TWDs).

- Have TWDs and radiological worker training at a level consistent with the known or anticipated radiation and contamination levels before accessing normally inaccessible radioactive material.

Managers shall ensure that:

- If radioactive material becomes dissociated (i.e., becomes contaminated) from an exempted or conditionally controlled item as a result of storage, use, handling, aging, damage, etc., the contamination shall be controlled in accordance with the requirements of this manual (see Section 4.2.3).

- **RP personnel** are notified:

    - Immediately upon the discovery of the loss or damage of any radioactive material. See also Chapter 11, "Radiological Incidents."

    - Of the procurement of any radioactive material or item containing radioactive material that is not on the Exempt Items List.

- Documentation specified in Chapter 9, "Control of Accountable Radioactive Sources," is completed with 60 days of transfer or shipping of accountable radioactive sources by their organization.

- When radioactive material is transferred or shipped by their organization, staff follows the requirements located in Section 4.2.5.

- Sandia facilities receiving the radioactive material have the approved documentation required to receive and conduct work with the radioactive material.

- The primary hazard screening (PHS) for any operation receiving radioactive material have been updated to account for the change in inventory, use, or location.

- The total radioactive material inventory anticipated for a facility, operation, or process has been entered into a PHS to account for material potentially received or transferred during operations and to ensure proper facility hazard categorizations in accordance with DOE-STD-1027-92.

- In cases where facility occupancy/use is transferred and continued operation of the facility is anticipated, the facility will be remediated to Attachment 6-1 levels or the new occupant/user of the space must be appraised and accept the current radiological conditions.

- In cases of final disposition, facilities meet authorized limits appropriate for the disposition path (such as Attachment 6-1 values, interagency agreement values, or waste acceptance criteria) and disposition documentation must be completed prior to transfer of real property to a new owner or final demolition activities commence.

- Sealed radioactive sources are: used, handled, and stored in a manner commensurate with the hazards associated with operations involving the sources. **[10 CFR 835.1201]**

Members of the Workforce shall:

- Immediately notify the Line Support Project Leader (at SNL/NM) or Health and Safety Department (8715/HASD) manager (at SNL/CA), and the responsible department manager in the event of loss or damage of radioactive material (see also Chapter 11, "Radiological Incidents").

- Notify RP personnel when radioactive material is procured and/or received.

- Notify the Source Registrar of the accountable radioactive source (ARS) database when accountable sources are bought, moved, or transferred.

- Contact the appropriate Division ES&H Team before opening, modifying, or

performing invasive maintenance on equipment containing normally inaccessible radioactive material.

Table 4.1 Radioactive Material Controls

Control Requirement	Exempted Items and Material	Conditionally Controlled Material	Controlled Material
Minimum radiological training	Not Required	RAD102 RAD210 or RAD230 may be required; consult RP personnel	RAD210 or RAD230 may be required; consult RP personnel
TWD	Not required	May not be required, consult RP personnel TWD recommended	Required
Posting and labeling	Not required	Per manufacturer's or RP guidance	Required; see Chapter 2
Survey: Upon receipt Routine Disposal	 Not required Not required Follow the guidance in CPR400.1.1, MN471001, *ES&H Manual*, Section 19B and Section 19C	 Yes Per manufacturer's guidance or RP guidance Yes	 Yes Yes Yes

Registration in Source Control Program	Not required	May not be required, consult RP personnel Recommended	Required for accountable radioactive sources Recommended for non-accountable sources
Leak test	Not required	Per manufacturer s guidance; consult RP personnel	Required for accountable radioactive sources Recommended for non-accountable sources
Disposal	Follow the guidance in CPR400.1.1/ MN471001, *ES&H Manual*, Section 19B and Section 19C	Follow the guidance provided by the manufacturer or in CPR400.1.1/ MN471001, *ES&H Manual*, Section 19B and Section 19C; consult RP personnel	Follow the guidance in CPR400.1.1/ MN471001, *ES&H Manual*, Section 19B and Section 19C
Dosimetry	Not required	May not be required; consult RP personnel	May be required; see Chapter 4

4.2.2 Control of Material, Property, and Equipment (ISMS Function: Control Hazards)

Requirements

Managers shall ensure that:

- Items and equipment in contamination areas, high contamination areas, and airborne radioactivity areas are **not** transferred to controlled areas unless all of the following criteria are true:

- Removable surface contamination levels on accessible surfaces do **not** exceed the removable surface contamination authorized levels specified in Attachment 6-1.

- Total contamination levels (fixed plus removable) do **not** exceed the total authorized contamination levels found in Attachment 6-1.

- Prior use suggests that the removable surface contamination levels on inaccessible surfaces are unlikely to exceed the removable surface contamination authorized levels specified in Attachment 6-1.

- Scrap Metal coming from a radiological area is evaluated to ensure that *ES&H Manual*, Chapter 10U, "Scrap Metal from a Radiological Area or Volumetrically Contaminated Metal," disposition restrictions are followed.

- Material and equipment with removable surface contamination exceeding the values specified in Attachment 6-1 be conditionally released only for onsite movement if they meet all of the following conditions:

  - Material or equipment is appropriately monitored.

  - Material or equipment is moved only from one posted radiological area for immediate placement in another posted radiological area.

  - Appropriate administrative and physical controls for the movement are established and exercised.

- Material and equipment with fixed contamination levels that exceed the total contamination values specified in Attachment 6-1 be released for use in controlled areas outside of the radiological areas if they meet both of the following conditions:

  - Removable surface contamination levels are below the removable surface contamination values specified in Attachment 6-1.

  - The material or equipment is routinely monitored and clearly marked or labeled to alert personnel of the contaminated status.

- Contamination exceeding Attachment 6-1 authorized limits that results from items list in Attachment 6-2, "Exempted Items List" are handled in the following manner:

  - The contamination is controlled commensurate with potential hazard (e.g., type of contaminant, level of radioactivity, area contaminated, potential for spread, etc.).

  - The contamination has been cleaned to the extent possible. Consult the appropriate Division ES&H Team for decontamination guidance.

  - The owning line organization has determined if the occurrence reporting criteria applies and make any necessary reports. See RPPM, Chapter 13, and *ES&H Manual*, Section 18C, "Occurrence Reporting," and Chapter 22, "Feedback and Improvement Process," for more information.

  - The contamination is disposed of as radioactive material. See CPR400.1.1/ MN471001, *ES&H Manual*, Section 19B, "Radioactive Waste Management," and Section 19C, "Mixed Waste Management," for information regarding waste.

- When unrestricted disposition of property or material occurs, one of the following is true:

  1. There is adequate, documented, process knowledge for a conclusion that the property or material was never in an area where contamination/ activation was possible (radiological surveillance not required in this case).

     Or

  2. All of the following are met:

     - There is documented radiological surveys that residual radioactivity is below applicable limits.

     - Inaccessible surfaces have been determined to be below applicable limits.

     - There is no volumetric contamination present as determined by an RMMA equivalent analysis of the material.

- Scrap metal is evaluated in accordance with *ES&H Manual*, Chapter 10U.

Note: See Attachment 6-4 for a decision flow chart of the release/disposal decision process.

Guidance

Managers should consider the following when releasing material and equipment from controlled areas:

- DOE 5400.5 states that material may be released for disposal provided the more restrictive total contamination limit in Attachment 6-1 is used for transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, and I-129. The 500 dpm/100 cm^2 limit applies to the release of material for use in controlled areas, for posting of areas as fixed contamination areas, and for personnel monitoring.

- Release of material that is potentially contaminated in depth (e.g., activated material, soils, liquids, etc.) to uncontrolled areas is not specifically addressed by 10 CFR 835 or DOE 5400.5 and should be handled on a case-by-case basis using the RMMA evaluation process.

4.2.2.1 Storage of Radioactive Material (ISMS Function: Control Hazards)

Managers shall ensure that:

- TWDs are used for access to radioactive material storage areas if the storage of such material creates a radiological area.

- Radioactive material storage areas are posted or the items are labeled in accordance with the requirements of this manual (see Chapter 2, "Posting and Labeling for Radiological Control").

- Contaminated items are controlled in a manner that prevents the spread of contamination.

Guidance

Managers should consider the following:

- Whenever possible, radioactive material should be stored in a locked cabinet or room with controlled access.
- Storage of non-radioactive material together with radioactive material should be minimized when practical.
- Storage of flammable or combustible material with radioactive material should be minimized when practical.
- Decontamination or disposal of radioactive material is the preferred alternative to long-term storage.
- Whenever possible, radioactive material should not be stored outdoors. If radioactive material must be stored outdoors, containers or wrapping material should be inspected routinely to ensure there has been no degradation (i.e., to prevent releases of radioactive material).

4.2.2.2 Control of Radioactive Material Quantities Less Than One-Tenth of the Values Specified in Appendix E.

Requirements

Managers shall ensure that all radioactive material, including quantities less than one-tenth of the values specified in Appendix E, not on the Exempted Items List is controlled to prevent exposure to workers or the public.

Guidance

Although an item or container is exempted from labeling if the quantity of radioactive material is less than one-tenth the values specified in Appendix E, Members of the Workforce should control radioactive material of quantities less than one-tenth of the values specified in Appendix E such that:

- Containers used to store numerous items of radioactive material that are less than one-tenth the quantity limits in Appendix E are labeled as described in Chapter 2, "Posting and Labeling for Radiological Control."
- Radiation exposures are maintained consistent with the ALARA principles as stated in Chapter 7, "Radiological Design and Control and ALARA Application."

- Members of the Workforce are aware of the presence of radioactive material and can take appropriate precautions.

- There are proper controls to prevent a release of radioactive material to the public or the environment.v

- The material is accounted for in some manner (e.g., an inventory, a PHS, or source database) to track the location for handling, use, and storage.

- Radioactive material inventories are maintained to ensure proper facility hazard categorization in accordance with DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Report.*

- The radioactive material is disposed of in accordance with the requirements of CPR400.1.1/MN471001, *ES&H Manual*, Chapter 19, "Waste Management."

For further information, consult the appropriate Division ES&H Team.

4.2.3 Control of Areas (ISMS Function: Control Hazards)

Requirements

Managers shall ensure that:

- The appropriate Division ES&H Team is contacted, in a timely manner, for assistance in determining the potential impact and providing appropriate support when radioactive material or sources are brought onsite by subcontractors to carry out their work in an area that is owned or controlled by their organization. (Control of radioactive material and sources brought onsite by subcontractors to carry out their work is generally beyond the scope of the RPPM.)

- Appropriate controls are maintained and verified to prevent the inadvertent transfer of removable contamination to locations outside of radiological areas under normal operating conditions.

- Facilities meet authorized limits appropriate for the disposition path (such as Attachment 6-1 values, interagency values, or waste acceptance criteria) and disposition documentation must be completed prior to transfer of real property to a

new owner or final demolition activities commence.

- Any area in which contamination levels exceed the values specified in Attachment 6-1 are controlled in a manner commensurate with the physical and chemical characteristics of the contaminant, the radionuclides present, and the fixed and removable surface contamination levels.

- Areas accessible to individuals where the measured total surface contamination levels exceed, but the removable surface contamination levels are less than, the corresponding surface contamination values specified in Attachment 6-1, are controlled as follows when located outside of radiological areas:

    - The area is routinely monitored to ensure the removable surface contamination level remains below the removable surface contamination values specified in Attachment 6-1.

    - The area is conspicuously marked [posted] to warn individuals of the contaminated status.

- Individuals exiting contamination, high contamination, or airborne radioactivity areas are monitored, as appropriate (e.g., whole body frisk), for the presence of surface contamination.

- Protective clothing is used for entry to areas in which removable contamination exists at levels exceeding the removable surface contamination values specified in Attachment 6-1.

- Step-off pads are used at access control points of contamination, high contamination, and airborne radioactivity areas.

  Note: An exemption to this requirement may be granted by the manager of the Radiation Protection Program.

- Containment devices (e.g., gloveboxes, glovebags) receive routine inspection and testing (consult the appropriate Division ES&H Team for further information).

- With regard to radiological buffer areas:

    - Radiological buffer areas are established around contamination areas and

airborne contamination areas as a secondary boundary to minimize the spread of contamination.

  - Typically, equipment used for radioactive contamination monitoring is located within and at the exit point of the radiological buffer area.

- A soil contamination area is established whenever and wherever there are areas with contaminated soil that is not releasable in accordance with DOE 5400.5, *Radiation Protection of the Public and the Environment* (consult the appropriate Division ES&H Team for further information).

- An underground radioactive material area is established whenever and wherever there are underground items that contain radioactive material, such as pipelines, covered ditches, tanks, inactive burial grounds, and sites of known or suspected spills.

Guidance

Managers should use the following information to assist with control of areas:

- The type of protective clothing required for entry into an area (radiological area, radioactive material area, fixed contamination area, soil contamination area, underground radioactive material area) should be prescribed based upon considerations of contamination levels, chemical and physical form of the contaminant, activities to be performed, and area accessibility.

- Other area and activity hazards, such as heat, flame, hazardous chemicals, physical obstructions, electrical shock, and limited visibility, should be considered when prescribing protective clothing.

- Protective clothing should be prescribed in RWPs for areas in which the removable contamination levels exceed the values in Attachment 6-1.

- When penetration of protective clothing by a contaminant is likely, such as during activities likely to induce heavy sweating or otherwise wet the individual, an additional layer of impenetrable clothing should be considered.

- For individuals exiting areas where the only contaminated areas are laboratory bench surfaces or fume hoods, or where contamination potential is limited to specific portions of the body, the frisking should concentrate on affected areas.

- If background radiation levels or other conditions at the exit point preclude performance of personnel frisking, the exit point should be relocated to an area of lower background levels. If relocation of the exit point is not practicable, individuals should proceed directly from the exit point to an appropriate area to perform a whole body frisk. The travel path should be monitored frequently for contamination spread during use and after the detection of any contamination at the frisking station.

- If relocation of the exit point is not practicable, individuals should proceed directly from the exit point to an appropriate area to perform a whole body frisk. The travel path should be monitored frequently for contamination spread during use and after the detection of any contamination at the frisking station.

- Necessary tools and equipment needed for work in contamination areas, high contamination areas, or airborne radioactivity area should be available and serviceable. Leave boxes/packing material in clean areas.

- Hoses, electrical cables, etc. should be properly secured to prevent movement of such items across boundaries of contamination, high contamination, and airborne radioactivity areas.

- Portable high-efficiency particulate air (HEPA) units may be used to provide ventilation to work areas or containments, or as part of HEPA vacuum units. Contact the Radiation Protection Project Leader for additional guidance.

- Areas of fixed contamination should be coated with two layers of a fixative coating, each with a different color.

- It is not necessary to establish a radiological buffer area (RBA) around a high contamination area or an airborne radioactivity area that is completely contained with a contamination area. The RBA at the perimeter of the contamination should suffice.

4.2.4 Radioactive Material Transportation (ISMS Function: Perform Work)

Requirements

Managers shall ensure that:

- All onsite radioactive material transfers or movements are performed in accordance with the requirements of this chapter and CPR 400.1.1/MN471001, *ES&H Manual*, Chapter 12, "Packaging and Transportation of Hazardous Material."

- The removable contamination limits specified in Attachment 6-1 apply to all onsite radioactive material transfer or movement and any radioactive material shipment offsite.

  Note: DOT limits apply to radioactive material shipments received from offsite.

- Transport conveyances are monitored in accordance with DOT regulations.

Guidance

Managers should consider the following when making transfers or movements of radioactive material:

- Onsite transfers or movements should be performed in accordance with written procedures. The procedures or other measures should use a graded approach and if necessary should discuss the following:
  - Radiological monitoring.
  - Radiological labeling.
  - ALARA.
  - Spill control/Secondary containment.
  - Notification to impacted personnel of the radioactive material movements.
  - Description of movement route.
  - Emergency procedures.

- Before transfer or movement and upon receipt of radioactive material, 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.

- Before transfer or movement and upon receipt of radioactive material, a comparison of package count to the shipping manifest should be made to ensure accountability.

- Transport conveyances should be visually inspected prior to loading to ensure that trailers are acceptable for the intended use.

- Transport of large volumes of radioactive material by non-DOE motor vehicles should be "exclusive use" to prevent commingling of DOE and other commercial shipments.

- The site emergency plan should describe appropriate responses for potential onsite radioactive material transportation accidents.

- Drivers of DOE and non-DOE motor vehicles should have a copy of their emergency response plan, or the emergency response information required by DOT, during onsite or offsite transportation.

- Written procedures for safely opening packages should be developed and maintained. These procedures should include due consideration of the type of package and potential hazards present.

4.2.5 Radioactive Material Disposal (ISMS Function: Perform Work)

Requirements

Managers shall ensure that radioactive waste is disposed in accordance with the requirements of CPR400.1.1, MN471001, *ES&H Manual*, Section 19B, "Radioactive Waste Management," and Section 19C, "Mixed Waste Management," and any applicable DOE directives.

Guidance

Managers should ensure that the following practices are evaluated and instituted, as appropriate, to support waste minimization:

- Restrict material entering radiological buffer areas and other areas surrounding radiological areas to that needed to perform work.

- Restrict quantities of hazardous material (e.g., paints, solvents, chemicals, cleaners, and fuels) entering radiological buffer areas and other areas surrounding radiological areas, and implement measures to prevent inadvertent radioactive contamination of such material.

- Substitute recyclable or burnable items in place of disposable ones and reuse equipment, chemicals solvents, and cleaners when practicable.

- Select consumable material (e.g., protective coverings and clothing) that are compatible with waste-processing systems, volume reduction, and waste form acceptance criteria.

- Reserve an assortment of tools primarily for use in contamination, high contamination, or airborne radioactivity areas. Tools should be maintained in a designated storage or distribution area, or a contaminated tool crib. Controls should be established for tool issuance and use.

- Survey potentially contaminated material from radiological areas to separate uncontaminated from contaminated material.

- Segregate known uncontaminated waste from potentially contaminated waste.

- Segregate reusable items (e.g., protective clothing, respirators, and tools) at step-off pads.

- Minimize the number and size of radiologically controlled areas.

- Emphasize training in waste reduction philosophies, techniques, and improved methods.

4.2.6 Scrap Metal Recycle (ISMS Function:Perform Work)

Requirements

Members of the Workforce shall comply with the DOE-imposed moratorium on the recycling of scrap metal as required by CPR400.1.1/MN471001, *ES&H Manual*, Section 10U, "Scrap Metal from a Radiological Area or Volumetrically Contaminated Metal".

5.0 RECORDS

Requirements

Members of the Workforce who generate occupational radiation protection related records shall use the special units of curie, roentgen, rad, and rem for activity, exposure, dose and dose equivalent respectively. Multiples and subdivisions of these units are allowed. SI units (becquerel [Bq], gray [Gy], and sievert [Sv])may be included in parenthesis after the special units.

Managers shall be responsible for ensuring that records are maintained:

- To document compliance with the Sandia radiation protection record-keeping requirements as implemented in the *Sandia Records Retention and Disposition Schedule* by the Recorded Information Management Department (4532).

- Until final disposition is authorized by the National Archives and Records Administration (NARA) through DOE.

6.0 REFERENCES

6.1 Requirements Source Documents

10 CFR 30, *Rules of General Applicability to Domestic Licensing of Byproduct Material*.

10 CFR 835, *Occupational Radiation Protection.*

DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance With DOE Order 5480.23, Nuclear Safety Analysis Reports*.

6.2 Related Documents

DOE G 441.1-1, *Management and Administration of Radiation Protection Programs Guide*.

DOE-STD-1098-99, *Radiological Control*

SNL, CPR400.1.1, MN471001, *ES&H Manual*:

- Chapter 12, "Packaging and Transportation of Hazardous Material."
- Chapter 13, "Hazards Identification/Analysis, and Risk Management."

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Corporate Process Requirement No: CPR400.1.1.32
Sponsor: Dori Ellis, 4000, Acting

Revision Date: March 31, 2006

Radiological Protection Procedures Manual

CHAPTER 7 – RADIOLOGICAL DESIGN AND CONTROL AND ALARA APPLICATION

Subject Matter Experts: Ted Simmons, Mark Miller
MN471016, Issue D
Effective Date: March 31, 2006; Replaces Document Dated: January 11, 2000

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* Indicates a substantive change

1.0 PURPOSE

1.1 Activities

This chapter identifies the methods Sandia uses to:

- Maintain personnel exposures to ionizing radiation as low as reasonably achievable (ALARA).
- Meet mandatory design objectives and standards as specified in 10 CFR 835, Subpart K, "Design and Control."
- Maintain records of associated activities.

1.2 SNL ALARA Policy Statement

In response to the heightened concern of the public, DOE and Sandia with regard to radiological hazards, Sandia's corporate policy on controlling radiological operations is as follows:

> " The policy of Sandia Corporation is to protect and preserve the environment and safety and health of its personnel, contractors, visitors, and the public. Sandia shall make deliberate efforts to reduce hazardous exposures and releases to as low as reasonably achievable considering technical, economic, and social factors." [CPSR400.1, *Environment, Safety and Health (ES&H) Policy*, Section 3.0, "Policy Requirement "]

2.0 SCOPE

In support of its corporate policy to protect and preserve the environment, and the safety and health of its personnel, contractors, and the public, Sandia is committed to maintaining hazardous exposures and releases to ALARA, while considering technical, economic, and social factors.

The ALARA program applies to relevant activities as indicated in Chapter 1, "Radiological Work Planning and Controls."

This chapter does not address emergency response activities.

3.0 RESPONSIBILITIES

3.1 Managers

Managers who sponsor radiological activities, facilities, or equipment designs or modifications are responsible for:

- Implementing ALARA practices as outlined in this chapter.
- Developing and achieving organizational ALARA goals.
- Ensuring that adequate pre-planning of work and ALARA design reviews are conducted such that designs of new or modified facilities meet DOE nuclear and radiological safety requirements as stated in this manual.
- Ensuring that radiological control and area monitoring systems are engineered as required in Chapter 12.
- Ensuring that visitors and members of the public are made aware of their ALARA-related responsibilities (see Section 3.2).
- Ensuring that required ALARA records are generated and retained.
- Ensuring that access to facilities by visitors and members of the public is appropriately controlled.

3.2 Sandia Personnel Visitors, and Members of the Public

Members of the Workforce, visitors, and members of the public performing radiological work are responsible for:

- Understanding and implementing the Sandia ALARA requirements for the locations where they perform work.
- Following ALARA requirements as specified in radiological work permits (see Chapter 1, "Radiological Work Planning and Controls").

Participating in ALARA reviews as requested by RP personnel and their management.

3.3 RP Personnel

RP personnel are responsible for:

- Providing workplace radiological monitoring services.
- Assisting line organizations in meeting requirements of the Sandia ALARA Program.

Note: The following services are available (subject to resource limitations); consult the appropriate Division ES&H Team for further information:

- Assistance with safety analysis reports (SARs) and National Environmental Policy Act (NEPA) documentation.
- Independent reviews of designs for radiological safety and compliance. Such reviews can meet the inspection requirements for quality-significant contracts that rely on dedication instead of contractor qualification.
- Coordination of ALARA consultation during the design of new and modified radiological or nuclear facilities.
- Specifying engineering and operational controls to maintain personnel exposure ALARA and preventing of radioactive contamination of personnel.
- Conducting dose and dose rate studies.

3.4 Sandia Delegated Representatives (SDRs)

SDRs for contract radiological engineering services are responsible for:

- Ensuring that contract radiological engineers observe the requirements and guidance of this chapter.
- Identifying these contracts as quality-significant and then implementing the quality-significant requirements of these contracts.

- Forwarding to the ALARA Coordinator any contractor-generated records of ALARA studies and design changes that affect radiological or nuclear facilities.

3.5 Radiation Protection Safety Committee (RPSC)

The RPSC is responsible for:

- Reviewing established radiological performance indicators.
- Functioning as an information and technical support resource when requested by project managers or ALARA coordinators.
- Reviewing and approving Environmental ALARA Decision Sheets (EADSs) or equivalent documentation prepared and signed by project managers and the Environmental ALARA Coordinator.
- Issuing ALARA evaluation results to the appropriate organization for implementation.
- Reviewing and approving the following:

  Radiological activities that exceed the appropriate trigger levels shown in Section 4.3, Table 7-1.

  Planned special exposures (see Chapter 1, Attachment 1-6, "Requirements for Planned Special Exposures [PSEs]").

  Note: The RPSC may delegate its review and approval authority to designated safety committees.

3.6 ALARA Coordinators

The ALARA Coordinator is responsible for:

- Advising the RPSC, the Sandia Radiation Protection Program Manager, and the managers of RP personnel regarding the goals, effectiveness, and recommendations of the ALARA Program.
- Promoting ALARA throughout SNL.

- Reviewing and approving all radiological work that exceeds the thresholds shown in Section 4.3, Table 7-1.
- Reviewing and interpreting established radiological performance indicators.
- Submitting ALARA design review documentation to the ES&H Records Center.

3.7 The Environmental ALARA Coordinator and the Environmental Operations Department

The Environmental ALARA Coordinator at Sandia/NM and/or the Environmental Operations Department at Sandia/CA are responsible for:

- Providing assistance to line organizations and Division ES&H Teams, as requested, for compliance with Section 4.6.
- Conducting dose assessments to determine actual or potential dose to members of the public.
- Conducting qualitative and quantitative environmental ALARA reviews.

3.8 Radiation ALARA Subcommittee

The Radiation ALARA Subcommittee of the RPSC is responsible for:

- Assisting managers in maintaining radiation exposures ALARA.
- Defining the Sandia ALARA process as discussed in this chapter.
- Performing ALARA reviews on proposed radiological work that exceed thresholds defined in this chapter (see Section 4.3, Table 7-1).
- Performing analyses of cumulative dose histories for Sandia.
- Communicating improvement opportunities to the RPSC.

4.0 PROCEDURE

4.1 Training

Requirements

Managers shall ensure that individuals are appropriately trained and that site-specific training addresses the requirements of this chapter (i.e., individual responsibilities for implementing ALARA measures).

4.2 Facility Design and Control

This section applies both to new construction and facility modifications to radiological or nuclear facilities whether the construction or modification is managed by the site facilities organization or directly by a line organization.

Requirements

Managers shall use the following process when constructing new or modifying existing radiological or nuclear facilities:

Step1 – Determine whether the design **only** involves exempt or conditionally-controlled radioactive material or inherently safe RGDs. If so, no further analysis is needed and no documentation is required.

Step 2 – If the operation involves controlled radioactive material or RGDs other than those classified as inherently safe, estimate the unmitigated annual individual and collective dose for workers. This may be done by comparison to existing, similar operations or other methods using time/motion or occupancy factors.

Step 3 – Compare the dose estimates to the following design criteria. If the design criteria are met, then apply the ALARA principle to reduce doses and proceed to step 5:

- Radiation exposure in controlled areas is maintained ALARA primarily through physical design features (e.g., confinement, ventilation, remote handling, and shielding).

- When the use of physical design features are demonstrated to be impractical, administrative controls are used to maintain radiation exposures ALARA.

- During the design of new facilities or modification of existing facilities, the following objectives are adopted:

    - Optimization methods are used to ensure that occupational exposures are maintained ALARA in developing and justifying facility design and physical controls.

      Note: An optimization study is not required when unmitigated individual dose will not exceed 500 mrem annually and collective doses will not exceed 1-person-rem annually.

    - Design objectives for controlling personnel exposure from external sources of radiation in areas of continuous occupational occupancy (2000 hours per year) maintain exposure levels below an average of 0.5 mrem (5 microsieverts) per hour and as far below this average as is reasonably achievable. The design objectives for exposure rates for potential exposure to a radiological worker where occupancy differs from the above shall be ALARA and shall **not** exceed 20 percent of applicable standards in 10 CFR 835.202 (see Attachment 1-1).

    - The design objective for control of airborne radioactive material under normal conditions is to avoid releases to the workplace atmosphere and in all situations to control the inhalation of such material by workers to levels that are ALARA.

    - The design or modification of a facility and the selection of materials include features that facilitate operations, maintenance, decontamination, and decommissioning.

- During routine operations, the combination of physical design features and administrative controls ensures that:

    - The anticipated occupational dose to general personnel does not exceed the limits established in 10 CFR 835.202 (see Attachment 1-1).

    - The ALARA process is utilized for personnel exposures to ionizing radiation.

Step 4 – Develop controls to ensure the preceding design criteria will be met.

Step 5 – Complete a report stating how compliance with each of the following criteria is satisfied or why it is not applicable. The report may be included in other facility documentation:

- 10 CFR 835.1001: If physical design features are impractical provide justification and state what administrative controls will be used to ensure the design objectives of 10 CFR 835 will be met.
- 10 CFR 835.1002(a): Document the optimization study of justify why an optimization study is not required.
- 10 CFR 835.1002(b): Document compliance with this requirement or justify inapplicability (**note:** Having no source of external radiation is a suitable justification for inapplicability).
- 10 CFR 835.1002 (c): Document compliance with this requirement or justify inapplicability (**note:** Having no radioactive material present or working with certified, sealed sources is a suitable justification for inapplicability).
- 10 CFR 835.1002(d): Document compliance with this requirement or justify inapplicability (**note:** Having no radioactive material present or working with certified, sealed sources is a suitable justification for inapplicability.

Step 6- Submit the report to the ALARA Coordinator.

Note: Design review and optimization are the responsibility of the line organization funding new construction or modification of radiological or nuclear facilities. In this chapter this organization is referred to as the sponsoring organization.

Guidance

Managers should consider design reviews for circumstances more benign than those described above.

RP personnel from the line support team for the sponsoring organization should be assigned to design teams planning new or modified radiological or nuclear facilities and their role defined at that time. They may be reviewers of the ALARA design or simply advisors. The design goals listed in the preceding section should be incorporated into

the initial design. As the design progresses the ALARA measures in the design should mature and be fully-developed at the time the design is final. Prior to the readiness review (see *ES&H Manual,* Section 13C), the documented ALARA review should be complete. ALARA design documentation should be reviewed during the readiness review.

- Designer Qualifications: ALARA designs should be performed by a qualified expert.
- Review/Validation & Approval of design: ALARA designs should be reviewed and approved by a qualified expert.

The Radiation Protection Program has a procedure for performing the ALARA review during design and modification to radiological . Line organizations may use the procedure as an acceptable process for meeting the requirements of this chapter. Section 4.0.D. of procedure RPO-06-629 documents the process.

4.3 Operational ALARA Reviews

Requirements

Managers shall be ensure that:

- The thresholds in Table 7-1 are applied after workplace controls have been implemented.
- A formal, documented ALARA review is conducted when the thresholds in Table 7-1 are exceeded.

  Note: ALARA reviews that are conducted because the thresholds in Table 7-1 have been exceeded should be performed by managers (or designees) and reviewed at the appropriate level, as indicated in Table 7-1. The checklist that can be used for this purpose is SF 2001-APR (Word file/Acrobat file).

Table 7-1. ALARA Review Thresholds.

Reviewer	Potential Highest Individual Dose	Potential Collective Dose*

Line Manager	100 mrem TEDE	500 person-mrem TEDE
ALARA Coordinator	500 mrem TEDE	2500 person-mrem TEDE
ALARA Subcommittee	1000 mrem TEDE	5000 person-mrem TEDE
*TEDE = total effective dose equivalent		

Guidance

Note: Technical work documents (TWDs) are required as indicated in Chapter 1, "Radiological Work Planning and Controls" and CPR400.1.1/ MN471001, *ES&H Manual*, Chapter 21, “Technical Work Documents (TWDs).” In preparing a TWD, the consider issues such as dose optimization, workplace controls, personal protective equipment (PPE), etc. This process is an ALARA review in its most basic form and is necessary and sufficient for most radiological activities at Sandia. Requirements for TWDs are indicated by the Integrated Safety Management System (ISMS) process.

Members of the Workforce should:

- Review and document expected workplace conditions during the TWD process to determine if Table 7-1 conditions have been met. This review should consider the following:
  - Job history (for repeat of a previous job).
  - Predicted concentrations of airborne radioactivity.
  - Removable contamination in work areas.
  - Potential external exposure.
- Implement formal, documented optimization methods early in the design process to achieve meaningful results. Consult RP personnel for assistance with optimization studies.

Note: If the projected or actual dose is less than 1-person-rem and individual doses are less than 500 mrem, a formal, documented optimization study is not required. See Section 4.5, "Performance Goals," for guidance when developing radiological

performance goals.

4.4 Operational ALARA Process

Note: The operational ALARA process is an integrated safety management approach that optimizes worker protection from all hazards and is considered part of the Sandia ALARA process. It encompasses three discrete phases:

1. Pre-job planning and dose assessment.
2. Specification and implementation of ALARA controls and dose tracking.
3. Post-job review.

4.4.1 Pre-job Briefings

Requirements

Managers shall ensure that pre-job briefings are:

- Conducted when thresholds in Table 7-1 are exceeded, to include the following at a minimum:
    - Scope of work to be performed.
    - Radiological conditions of the workplace.
    - Procedural and technical work document (TWD) requirements (see CPR4001.1, MN471001, *ES&H Manual*, Chapter 21, "Technical Work Documents [TWDs]").
    - Special radiological control requirements.
    - Radiological hold-points (i.e., radiologically limiting conditions, such as contamination or radiation levels that may void the associated TWD).
    - Communications and coordination with other groups.
    - Provisions for housekeeping and final cleanup.

- Emergency response provisions.

- Provided to individuals who begin work on a job that is already on-going.

4.4.2 In-Progress ALARA Inspections

Guidance

Managers should ensure that:

- Periodic ALARA inspections are performed during jobs that require a pre-job ALARA review. These inspections should address the following:
  - Appropriate use of shielding
  - Appropriate use of personal protective equipment (PPE), including respiratory protection devices
  - Monitoring of stay times
  - Minimizing the time in radiological areas
  - Maximizing the distance from radioactive sources
  - Effective use of mock-up training and pre-job briefings
- Individual and collective doses are tracked and periodically compared to the dose estimates to determine if intervention is required.
- In-progress inspections are conducted with the assistance of RP personnel.
- Any concerns identified during an in-progress inspection are documented and reviewed to determine if modification of associated TWDs is necessary.

4.4.3 Post-Job Reviews

Guidance

Managers should ensure that post-job reviews:

- Are performed when:
    - A pre-job ALARA subcommittee review is required.
    - An actual collective dose equivalent of 5 person-rem or greater or a 1 rem total effective dose equivalent (TEDE) individual dose occurs.
    - Actual doses outside the range of ± 25% of pre-job estimates occur.
    - The "stop radiological work" authority is implemented (see Chapter 1, "Radiological Work Planning and Controls").
    - Significant lessons learned are identified.
- Compare actual person-hours and person-rem with the original estimates.
- Evaluate the effectiveness and cost of ALARA controls.
- Document lessons learned.
- Include recommendations on ways to control dose and contamination for similar activities.
- Occur as soon as is practical after the job is completed.
- Are attended, at a minimum, by:
    - RP personnel who are knowledgeable of the work performed.
    - The responsible manager and/or cognizant job supervisor.

4.5 Performance Goals

Requirements

Managers shall ensure that each division identifies performance goals as specified in Table 7-2.

Table 7-2. Performance Goals.

Level	Goals	Type
1	The maximum TEDE to a worker less than 500 mrem or the collective exposures less than 1 person rem.	Optional
2	The maximum TEDE to a worker exceeds 500 mrem or the collective radiation dose exceeds 1 person-rem.	Required

Guidance

Managers should ensure that:

- Performance goals include, as appropriate, annual collective dose for the facility or operation (person-rem) and the maximum TEDE to an individual (rem).
- Documentation of performance goals includes the following:
  - Project activity or description.
  - Radiological conditions and their projected or calculated trends.
  - Radiological hazards impacts.
  - Performance goals and their quantitative values.
  - Management signature.

4.6 Environmental ALARA

Requirements

Managers shall implement the ALARA process for all new facilities or operations that have a reasonable potential to cause dose to the public or radiological contamination of the environment. **[DOE 5400.5, II.2.]**

Note: At Sandia, this is accomplished through a graded approach of screening and qualitative or quantitative evaluations, as appropriate.

A qualitative environmental ALARA evaluation will typically consist of an assessment of the potential dose to the public or other environmental impacts. The outcome of the

qualitative assessment may result in any of the following:

- No action.
- A recommendation for low-cost or low-impact administrative or engineering controls to minimize the dose to the public or release(s) to the environment.
- A recommendation that a quantitative (i.e., cost-benefit) evaluation be performed.

A qualitative environmental ALARA evaluation may be initiated in one or more of the following ways:

- The responsible line organization recognizes the potential for dose to a member of the public, as a result of the screening process (Attachment 7-1) or other means, and seeks the assistance of the Environmental ALARA Coordinator.
- The Environmental ALARA Coordinator screens environmental checklists (ECLs) generated per the National Environmental Policy Act (NEPA) and initiates contact with the responsible line organization for those activities that have a reasonable potential for dose to the public (see CPR 400.1.1, MN 471001, *ES&H Manual*, Section 10B, "NEPA Sensitive Species, and Historic Properties").
- The Division ES&H Team, the Water Quality contact, or the Radiological NESHAP contact recognize the potential for dose to the public as a result of other permitting processes.

A quantitative environmental ALARA evaluation consists of a detailed cost-benefit analysis and should include several dose reduction alternatives, as well as a "no-action" alternative. Evaluation of alternatives should take into account dose impacts to occupational workers, if any. DOE does not require, nor may it be feasible, to always select the alternative with the lowest public dose impact.

A quantitative Environmental ALARA evaluation may be initiated in one or more of the following ways:

- A NEPA determination that an environmental impact statement/mitigation action plan (EIS/MAP) is required, due to environmental radiation protection reasons.
- A qualitative evaluation indicates the potential for dose to an individual offsite

member of the public in excess of 10 mrem/year.

Managers of radiological operations shall have the final decision-making authority on the implementation of recommendations resulting from the environmental ALARA process.

Guidance

Managers may use the screening process (see Attachment 7-1) as a tool to assist in determining the need for more detailed environmental ALARA evaluations. Consult the Environmental ALARA Coordinator for assistance.

5.0 RECORDS

Requirements

Members of the Workforce who generate occupational radiation protection related records shall use the special units of curie, roentgen, rad, and rem for activity, exposure, dose and dose equivalent respectively. Multiples and subdivisions of these units are allowed. SI units (becquerel [Bq], gray [Gy], and sievert [Sv])may be included in parenthesis after the special units. **[10 CFR 835.4]**

Managers shall ensure that records are maintained:

- To document compliance with SNL's radiation protection record-keeping requirements as implemented in the *Sandia Records Retention and Disposition Schedule* by the Recorded Information Management Department (4912). **[10 CFR 835.701(a)]**

- Until final disposition is authorized by the National Archives and Records Administration (NARA) through DOE. **[10 CFR 835.701(b)]**

Managers shall maintain the following ALARA-specific records:

- Documentation of any ALARA reviews (pre-job, in-process, or post-job), if performed.

- Actions taken to maintain occupational exposures ALARA are documented, including the actions required for this purpose by 10 CFR 835.101 (as presented in the *SNL Radiation Protection Program*), as well as facility design and control actions (see Section 4.2) **[10 CFR 835.704]**

- Documentation of performance goals are maintained and are retrievable upon request.

6.0 REFERENCES

6.1 Requirements Source Documents

10 CFR 835, *Occupational Radiation Protection*.

DOE 5400.5, *Radiation Protection of the Public and the Environment*.

6.2 Implementing Documents

DOE G 441.1-2, *Occupational ALARA Program Guide*.

SNL, *Facilities Development Center Design Manual*.

SNL, GN470072, *Nuclear Criticality Safety*.

6.3 Related Documents

DOE, G-10CFR835/B2, *Implementation Guide for Use with Title 10, Code of Federal Regulations, Part 835, Occupational Radiation Protection: Occupational ALARA Program*.

DOE G 441.1-1, *Management and Administration of Radiation Protection Programs Guide*.

DOE-STD-1098-99, *Radiological Control*.

ICRP, Publication 37, *Cost-Benefit Analysis In The Optimization Of Radiation Protection*, Annals of the International Commission on Radiological Protection, 10(2/3), Oxford: Pergamon Press, 1983.

ICRP, Publication 55, *Optimization And Decision Making In Radiological Protection*, Annals of the International Commission on Radiological Protection, 20(1), Oxford: Pergamon Press, 1989.

PNL-6577, *Health Physics Manual of Good Practices for Reducing Radiation Exposures to Levels that are As Low As Reasonably Achievable (ALARA)*, Pacific Northwest Laboratories, June 1988.

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Corporate Process Requirement No: CPR400.1.1.32
Sponsor: Dori Ellis, 4000, Acting

Revision Date: November 27, 2006

Radiological Protection Procedures Manual

*CHAPTER 8 – MONITORING AREAS AND MATERIAL

Subject Matter Expert: Martin Brennan
MN471016, Issue G
Effective Date: November 27, 2006; Replaces Document Dated: July 18, 2005
Review Date: November 16, 2006

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*Indicates a substantive change

1.0 PURPOSE

This chapter describes radiological survey requirements at Sandia-controlled premises.

For purposes of this document, Members of the Workforce are:

- Sandia employees.
- Sandia contractors as specified in CPR400.1.1/MN471001, *ES&H Manual*, Section 1B, "What Is the Scope."

2.0 SCOPE

This chapter applies to all Members of the Workforce at all Sandia-controlled premises.

3.0 RESPONSIBILITIES

3.1 Radiation Protection (RP) Personnel

RP personnel are responsible for all radiological surveys of record at Sandia. Surveys of record are performed only by personnel who are trained and qualified.

Note: Surveys of record include release surveys, surveys performed to evaluate radiological hazards, and surveys performed to determine radiological control requirements.

3.2 Managers

Managers are responsible for ensuring that:

- Areas are monitored when required (see Section 4.1).
- Air monitoring is performed when required (see Section 4.2).

- Packages containing radioactive material are monitored upon receipt (see Section 4.3).
- High and very high radiation areas are monitored during access (see Section 4.4).
- Items to be released from contamination areas and airborne radioactivity areas are surveyed (see Section 4.5).
- Non-radiological areas containing fixed contamination are routinely monitored (see Section 4.6).
- Leak tests are performed for accountable sealed radioactive sources (see Section 4.7).

3.3 Members of the Workforce

Members of the Workforce are responsible for:

- Notifying management and Radiation Protection (RP) personnel in a timely manner of changes in radiological conditions within their work areas.
- Requesting a radiological survey when they suspect that unusual radiological conditions exist.

3.4 Receiving, Mail and Material Movement Department (10263)

Department 10263 is responsible for complying with the monitoring requirements of 10 CFR 835.405 for incoming packages that contain radioactive material (see Chapter 6, Section 4.1.3, "Receipt of Radioactive Material").

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*4.0 PROCEDURE

4.1 General

Requirements

Managers shall be responsible for ensuring that areas are monitored to:

- Demonstrate compliance with the requirements of this chapter.
- Document radiological conditions.
- Detect changes in radiological conditions.
- Detect the gradual buildup of radioactive material.
- Verify the effectiveness of engineering and process controls in containing radioactive material and reducing radiation exposure.
- Identify and control potential sources of individual exposure to radiation and/or radioactive material. **[10 CFR 835.401(a)]**

The Radiation Protection (RP) Program Manager shall ensure that surveys of record are performed only by RP personnel who are trained and qualified.

Members of the Workforce shall consult the appropriate Division ES&H Team for assistance in evaluating and implementing monitoring requirements.

Guidance

Managers should ensure that:

- Survey frequencies are established based on:
  - Potential or actual radiological conditions.
  - Probability of change in conditions.
  - Area occupancy factors.
- Whenever practicable, surveys are performed before, during, and at the completion of work that has the potential for causing changes in radiological conditions.
- Current survey results and/or survey maps are readily available to inform

personnel of radiological conditions.

- Unreviewed survey documents (i.e., without reviewer's signature) are used for information purposes only and are **not** official records.

4.2 Air Monitoring

Requirements

Managers shall be responsible for ensuring that monitoring of airborne radioactivity is performed:

- Where an individual is likely to receive an exposure of 40 or more derived air concentration (DAC) hours in a year (see DACs in Appendix A [Word file/Acrobat file]). **[10 CFR 835.403(a)(1)]**

- As necessary to characterize the airborne radioactivity hazard where respiratory protective devices have been prescribed for protection against airborne radionuclides. **[10 CFR 835.403(a)(2)]**

- In real-time, as necessary, to detect and provide warning of airborne radioactivity concentrations that warrant immediate action to terminate inhalation of airborne radioactive material. **[10 CFR 835.403(b)]**

Guidance

Managers should ensure that air sampling is performed in circumstances such as the following:

- To develop baseline airborne radioactivity levels and verify containment integrity during startup of a new facility or a new activity in an existing facility.

- To establish the need for posting of airborne radioactivity areas and determine when respiratory protection should be worn by workers.

- To assess unknown airborne radioactive material hazards when special maintenance work is required on systems contaminated with radioactive material or when there is a loss of process controls.

- To assist in determining the type and frequency of bioassay measurements needed by radiological workers.

- To provide an estimate of worker exposures for situations where bioassay measurements may **not** be available or their validity is questionable.

- To ensure that airborne radioactivity levels have **not** changed over time, resulting in the need to change posting, respiratory protection, or air sampling requirements.

4.2.1 Breathing Zone Air Sampling (Lapel or Fixed Location)

[R - 10 CFR 835.402 - .403]

Requirements

Managers shall be responsible for ensuring that the breathing zone air sampling is performed, provided that bioassay is not the technically preferred method to perform dosimetric evaluation or the technical limitations of breathing zone sampling warrant the use of other air sampling strategies, when:

- Members of the Workforce can inhale radioactive material from work activities that are being performed in:
    - A high contamination area.
    - An airborne radioactivity area.
- There is a reasonable expectation that Members of the Workforce will be exposed to an airborne concentration in excess of 0.02 annual limit on intake (ALI).

4.3 Receipt of Packages Containing Radioactive Material

Guidance

Members of the Workforce, prior to opening a package containing radioactive material, should request that Radiation Protection (RP) personnel be present to monitor the package contents.

Note: The Shipping, Receiving, and Distribution Department (10263) monitors incoming

packages that contain radioactive material in accordance with 10 CFR 835.405 (see Chapter 6, Section 4.1.3).

4.4 Monitoring During Access to High and Very High Radiation Areas

Requirements

Managers shall be responsible for ensuring that high and very high radiation areas are monitored as necessary during each entry to determine the exposure rates to which the individuals are exposed. **[10 CFR 835.502(a)(1), 10 CFR 835.502(c)]**.

Note: See Chapter 5, Section 4.2, "High and Very High Radiation Areas," for entry controls. See Chapter 4, Section 4.2.1 for personnel monitoring needs.

4.5 Release of Materials and Equipment from Radiological Areas

Requirements

Managers shall be responsible for ensuring that materials and equipment to be released from contamination areas, high contamination areas, and airborne radioactivity areas are surveyed by Radiation Protection (RP) personnel.

Note: See Chapter 6, Section 4.2.2, "Control of Material, Property, and Equipment (ISMS Function: Control Hazards)" for the criteria for release. **[10 CFR 835.1101]**

4.6 Non-Radiological Areas Containing Total Contamination Exceeding RPPM Attachment 6-1

Requirements

Managers shall be responsible for ensuring that routine monitoring is accomplished to ensure that the removable surface contamination level remains below the removable surface contamination values, specified in Attachment 6-1, for nonradiological areas that are accessible to individuals where the measured total surface contamination levels exceed, but the removable surface contamination levels are less than, corresponding

surface contamination values specified in Attachment 6-1. **[10 CFR 835.1102]**

Note: See Chapter 6, Section 4.2.3, "Control of Areas (ISMS Function: Control Hazards)" for control of such areas.

4.7 Accountable Sealed Radioactive Sources

Requirements

Source custodians shall be responsible for ensuring that leak tests are performed for accountable sealed radioactive sources. **[10 CFR 835.1202]**

Note: See Chapter 9, Section 4.7, "Leak Testing," for additional information regarding sealed radioactive sources.

4.8 Radiation Generating Devices (RGDs)

Requirements

Managers shall be responsible for ensuring that RGDs are surveyed by RP personnel as specified in Chapter 10, Section 4.10, Radiation Surveys."

4.9 Discrete Particulate Contamination

Requirements

Managers shall ensure that when discrete particles are anticipated based on work planning or identified during operations, special surveillance measures are implemented for purposes of characterizing areas, defining radiological controls, release of tools, equipment, other items as well as personnel from radiological areas, and making other radiological decisions.

Note: The special methodologies for discrete particle identification rely heavily on the use of large area wipes and direct surveillance using field instrumentation. If the discrete particulate consists of nuclide (s) of concern that are low energy beta emitters (such as metal tritides or 63Ni), consult with RP personnel as these measures are generally not appropriate.

*4.10 Radiological Monitoring

*4.10.1 Purpose of Monitoring

Requirements

Managers shall ensure that radiological monitoring of radiation exposure levels, contamination, and airborne radioactivity are conducted to meet regulatory requirements as indicated above in Section 4.1.

Note: The following are some of the situations which require that a survey be conducted:

- ALARA planning.
- Compliance with DOT regulations.
- Determination if radioactive material had degraded or migrated.
- Documentation of sealed source integrity.
- Establishment of boundary controls.
- Establishment of radiological controls.
- Release of material from radiological areas.
- Support of requirements of the RWP.

Guidance

Members of the Workforce may request a radiological survey at any time by contacting one of the following:

- Division ES&H Teams
- RP personnel at SNL/CA: 294-1503

*4.10.2 Routine Monitoring Schedules

Requirements

[R - 10 CFR 835.401(a)]

Managers, in conjunction with the Radiological Protection Line Support Project Leader (or designee), shall ensure that:

- Routine monitoring schedules are established.
- Monitoring is performed at the scheduled frequency.

Guidance

Use Attachment 8-1 as a basis for establishing routine survey frequencies along with process knowledge and historical data.

*4.10.3 Deviations from Schedules

Requirements

[S]

Radiation protection line support project leaders or designees shall:

- Document all deviations from the recommended monitoring schedule.
- Notify the line manager in advance of all deviations from or permanent changes to the established monitoring schedule.

4.10.4 Review of Monitoring Frequencies

Requirements

[R - 10 CFR 835.401(a)]

Managers shall ensure that monitoring frequencies are reviewed annually, or more frequently, if there are significant changes to work scope or activities.

5.0 RECORDS

Requirements

Members of the Workforce who generate occupational radiation protection related records shall use the special units of curie, roentgen, rad, and rem for activity, exposure, dose and dose equivalent respectively. Multiples and subdivisions of these units are allowed. SI units (becquerel [Bq], gray [Gy], and sievert [Sv])may be included in parenthesis after the special units. **[10 CFR 835.4]**

Managers shall be responsible for ensuring that records are maintained:

- To document compliance with Sandia's radiation protection record-keeping requirements as implemented in the *Sandia Records Retention and Disposition Schedule* by the Recorded Information Management Department (4912). **[10 CFR 835.701(a)]**

- Until final disposition is authorized by the National Archives and Records Administration (NARA) through DOE. **[10 CFR 835.701(b)]**

6.0 REFERENCES

6.1 Requirements Source Documents

10 CFR 835, *Occupational Radiation Protection*.

6.2 Related Documents

DOE G 441.1-1, *Management and Administration of Radiation Protection Programs Guide*.

DOE-STD-1098-99, *Radiological Control*.

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Corporate Process Requirement No: CPR400.1.1.32
Sponsor: Dori Ellis, 4000, Acting

Revision Date: May 24, 2007

Radiological Protection Procedures Manual

CHAPTER 9 – CONTROL OF ACCOUNTABLE SEALED RADIOACTIVE SOURCES

Subject Matter Expert: Kevin Rolfe
MN471016, Issue G
Effective Date: May 24, 2007; Replaces Document Dated: November 14, 2002
Review Date: September 26, 2006

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*Indicates a substantive change

Radioactive Sources

1.0 PURPOSE

This chapter describes the processes that Members of the Workforce (MOW) follow to control Accountable Sealed Radioactive Sources (ARS). It also describes Sandia's program for implementing the requirements in 10CFR835.1202.

2.0 SCOPE

The requirements of this chapter apply only to MOW responsible for the use of ARS.

Compliance with the requirements in this chapter assures the requirements of 10CFR835.1202 are met.

MOW who use ARS, capable of generating external radiation fields in excess of 100 millirem/hour deep dose equivalent from all radiation emissions at 30 centimeters from the unshielded source are considered high strength radioactive sources and, are subject to additional requirements (see Section 4.5).

MOW who use ARS, are also subject to all the requirements contained in Chapter 6," Control of Radioactive Material."

The Device and Radioactive Source Tracking System (DARTS) is the database application used to track ARS. Registration of all ARS is mandatory and all source leak tests, inventories, and changes described in this chapter shall be documented in DARTS.

Note: DARTS can be accessed by typing "DARTS" into the address line of the SRN Techweb browser.

Guidance

As a best work practice, non-accountable radioactive sources and other radioactive

materials may be registered in DARTS for PHS inventory purposes.

3.0 RESPONSIBILITIES

3.1 Source Registrar

The source registrar is responsible for:

- Managing the Accountable Sealed Radioactive Source Control Program and DARTS.
- Ensuring that source custodians are notified frequently and redundantly as necessary, when source leak tests and/or source Inventories are due.
- Ensuring that source custodians and their management are notified frequently and redundantly as necessary, when source leak tests and/or source Inventories are overdue.
- Ensuring that appropriate RP personnel and the source custodian are notified of source leak test results that exceed 0.005 µCi.
- Determining whether or not specific radioactive sources are subject to the requirements of this chapter.

3.2 Managers

Managers of departments who maintain custody of ARS, regardless of location, are responsible for ensuring:

- All sources under their control are maintained in compliance with this chapter.
- Each ARS is assigned to a source custodian.

  Note: It is recommended that an *alternate* source custodian also be assigned to assume the responsibilities when the source custodian is unavailable.

- Qualified MOW are assigned the role of the source custodian when personnel changes are made or roles within an organization change.
- Source custodians and source users are appropriately trained (see Attachment 9-1).

3.3 Source Custodians

Source custodians are responsible for:

- Ensuring that the requirements of this chapter are met prior to using any ARS.
- Notifying RP personnel and the source registrar of any ARS acquisitions.
- Maintaining the appropriate minimum radiological training (see Attachment 9-1).
- Ensuring that all of their ARS are registered in DARTS.
- Ensuring that the necessary records and documents are maintained (see Section 5.0).
- Ensuring that source leak tests are performed in accordance with the requirements in Section 4. 4.
- Ensuring that radiation surveys are performed on active high strength radioactive sources in accordance with the requirements in Section 4. 5.
- Performing source inventories in accordance with the requirements in Section 4. 6.
- Completing the necessary updates in DARTS to reflect the changes described in Section 4.7.
- Taking appropriate actions for a lost or damaged ARS in accordance with the requirements in Chapter 11, “Radiological Incidents” and Chapter 13 “Feedback and Improvement.”
- Controlling any leaking ARS in a manner that minimizes the spread of radioactive contamination.

Note: When the Source Custodian is unavailable, the responsibilities specified in this section are performed by the MOW assigned as alternate custodian.

3.4 Radioactive Source Users

Radioactive source users are responsible for:

- Maintaining the appropriate minimum radiological training (see Attachment 9-1).
- Notifying the source custodian whenever:
  - Placing an ARS into storage or returning it to active service.
  - Any damage to an ARS is suspected.
- Taking appropriate actions for a lost or damaged ARS in accordance with the requirements in Chapter 11 “Radiological Incidents” and Chapter 13 “Feedback and Improvement”.

3.5 Radiation Protection (RP) Personnel

RP personnel are responsible for:

- Conducting source leak tests when requested.
- Choosing the appropriate analytical method capable of detecting 0.005 µCi. **[10CFR835.1202(b)]**
- Documenting and reporting the results of source leak tests to the source custodian.
- Forwarding all approved source leak test surveys to the source registrar.

4.0 PROCEDURE

4.1 Acquiring and Receiving an ARS

Requirements

Source custodians shall perform the following steps prior to the use of any newly acquired ARS:

1. Notify RP personnel and the source registrar of any ARS acquisitions.

2. Verify that a PHS is in place and updated, as appropriate, as well as any required RP approved TWD, in accordance with the following:

   - Chapter 1, “Radiological Work Planning and Controls.
   - ES&H Manual, Section 13A, “Hazards Identification and Classification Process.”
   - ES&H Manual, Chapter 21, “Technical Work Documents (TWDs).”

3. Schedule the appropriate radiological surveys with RP personnel (i.e., receipt and source leak tests).

   Note: Specific ARS are exempted from source leak testing (see Section 4.4).

4. Verify that the source leak test results indicate that the ARS is not leaking.

5. Register the ARS in DARTS (see Section 4.2).

4.2 Registering a Newly Acquired ARS in DARTS

Requirements

Source custodians shall perform the following steps to register all newly acquired ARS in DARTS within 30 days of receipt:

Note: Non-Sandia owned ARS, subject to the requirements of this manual (see “Introduction”, Section 2.8.1) are required to be registered in DARTS only if they will be on Sandia-controlled premises for greater than 30 days.

1. Complete the Radioactive Source Registration Form, SF 2001–SRF (12-2002) (MSWord / PDF) and submit it to the source registrar.

2. Include any pertinent documentation sent by the manufacturer with the Radioactive Source Registration Form (e.g., source calibration certificates, integrity test certifications, shipping documents, special form certificates).

3. Verify that their ARS is registered and has passed a source leak test, if required (see Section 4.4), prior to use.

   Note 1: An ARS that is registered prior to conducting the initial source leak test survey is registered with an in storage status.

   Note 2: A unique identification number is assigned to each ARS registered in DARTS; the source registrar will furnish the source custodian with a barcode identification label to attach to the ARS.

4. Review the information in DARTS and consult with the source registrar to correct any discrepancies.

5. Label the ARS (see Section 4.3).

6. Perform an initial source inventory and enter it into DARTS (see Section 4.6).

4.3 Labeling ARS

Requirements

Source custodians shall attach the appropriate barcode identification label to the ARS. The label is provided by the source registrar when the ARS is registered.

Note: Additional labeling requirements for ARS as radioactive material are contained in Chapter 2 “Posting and Labeling for Radiological Control.”

Guidance

- The barcode identification label should be applied directly to the source. If this is not practical, then the label should be applied to the source housing or storage

container. If the label is not affixed directly to the source, then a method of tracing the source to its label should be implemented (e.g., associating a serial number or a unique description of the source with the label).

- A current Radioactive Source Information sheet for each source should be maintained near the storage location or be readily available.

  Note: A Radioactive Source Information sheet for each source can be printed from DARTS.

4.4 Source Leak Testing

ARS that require leak testing are identified in Attachment 9-1.

Requirements

Source custodians shall:

- Schedule source leak test surveys with the appropriate RP personnel prior to the source leak test due date.

  Note: The source leak test survey **is not** considered complete until the survey documentation is reviewed by RP personnel.

- Subject ARS to a source leak test:

  - Upon receipt,
  - When damage is suspected, and
  - At intervals not to exceed six months. **[10 CFR 835.1202(b)]**

  Note 1: The time interval to conduct these activities may be extended by a period not to exceed 30 days to accommodate scheduling needs. **[10 CFR 835.3(e)]**

  Note 2: Source leak tests shall be capable of detecting radioactive material leakage equal to or exceeding 0.005 µCi. **[10 CFR 835.1202(b)]**

- Control any ARS found to be leaking radioactive material in a manner that

minimizes the spread of radioactive contamination. **[10 CFR 835.1202(e)]**

- Subject any ARS in storage to a source leak test prior to returning it to service. **[10 CFR 835.1202(c)]**

Exemptions from Leak Testing

ARS are exempt from source leak testing if they:

- Consist solely of:
  - Tritium or,
  - Gaseous radioactive material. **[10 CFR 835.1202(b)]**
- Have been removed from service (see Section 4.7.1) **[10 CFR 835.1202(c)]**

An ARS is not subject to periodic source leak testing if that source is located in an area that is unsafe for human entry or otherwise inaccessible **[10 CFR 835.1202(d)]** (e.g., oxygen deficient or very high radiation areas including neutron sources used for reactor startup while an integral part of the reactor assembly).

Note 1: This exemption is not applicable to sources that are located in instruments or other devices located inaccessible areas, nor should it be applied to sources that may be considered inaccessible due to radiological conditions created by the presence of the source itself; source leak tests are performed on these sources by wiping the area where contamination is most likely to occur from a failure of source integrity.

Note 2: If a source is removed from the unsafe area or otherwise becomes accessible, then this exception no longer applies.

4.5 High Strength Radioactive Sources

Requirements

This section applies only to ARS capable of generating external radiation fields in excess of 100 millirem/hour deep dose equivalent from all radiation emissions at 30 centimeters from the unshielded source.

In addition to the other requirements of this chapter, source custodians shall:

- Coordinate with RP personnel to determine if a particular ARS meets the above criteria.
- Notify the source registrar of any ARS that meets this criterion to ensure that it is identified as a high strength radioactive source in DARTS.
- Maintain the appropriate minimum radiological training (see Attachment 9-1).
- Schedule radiation surveys with the appropriate RP personnel representative.
- Subject high strength radioactive sources to radiation surveys:
    - Prior to initial use.
    - Prior to returning a high strength radioactive source in storage to active service.
    - Anytime changes occur that could increase radiation exposure from the high strength radioactive source (see Attachment 9-2).
    - Annually when in active service.

      Note: Failure to complete the annual radiation survey will automatically remove the source from active service in DARTS.
- Configure high strength radioactive sources so that the radiation surveys are conducted under the worst-case operating conditions that will produce the maximum exposure in the area under evaluation.

  Note: If a high strength radioactive source is not surveyed under worst-case conditions, ensure that an appropriate operating restriction is reflected in the TWD associated with the high strength radioactive source (see Attachment 9-3 for examples of circumstances that require restrictions be noted in TWDs).
- Maintain access controls per Chapter 5, “Entry Control.”

- Maintain radiological postings per Chapter 2, “Posting and Labeling for Radiological Control.”
- Use dosimetry per Chapter 4 “Radiation Dosimetry.”

Guidance

Source custodians should:

- Perform operational checks of safety devices as prescribed by the manufacturer.
- Document and maintain records of:
  - Operations,
  - Maintenance, and
  - Operational checks of safety devices.
- Specifically identify in TWDs:
  - Radiation protection precautions;
  - Dose reduction methods;
  - Special dosimetry; and
  - Monitoring requirements.
- Arrange for radiation monitoring during and after use of high strength radioactive sources to verify: the adequacy of controls; posting of immediate and adjacent areas; and return of the source to a safe condition.
- Arrange for radiation monitoring during and after use of high strength radioactive sources moved from a shielded position for use and then returned to the shielded position when not in use, to verify the source has been returned to a safe condition (e.g., radiography cameras).

4.6 Source Inventorying

Requirements

All ARS are required to be inventoried.

Source custodians shall:

- Inventory their ARS at intervals not to exceed six months. **[10 CFR 835.1202(a)]**
    - The inventory must:
        - Establish the physical location of each ARS. **[10 CFR 835.1202(a)(1)]**
        - Verify the presence and adequacy of associated postings and labels. **[10 CFR 835.1202(a)(2)]**
        - Establish the adequacy of storage locations, containers, and devices. **[10 CFR 835.1202(a)(3)]**
        - Verify that the ARS use status is accurately reflected in DARTS.
        - Correct all discrepancies prior to documenting completion of the inventory.

    Note 1: The time interval to conduct these activities may be extended by a period not to exceed 30 days to accommodate scheduling needs. **[10 CFR 835.3(e)]**

    Note 2: Consult the appropriate RP personnel for assistance with inventory-related questions (e.g., the adequacy of postings and labels or the adequacy of storage locations, containers, and devices.)

- Complete the inventory using the inventory tab in DARTS or with a barcode scanner provided by the source registrar.

    Note: Instructions for using the barcode scanner will be provided by the source registrar upon issue.

- Return the barcode scanner to the source registrar once the inventory is completed.

Discrepancies between the physical location of the ARS and the location of record in DARTS during inventory

If the physical location of an ARS is not the location of record indicated in DARTS at the time of the inventory, then:

- Enter the physical location of the ARS at the time the inventory is performed in DARTS; and
- Indicate if the ARS location of record in DARTS requires updating.

Note: The location of record in DARTS must be updated within five business days after moving a source to a new physical location. The requirements for moving an ARS to a new physical location are in Section 4.7.2.

Guidance

All non-accountable sources registered in DARTS should be inventoried using the same method as for ARS.

Use of a Tamper-Indicating Device (TID) as an alternative to a Physical inventory

A source or sources placed in a container sealed with a TID can be inventoried by checking that the TID is in place and has not been tampered with provided that the bullets below have been meet:

A TID is a one-time use only device installed on a container or storage repository in a manner that ensures a clear indication of the integrity of the container or the repository.

- Containers are designed so that attempts to open the TID'd container will result in damage to the container and/or the TID thus indicating tampering.
- Perform an inventory of all sources being secured in a TID'd container.
- Document and verify the inventory prior to attaching the TID.

- Maintain a local inventory of all sources secured in a TID'd container.
- Each TID has a unique identification number that is documented on the locally maintained source inventory.
- If the TID or container is compromised in any manner, either intentional or unintentional, then the source inventory cannot be completed by this method and each source must be individually inventoried.

4.7 Documenting Changes that Affect the Use or Status of an ARS

Requirements

Source custodians shall update DARTS when:

- Placing an ARS into storage or returning one to active service (see Section 4.7.1).
- Moving an ARS to a new physical location (see Section 4.7.2).
- Transferring custodianship (see Section 4.7.3.1) or loaning (see Section 4.7.3.2) an ARS to another MOW within Sandia Corporation.
- Transferring (permanently) or loaning an ARS to a Non-Sandia Organization (see Section 4.7.4).
- Making an ARS available for reapplication (see Section 4.7.5).
- Disposing of an ARS (see Section 4.7.6).

4.7.1 Placing an ARS into Storage or returning one to Active Service

Changes in status reflect how the ARS is being used and may affect the tracking and testing requirements of that ARS.

Requirements

Source custodians shall update the ARS status in DARTS to either “Storage” or “Active” within five business days of removing an ARS from service or returning one to active service. Note: An ARS available for reapplication shall be identified as such in DARTS (see Section 4.7.5) and handled in the same manner as those ARS in storage.

Source custodians shall:

- Secure stored ARS in a controlled location.
- Complete periodic inventories for ARS in storage as required (see Section 4.6).
- Subject the ARS to a source leak test, if it's currently in storage, prior to returning it to service (see Section 4.4). **[10 CFR 835.1202(c)]**

  Note: ARS removed from service are not subject to periodic source leak testing (see Section 4.4). **[10 CFR 835.1202(c)]**

Guidance

In addition to the requirements in Chapter 2, “Posting and Labeling for Radiological Control,“ source custodians should:

- Label sources in storage with:
  - The source identification number.
  - The words "storage" or "out of service."
  - The instruction to have the ARS leak tested prior to being returned to active service.

  Note: Storage labels are available from the source registrar.
- Implement a method of tracing a source to its label if the label is not affixed directly to the source.

4.7.2 Moving an ARS to a New Physical Location

Requirements

Source custodians shall:

- Notify the appropriate RP personnel of the new physical location.
- Post the new physical location in accordance with Chapter 2, “Posting and Labeling for Radiological Control.”
- Update the location of record in DARTS within five business days of the move.

  Note: Source custodians are not required to update the location of record in DARTS when an ARS is:

  - Returned to the location of record within five business days; or
  - Returned to the location of record prior to the next inventory cycle and a logbook is maintained at the location of record identifying the ARS physical location and the date the ARS was moved to that location.

Guidance

Radiological surveys should be performed at the new physical location after an ARS is moved, to verify that the radiological conditions have not changed.

4.7.3 Transferring Custodianship or Loaning an ARS to another MOW

4.7.3.1 Transferring Custodianship

Responsibilities for source custodians are described in Section 3.3.

Requirements

The relinquishing source custodian shall:

- Notify the new source custodian, the source registrar, and RP personnel of the intent to transfer custody.
- Transfer all documentation pertaining to the ARS to the new source custodian.
- Update the appropriate source custodian field in DARTS within five business days

of the physical transfer.

The new source custodian shall:

- Update the location of record in DARTS if necessary (see Section 4.7.2).
- Coordinate with the source registrar to perform an Inventory on the transferred ARS (see Section 4.6).

4.7.3.2 Sandia Loans

When a source custodian loans an ARS to another MOW the source custodian maintains responsibility for the ARS as described in Section 3.3.

Requirements

Source custodians shall:

- Verify that appropriate work authorization documents are in place prior to the loan.
- Note: Contact RP personnel if there are any questions.
- Verify that the MOW who is borrowing the ARS has the appropriate training (see Attachment 9-1).
- Subject the ARS to a source leak test, if it is currently in storage, prior to returning it to service (see Section 4.4). **[10 CFR 835.1202(c)]**
- Update the status to “active” (see Section 4.7.1) and the location of record (see Section 4.7.2) in DARTS within five business days, if necessary.

4.7.4 Permanent Transfers or Loans of an ARS to a Non-Sandia Organization

When an ARS is permanently transferred or loaned for a period of time to a non-Sandia organization (e.g., government agency or university). That organization shall assume ownership of the ARS while it is in their possession and is responsible for all regulatory compliance. Source custodians shall perform all permanent transfers or loans of an ARS in accordance with CPR500.2.3, “Property/Assets User's Manual”.

In addition, the source custodian shall:

- Verify that the receiving organization is appropriately licensed (e.g., DOE, NRC, State Agreement, or other applicable government authority) to receive the ARS.
    - Obtain a copy of the license or equivalent document from the receiving organization
    - Verify that the ARS will be covered under their license or equivalent document

      Note: Contact RP personnel for assistance in reviewing the license or equivalent document
- Notify RP personnel prior to the transfer so the appropriate radiological surveys can be performed (i.e., packaging and shipping).
- Identify and document a point of contact along with the phone number and address of the receiving organization.
- Update the status of the ARS to “Permanent Transfer” or “Loaned” as appropriate in DARTS within five business days.
- Provide the Source Registrar with copies of the following documents:
    - Receiving organization's license or equivalent document
    - Shipping documents
    - Radiological surveys
    - Any other related documentation not previously mentioned.

  Note: Any offsite movement of radioactive material is subject to the requirements in ES&H Manual, Chapter 12 “Packaging and Transportation of Hazardous Material.”

4.7.5 Making an ARS available for Reapplication

Requirements

If an ARS can still be used but is no longer needed, the source custodian shall:

- Verify that the ARS is not damaged or is leaking radioactive material (see Section 4.4).

  Note: An ARS that is damaged or is leaking radioactive material can not be reapplied and should be disposed of (see Section 4.7.6).

- Remove the ARS from service and place it into storage (see Section 4.7.1).

  Note: An ARS that is available for reapplication is handled the same as an ARS in storage.

- Update the status in DARTS to “Reapplication.”

If a new use for the ARS is identified the current source custodian shall transfer the ARS in accordance with Section 4.7.3 or Section 4.7.4, as appropriate.

Note: An ARS may remain available for reapplication while a disposal request is in process however, the status in DARTS must be updated to “Disposed” when it is picked up as radioactive waste.

Guidance

Information regarding an ARS available for reapplication can be accessed in DARTS or by contacting the source registrar.

MOW who are interested in an available ARS should contact the current source custodian directly to arrange for a transfer. (see Section 4.7.3.1).

4.7.6 Disposing of an ARS

Requirements

If an ARS is no longer needed and it cannot be reapplied (see Section 4.7.5) the source custodian shall:

- Notify RP personnel so the appropriate radiological surveys can be performed (i. e., waste characterization).

- Submit a Radioactive Or Mixe d Waste Disposal Request (DR) Form to the Regulated Waste/Nuclear Material Disposition Department (RWNMDD).

- Update the status in DARTS to “Reapplication” if the ARS is not damaged or leaking, otherwise update the status to “Storage.”

- Update the status in DARTS to “Disposed” after the ARS is picked up by RWNMDD personnel.

  Note: The RWNMDD assumes all responsibility for the ARS after it is picked up as radioactive/mixed waste.

4.8 Loss or Damage of an ARS

Requirements

Immediately upon determining that an ARS has been lost or damaged, the user shall take the appropriate actions per Chapter 11, “Radiological Incidents” and prepare a Radiological Process Improvement Report (RPIR) per Chapter 13, “Feedback and Improvement.”

5.0 RECORDS

Requirements

Unless otherwise specified, the quantities used in the required occupational radiation protection related records generated by MOW shall be clearly indicated in the special units of curie, rad, roentgen, or rem, including multiples and subdivisions of these units. **[10 CFR 835.4]**

Records shall be maintained to document compliance with this chapter. **[10 CFR 835.701 (a)]**

Unless otherwise specified, records shall be retained until final disposition is authorized by DOE. **[10 CFR 835.701(b)]**

Source custodians shall:

- Maintain the necessary records to demonstrate compliance with the requirements of this chapter including:
    - Source Registration Forms.
    - Source Inventory histories.
    - Source Leak Test histories. **[10 CFR 835.704(f)]**
- Maintain any pertinent documentation sent by the manufacturer (e.g., source calibration certificates, integrity test certifications, shipping documents, special form certificates).

  Note 1: Documentation that is sent to the source registrar for source registration (see Section 4.2) is forwarded to the Integrated Information Services Recorded Information Management Department to comply with Sandia's radiation protection record-keeping requirements as implemented in the *Sandia Records Retention and Disposition Schedule*.

  Note 2: As of October 1, 2006, records of source leak tests and the source inventories are maintained in DARTS. All official source records previous to this date are maintained by the Integrated Information Services Recorded Information Management Department.

6.0 REFERENCES

6.1 Requirements Source Documents

10 CF R 835, *Occupational Radiation Protection*.

6.2 Related Documents

DOE G 441.1-1, *Management and Administration of Radiation Protection Programs Guide*.

DOE G 441.1-5, *Radiation-Generating Devices Guide.*

DOE G 441.1-13, *Sealed Radioactive Source Accountability and Control Guide.*

DOE-STD-1098-99, *Radiological Control.*

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Corporate Process Requirement No: CPR400.1.1.32
Sponsor: Dori Ellis, 4000, Acting

Revision Date: June 15, 2007

Radiological Protection Procedures Manual

CHAPTER 10 – RADIATION-GENERATING DEVICES (RGDs)

Subject Matter Expert: Kevin Rolfe
MN471016, Issue J (I not used)
Effective Date: June 15, 2007; Replaces Document Dated: September 29, 2005
Review Date: September 26, 2006

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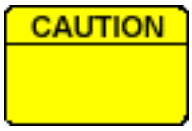
*Indicates a substantive change

1.0 PURPOSE

The purpose of this chapter is to provide the requirements for identifying, classifying, registering, safely operating, routinely surveying, and disposing of all radiation-generating devices (RGDs) so that personnel exposure to radiation is minimized.



Caution: Other hazards, such as high voltage and explosives, are often associated with the operation and maintenance of an RGD. See CPR400.1.1, MN471001, *ES&H Manual*, and its supplements for information about these hazards.

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*2.0 SCOPE

*2.1 Devices That Are Considered RGDs

This chapter applies to activities involving the use of radiation-generating devices (RGDs).

*2.2 Devices That Are Not Considered RGDs

The following devices are not considered RGDs and are therefore exempt from the requirements of this chapter:

- All sealed radioactive sources.
- Commercial office equipment such as television receivers, computer video monitors, reproduction machines, and commercially available CRTs (e.g., laboratory monitors and oscilloscopes).

- Devices that are either physically or administratively restricted to operate at a peak accelerating potential (not power supply) of less than 10 kVp.

- Laser systems not exceeding 10^{15} W/cm^2 intensity.

- Individual neutron-generating devices (such as neutron tubes, weapon component neutron generators, field test neutron generators, controlatrons, and zetatrons) provided that the equipment or component that supplies the energy necessary to directly or indirectly initiate the generation of neutrons is registered or exempted. See Section 4.7.1 for information on registration of RGDs.

2.3 Devices That May Be Exempt from the Requirements of This Chapter

Devices whose operations are covered by documented safety and oversight processes and dedicated radiation protection support that meets or exceeds the requirements of this chapter are exempt from all but the following requirements:

- Registration in the RGD database for tracking purposes (see Section 4.7.1).

- Classification as to installation class and type (see Section 4.6).

- Labeling (see Section 4.7.2).

- Notification of the Device Registrar (i.e., RP personnel) regarding changes such as status, custodian, and location (see Section 4.7.3).

Note: An example of such a device is the nuclear facilities under the oversight of the Sandia Nuclear Criticality Safety Committee.

Devices for which a documented analysis shows that the worst-case accident would result in a deep dose to the whole body of no more than 10 mrem, a dose to the lens of the eye of no more than 30 mrem, and a dose to the skin or any extremity of no more than 100 mrem, may be exempt from the requirements of this chapter. Requests for exemption are considered on a case-by-case basis per Section 4.1.

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*3.0 RESPONSIBILITIES

3.1 Device/RGD Registrar

The Device Registrar is responsible for:

- Managing the RGD Control Program and the RGD control database.
- Notifying RGD custodians when required RGD surveys and inventories are due.
- Notifying RGD custodians and their managers when RGD surveys and inventories are past due.

3.2 Managers

Managers of departments that own or use radiation-generating devices (RGDs) are responsible for:

- Assigning each RGD to an RGD custodian.
- Reassigning RGDs to new RGD custodians as necessary when personnel leave their department.
- Verifying that all RGD custodians and operators of RGDs under their control have received the required training (see Section 4.8).
- Ensuring that all RGDs under their control are acquired, classified, registered, operated, surveyed, stored, and disposed of in compliance with this chapter.
- Ensuring that each RGD under their control is inventoried annually.
- Approving technical work documents (TWDs) for RGDs under their control. (See CPR400.1.1, MN471001, *ES&H Manual*, Chapter 21, "Technical Work Documents [TWDs]").
- Transferring RGDs offsite according to Section 4.2.
- Notifying RP personnel before bringing a non-SNL RGD on site.

- Approving the submission of requests for exemption per Section 4.1.
- Notifying RP personnel of any unexpected increase in the dosimeter readings of RGD custodians and operators of RGDs under their control so that a radiation survey can be performed.

*3.3 RGD Custodians

RGD custodians are responsible for:

- Completing required training (see Section 4.8).
- Registering RGDs with the Device Registrar, including classifying the RGD as to installation class and type.
- Scheduling radiation surveys of RGDs as required, including notifying RP personnel of any change that could affect the radiation exposure of any person (see Section 4.10).
- Performing RGD inventories as required. (see Section 4.11).
- Ensuring that, when required, RGDs have valid TWDs that have been reviewed and recommended for approval by RP personnel. (See CPR400.1.1, MN471001, *ES&H Manual*, Chapter 21, "Technical Work Documents [TWDs]").
- Ensuring that RGD-related operations and maintenance records are maintained (see Section 5.0).
- Notifying the Device Registrar of changes affecting RGDs, such as:
    - Transfer of responsibility to another RGD custodian.
    - Movement of an RGD to another location.
    - Offsite transfer of an RGD.
    - Deactivation/storage of an RGD.

- Reactivation of an out-of-service RGD.
- Reclassification of an RGD.
- Disposal/reapplication of an RGD.

- Maintaining safety interlock schematics (mechanical and electrical) and operational and technical manuals supplied by manufacturers, along with blue prints or other pertinent information about RGDs.
- Disposing of RGDs according to Section 4.13.

3.4 RGD Operators

RGD operators are responsible for:

- Notifying the RGD custodian of any changes that affect the operation of the RGD.
- Completing required training, including device-specific training (see Section 4.8).
- Properly wearing dosimetry, if required (see Section 4.12).
- Operating RGDs in accordance with approved TWDs, when required. (See CPR400.1.1, MN471001, *ES&H Manual*, Chapter 21, "Technical Work Documents [TWDs]").
- Maintaining access control (according to Chapter 5, "Entry Control") over any radiation areas, high radiation areas, and very high radiation areas created during operation of RGDs.

Note: In the case of a matrix operation, the facility operator maintains responsibility for access control outside these areas.

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*4.0 PROCEDURE

Note 1: See the "Introduction" for information on requirements for SNL contractors (e.g.,

factory or service representatives setting up new radiation-generating devices (RGDs) or performing maintenance or repair on existing RGDs).

Note 2: An RGD exercise is available for review as part of RAD250, Management of Radiological Operations.

4.1 Requests for Exemptions from the RGD Program (ISMS Function: Plan Work)

Requirements

Managers shall be responsible for:

- Approving the submission of requests for exemption from the RGD Program.
- Submitting requests for exemption to RP personnel, including dose calculations or analysis data demonstrating that affected RGDs meet the criteria for exemption.

Note 1: Examples of RGDs that may be exempt from the RGD Program include devices for which a documented analysis shows that the worst-case accident would result in a deep dose to the whole body of no more than 10 mrem in a year, a dose to the lens of the eye of no more than 30 mrem in a year, and a dose to the skin or any extremity of no more than 100 mrem in a year.

Note 2: Requests for exemption will be considered on a case-by-case basis. If the request is granted, the requester will be advised (in writing, by RP personnel) that the device has been exempted from the requirements of the RGD Program.

4.2 Offsite Operation of SNL RGDs (ISMS Function: Plan Work)

Requirements

Managers shall do the following before transferring RGDs offsite:

- Review the "Introduction" to determine if RPPM requirements apply to the offsite operations.
- Contact the SNL Legal Division, ES&H, Corporate & International Law Center, for

information about appropriate documentation (e.g., contract provisions concerning government-furnished property or hazardous material used offsite, or an equipment loan agreement).

- Notify the Device Registrar of the offsite transfer.

Guidance

SF 2001-RGC, Radiation-Generating Device Change Form (Word file/Acrobat file) may be used to notify the Device Registrar of offsite transfers.

4.3 Onsite Operation of Non-SNL RGDs (ISMS Function: Plan Work)

Requirements

Managers shall:

- Notify RP personnel before bringing a non-SNL RGD on site (e.g., when contracting for RGD services).
- See the "Introduction" to determine if RPPM requirements will apply to onsite operations.

*4.4 Out-of-Service RGDs (ISMS Function: Control Hazards)

Requirements

Note: With regard to operational requirements, out-of-service RGDs are only required to meet those specified in Section 4.7.

Guidance

RGD custodians should:

- Ensure that no power is supplied to out-of-service RGDs that emit electronically generated radiation.

- Label out-of-service RGDs with:
  - The appropriate device identification number.
  - The words "STORAGE" or "OUT OF SERVICE."
  - Instructions stating that RP personnel should be notified before operating the RGD.

4.5 Pre-Operational and Initial Operating Activities (ISMS Function: Plan Work)

Requirements

Managers shall, before authorizing the operation of a newly acquired RGD, appoint an RGD custodian to maintain direct control over installation and operation of the RGD.

Note 1: This requirement applies regardless of location and regardless of whether operation of an RGD is subject to the other requirements of this chapter.

Note 2: An alternate custodian is not required, but one may be designated to assume the responsibilities of the primary custodian when they are unavailable.

RGD custodians shall do the following before operating, or permitting the operation of, a newly acquired RGD:

- Except as noted below, have a technical work document (TWD) reviewed and recommended for approval by RP personnel, and approved by the responsible manager. See Section 4.9 and CPR400.1.1, MN471001, *ES&H Manual*, Chapter 21, "Technical Work Documents (TWDs)," for more information on TWDs.

  Note: Commercially obtained RGDs that are expected to meet the criteria for classification as "exempt shielded" (see Attachment 10-1) need not have a TWD for initial operation, provided the RGD is operated only within design specifications with all safety features (e.g., interlocks) engaged and all shielding in place.

- Verify that a PHS is in place, and updated, as appropriate, in accordance with RPPM Chapter 1, “Radiological Work Planning and Controls,” and *ES&H Manual*,

Chapter 13, “Hazards Identification/Analysis and Risk Management.”

- Except for neutron generator operations and as noted below, ensure that a radiation survey is performed during initial radiation-producing or radiation-utilizing activities.

  Note: Commercially-obtained RGDs that are expected to meet the criteria for classification as "exempt shielded" (see Attachment 10-1) may be operated within design specifications, with all safety features (e.g., interlocks) engaged, and with all shielding in place to ensure the device is operational before contacting RP personnel for a radiation survey.

- Ensure that training (see Section 4.8), dosimetry (see Section 4.12), radiological posting (see Chapter 2), and access controls (see Chapter 5), are appropriate for expected radiological conditions.

- After the initial operation and radiation survey are complete, classify and register the RGD with the Device Control Program (see Section 4.7).

  Note: The classification of an RGD determines its subsequent operating requirements.

4.6 Classification of RGDs (ISMS Function: Plan Work)

Requirements

RGD custodians shall:

- Classify operational RGDs as to the installation class and type per Attachment 10-1.

  Note 1: For new RGDs, the classification is indicated on the registration form when the RGD is registered.

  Note 2: Specific operating requirements for RGDs depend on the type of RGD and the installation class in which it is operated (see Attachment 10-2).

  Note 3: Out-of-service RGDs need not be classified until they become operational.

- Reevaluate RGDs that have been moved or modified (see Attachment 10-4) to determine whether classifications and operating requirements have changed.

  Note 1: Some classifications require concurrence from RP personnel (see Attachment 10-1).

  Note 2: The classification of an RGD can be changed using SF 2001-RGC, Radiation-Generating Device Change Form (Word file/Acrobat file).

Guidance

RGD custodians should consult with RP personnel to determine appropriate RGD installation classes.

4.7 Registration/Labeling/Notification of Change in Status (ISMS Function: Plan Work)

4.7.1 Registration

Requirements

Custodians shall, for each RGD assigned to them:

- Register the RGD with the Device Control Program. This requirement applies regardless of location and regardless of whether operation of the RGD is subject to the other requirements of this chapter.

  Note 1: Custodians of neutron generator operations (see Attachment 10-1, Section 5.0), shall register either the neutron generating device (e.g., weapon component neutron generators and neutron tubes, field test neutron generators, controlatrons and zetatrons) or the equipment or device that supplies the energy necessary to directly or indirectly initiate the generation of neutrons.

  Note 2: SF 2001-RGR, Radiation-Generating Device Registration Form (Word file/ Acrobat file) may be used to register RGDs.

- Indicate classification upon registration.

Note: Out-of-service RGDs need not be classified until they become operational.

4.7.2 Labeling

Requirements

Custodians shall label each RGD assigned to them with labels bearing the following, at a minimum:

- The RGD identification number assigned by the Device Control Program.
- The installation class and type, if applicable.
- The next routine survey due date, if applicable.

  Note: Portable or Mobile Radiography devices are not labeled with a next routine survey due date because these devices require surveys prior to operation in each location.

Note 1: The Device Control Program will supply labels to RGD custodians upon registration of new RGDs or upon changes of status or classifications of existing RGDs.

Note 2: See Section 4.4 for information on labeling out-of-service RGDs.

Note 3: For RGDs that are exempt from the requirements of this chapter, an exempt label is available from the Device Control Program.

Guidance

Custodians should affix labels as follows:

- Place labels on or near the controls (power supplies) of the RGDs.
- If x-ray generating heads are located remotely from their power supplies, attach additional labels bearing the RGD identification number to the heads.

4.7.3 Notification of Change in Status (ISMS Function: Feedback and Improvement)

Requirements

Custodians shall:

- Notify the Device Control Program of any change in status of an RGD, such as:
  - Transfer of responsibility to another RGD custodian.
  - Movement to another location.
  - Offsite transfer.
  - Deactivation/storage.
  - Reactivation of an out-of-service RGD.
  - Reclassification.
  - Disposal/reapplication.
- Obtain a new label from the Device Control Program if a change of status affects any information on the existing label.

Guidance

SF 2001-RGC, Radiation-Generating Device Change Form (Word file/Acrobat file) may be used to notify the Device Registrar of changes.

*4.8 Training (ISMS Function: Plan Work)

*4.8.1 Radiological Training

Note: The following table presents required and recommended radiological training related to RGDs. See Chapter 3, "Radiological Training Program," for additional information on radiological training.

Work Activity or Role	Required	Recommended

Custodians and operators of:		
• Exempt shielded, inherently safe RGDs	RAD102	N/A
• Exempt shielded, certified cabinet RGDs	RAD102	RAD214
• RGDs classified as unattended installations	RAD102	N/A
• RGDs (other than those noted above) that emit only electronically-generated x-rays and who do not require access to radiological areas other than radiation areas	RAD214 or RAD210	N/A
• RGDs that emit neutrons, have the potential to contaminate or activate other materials, or who require access to radiological areas other than radiation areas	RAD210 or RAD230	N/A
RGD classifications are discussed in Section 4.2.		

4.8.2 Device-Specific Training

Requirements

Managers shall be responsible for ensuring that, in addition to the radiological training specified in Section 4.8.1, operators of all RGDs have documented device-specific training for the RGD that they operate. This training may be accomplished by on-the-job training, training by equipment manufacturers, or by reading, understanding, and signing an approved technical work document (TWD). (See CPR400.1.1, MN471001, *ES&H Manual*, Chapter 21, "Technical Work Documents [TWDs].")

Guidance

Managers should ensure that device-specific training for RGD operators is commensurate with the level of hazard presented by the device. For example, Chapter 3, "Radiological Training Program," provides guidance on device-specific training for industrial radiographers and radiographer assistants.

4.9 Technical Work Documents (TWDs) (ISMS Function: Control Hazards)

Requirements

Managers shall be responsible for ensuring that all RGDs, except "exempt shielded, inherently safe" RGDs have associated TWDs that have been reviewed and recommended for approval by RP personnel.

Guidance

SNL personnel should see the following:

- Chapter 1, "Radiological Work Planning and Controls," for information about radiological work permits (RWPs).
- Attachment 10-3 for recommendations regarding the content of TWDs.

4.10 Radiation Surveys (ISMS Function: Analyze Hazards)

Requirements

Managers shall be responsible for ensuring that:

- All RGDs except those classified as "exempt shielded, inherently safe" or "neutron generator operations" receive a routine periodic radiation survey performed by RP personnel in accordance with Attachment 10-2.
- Radiation surveys are performed during initial setup of RGDs that are operated in open installations.

- In addition to any routine periodic surveys specified in Attachment 10-2, all RGDs, including those classified as "exempt shielded, inherently safe," have radiation surveys performed by RP personnel after any change that could increase the radiation exposure of any person or area. See Attachment 10-4 for examples of changes that could increase radiation exposure from RGDs.

- RGDs have a radiation survey performed by RP personnel:

- As specified in technical work documents (TWDs) associated with the RGDs. (See CPR400.1.1, MN471001, *ES&H Manual*, Chapter 21, "Technical Work Documents [TWDs]").

- When dosimeter readings show an unexpected increase in exposures over the previous monitoring period.

RGD custodians shall:

- Determine when radiation surveys are required.

- Schedule radiation surveys by contacting RP personnel.

  Note: RGD custodians are not responsible for scheduling surveys that are necessitated by unexpected increases in dosimeter readings. As specified above, this is the manager's responsibility. RP personnel can assist in determining responsibilities for radiation surveys.

- If an RGD is not surveyed under worst-case conditions, ensure that an appropriate operating restriction is reflected in the TWD associated with the RGD. See Attachment 10-5 for examples of circumstances that would require restrictions to be noted in TWDs.

  Note: Worst-case conditions under which RGDs would ideally be surveyed include combinations of x-ray tube potential, current, beam orientation, and conditions of scatter radiation that produce the maximum exposure at the external surface of the RGD.

4.11 Inventories

Requirements:

RGD Custodians shall perform an inventory of all RGDs in their custody at intervals not to exceed 12 months. This inventory shall be documented on an RGD Inventory sheet and will include a review of the following information:

- Primary and Alternate Custodians and their training
- RGD Location
- RGD Status
- RGD Classification Type and Subtype

The Custodian shall identify any discrepancies found in the RGD database on the RGD Inventory Sheet and ensure the Device Registrar has received the changes.

Note: The RGD location is not required to be updated for Portable RGDs provided the RGD move is less than 60 days AND an RGD survey is performed in the new location prior to operation.

Guidance:

Review other data (i.e., Name; Serial #; Model #) associated with an RGD annually to verify database accuracy.

4.12 Dosimetry (ISMS Function: Analyze Hazards)

Requirements

Whole-body thermoluminescent dosimeter (TLD) requirements are specified in Attachment 10-2.

Guidance

Managers should consider extremity dosimeters for operators of RGDs who perform beam alignment or other activities that could expose their hands to the direct beam. Managers should consider multiple whole-body dosimetry for activities involving uneven exposure of the trunk and head.

*4.13 Disposal of RGDs (ISMS Function: Analyze Hazards)

Requirements

RGD custodians shall do the following before disposing of RGDs:

- Disable RGDs in such a way that they cannot be used without servicing by a qualified technician.
- Remove the SNL label from the RGD.

  Note: Other radiation warning signs and labels should be left on the RGD.

- Notify the Device Control Program of the disposal or reapplication of the RGD, furnishing copies of all disposition records.

Guidance

SF 2001-RGC, Radiation-Generating Device Change Form (Word file/Acrobat file) may be used to notify the Device Registrar of disposal or reapplication.

5.0 RECORDS

Requirements

SNL personnel who generate occupational radiation protection related records shall use the special units of curie, roentgen, rad, and rem for activity, exposure, dose and dose equivalent respectively. Multiples and subdivisions of these units are allowed. SI units (becquerel [Bq], gray [Gy], and sievert [Sv])may be included in parenthesis after the special units. **[10 CFR 835.4]**

Managers shall be responsible for ensuring that records are maintained:

- To document compliance with SNL's radiation protection record-keeping requirements as implemented in the *Sandia Records Retention and Disposition Schedule* by the Recorded Information Management Department (4912). **[10 CFR**

835.701(a)]

- Until final disposition is authorized by the National Archives and Records Administration (NARA) through DOE. **[10 CFR 835.701(b)]**

RGD custodians shall retain records of the operations and maintenance of all RGDs, including the following activities, as applicable:

- Results of operational checks of the safety devices.
- Findings and corrective actions resulting from either of the above.
- Descriptions of all maintenance work that affects the radiation-generating capabilities of the RGD.

Guidance

RGD custodians should:

- Ensure that record entries are descriptive enough to ensure tracking of all aspects of the operation, geometry, material being irradiated, and quality of the radiation emitted by RGDs in order to reconstruct doses, if necessary.
- Retain copies of the results of radiation surveys.

6.0 REFERENCES

6.1 Requirements Source Documents

10 CFR 835, *Occupational Radiation Protection*.

21 CFR 1020.40, *Cabinet X-Ray Systems.*

6.2 Related Documents

ANSI N43.2-1977 (R1989), *Radiation Safety for X-Ray Diffraction and Fluorescence*

Analysis Equipment.

ANSI N43.3-1993, *For General Radiation Safety - Installations Using Non-Medical X-Ray and Sealed Gamma-Ray Sources, Energies Up To MeV*.

DOE G 441.1-1, *Management and Administration of Radiation Protection Programs Guide*.

DOE G 441.1-5, *Radiation-Generating Devices Guide for Use With Title 10, Code of Federal Regulations, Part 835, Occupational Radiation Protection*.

DOE-STD-1098-99, Chg 1, *Radiological Control*.

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Corporate Process Requirement No: CPR400.1.1.32
Sponsor: Dori Ellis, 4000, Acting

Revision Date: May 25, 2004

Radiological Protection Procedures Manual

*CHAPTER 11 - RADIOLOGICAL INCIDENTS

Subject Matter Expert: Lance Bollinger
MN471016, Issue F
Effective Date: May 25, 2004; Replaces Document Dated: August 30, 2000
Review Date: April 23, 2007
Administrative Changes: June 29, 2005 and May 18, 2007

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* Indicates a substantive change

1.0 PURPOSE

This chapter describes the requirements and guidance for Members of the Workforce (MOW) who perform initial incident response, recovery, and post-incident actions to control the spread of contamination and to minimize radiation exposures during a

radiological incident.

For purposes of this document, Members of the Workforce are:

- Sandia employees.
- Sandia contractors as specified in CPR400.1.1/MN471001, *ES&H Manual*, Section 1B, "What Is the Scope."

2.0 SCOPE

This chapter applies to all MOW and members of the public.

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*3.0 RESPONSIBILITIES

3.1 Managers

Managers with personnel and/or operations involved in a radiological incident are responsible for:

- Coordinating with facility manager/designees to ensure that necessary occurrence notifications are accomplished (see CPR400.1.1/MN471001, *ES&H Manual*, Chapter 18, "Reporting, Investigating, and Correcting ES&H Events").
- Ensuring that nuclear accident dosimeters are available for operations involving critical mass quantities of fissile material and ensuring that nuclear accident dosimeter screening procedures are in place (see Chapter 4, "Radiation Dosimetry").
- Ensuring that radiological area boundaries are established and that entry control requirements are implemented as necessary and as soon as practical.
- Completing an SF 2050-P, "Report of Occupational Injury/Illness" (Word file/ Acrobat file), in conjunction with the health services organization, for any bodily

contamination or exposure leading to an incident response for any of their reporting personnel.

- Ensuring that radiation exposure limits to personnel (internal and external) are established and documented prior to authorizing return to radiological work, if required (see Chapter 4, "Radiation Dosimetry").

- Ensuring that appropriate approvals are obtained prior to restarting operations and allowing involved personnel to return to work in radiological areas (see Section 4.5 and CPR400.1.1/MN471001, *ES&H Manual*, Section 13C, "Authorization Basis Process").

- Participating in post-incident investigations and root cause analyses and developing corrective actions, as required (see CPR400.1.1, MN471001, *ES&H Manual*, Section 22B, "Root Cause Analysis [RCA]").

- Identifying potential issues of nuclear safety noncompliance related to the incident (see CPR400.1.1/MN471001, *ES&H Manual*, Section 18G, "Identifying, Reporting, and Correcting Nuclear Safety Nonconformances").

3.2 Facility Manager/Designees

Facility managers/designees are responsible for ensuring that appropriate notifications are made in the event of radiological incidents, per CPR400.1.1/MN471001, *ES&H Manual,* Section 18C, "Occurrence Reporting."

*3.3 Health Services Organizations

The Health, Benefits and Employee Services Center (3300) at Sandia/NM is responsible for:

- Medical treatment.

- Personnel decontamination when there is also an injury or when limited non-intrusive decontamination efforts, performed by the individual or Radiological Protection (RP) personnel, have not been successful.

- Medical documentation of an injury or personal contamination.

- Counseling related to potential injuries and radiation exposures (e.g., counseling for pregnant workers that may be exposed to radiation during an incident).

Note: SNL/CA, SNL/TTR and other SNL sites have medical services provided in accordance with local capabilities or agreements.

3.4 Emergency/Incident Response Personnel

Emergency/incident response personnel from the Emergency Management Department (10336) are responsible for emergency management functions, including the Incident Command System (ICS) at SNL/NM, as described in PN471011, *SNL/NM Emergency Plan*. SNL/CA, SNL /TTR and other SNL sites maintain or are provided equivalent emergency systems.

*3.5 Radiation Protection

RP personnel are responsible for:

- Coordinating with the incident commander (IC), management, or other responsible persons, when necessary, to identify, quantify, and mitigate radiological hazards. Radiation protection activities during incident response may include, but are not limited to, assessment of radiation or contamination levels, air sampling, bioassay sampling based on recommendations of the internal dosimetry function, and assisting with the screening of nuclear accident dosimeters.
- Providing technical advice and oversight of radiological incident actions.
- Assisting with the establishment and posting of radiological area boundaries and implementing the radiological controls.
- Performing limited, non-abrasive personnel decontamination (i.e., when an injury has occurred and when an injury has not occurred).
- Notifying the appropriate health services organization, when limited, non-abrasive personnel decontamination has been performed.
- Assisting health services personnel with:
    - Evaluation and decontamination of individuals who are not successfully

decontaminated using limited non-abrasive techniques.

- Completion of the associated documentation (per the MNMED-021, *Radiological Incident Medical Procedures Manual [RIMPM])*.
- Investigations and root cause analyses, as applicable.
- Informing managers and MOW of their responsibility to report contamination incidents to the appropriate health services organization to initiate the injury/ illness reporting process.
- Assisting managers in completing SF 2050-P, "Report of Occupational Injury/ Illness" (Word file/Acrobat file).
- Participating in investigations and root cause analyses, as applicable.

Note: Qualified radiological workers may provide additional support under the supervision of qualified radiological control technicians (RCTs).

3.6 IH Compliance Services & RP Laboratories Department (10321)

The IH Compliance Services and RP Laboratories Department (10321) is responsible for providing internal and external dosimetry services and consultation, analyses of radiological samples, and instrument repair and calibration services as necessary to support incident/emergency response.

3.7 Members of the Workforce and Members of the Public

Members of the Workforce are responsible for reporting abnormal radiological conditions to RP personnel and the responsible department manager. Members of the public (visitors) should follow the directions from MOW during incidents/emergencies.

Note: See CPR400.1.1/MN471001, *ES&H Manual*, Section 1D, "Who Does What," for additional information regarding members of the public (visitors) at Sandia.

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*4.0 PROCEDURE

4.1 General Information

Radiological incidents are categorized as operational emergencies or as non-emergencies.

Requirements

Members of the Workforce who report an incident shall make the appropriate notification as indicated in Table 1.

Table 1. Radiological Incident Notifications

Incident*	Radiological Criteria	Actions
Emergency	An unplanned radiological incident that potentially poses a significant hazard to the health and safety of workers, the public, or detrimental effects to the environment.	Notify incident commander (IC) using the emergency hotline.
Non-emergencies:		
Reportable occurrence	Is classified below the criteria of an operational emergency but qualifies as one of the major criteria groups that require occurrence reporting (see CPR400.1.1/MN471001, *ES&H Manual*, Section 18C, "Occurrence Reporting").	Notify the IC using the non-emergency hotline.
Non-occurence trackable event (NOTE)	An event that **does not** meet DOE criteria for occurrence reporting, but has a potential to cause a serious adverse ES&H impact and is a potential precursor event.	Notify IC using the non-emergency hotline.

* If you are unsure of incident categorization, or if additional assistance is required, notify the IC.

Note: See CPR400.1.1/MN471001, *ES&H Manual*, Chapter 15, "Emergency Preparedness and Management" for additional guidance on emergency response.

Guidance

MOW should respond quickly to radiological incidents/emergencies in order to protect personnel and property, mitigate the incident/emergency, and maintain exposures to as low as reasonably achievable (ALARA).

During the time-critical response phase, managers may waive normal operational requirements (such as postings, RWPs, etc.). However, as soon as the time-critical elements have been accomplished and recovery operations have begun, normal operational requirements must again be followed.

*4.2 Initial Actions

Requirements

4.2.1 Common Actions

Members of the Workforce involved in a radiological incident shall take the appropriate general, initial actions documented below to the extent deemed safe and to the extent that they are comfortable with doing so.

- Stop work and contain the radiological hazard, if possible, employing actions such as the following, unless such actions are imminently dangerous:
    - Attempt to stop spills by righting containers.
    - Turn off equipment or stop operations that may be generating airborne hazards.
    - Secure ventilation in the case of potential airborne hazards except ventilation known to be HEPA-filtered.
    - Shut down radiation-generating equipment or shielding sources that may be

causing high radiation levels.

- Note the readings of any work area radiation area monitors (RAMs) and continuous air monitors (CAMs), if possible.

- Alert MOW in the affected area.
- Evacuate the immediate affected area and do the following:
  - Take actions to minimize the spread of contamination during evacuation, if possible.
  - Remain at the designated location to aid with the accounting for personnel and to facilitate monitoring by RP personnel.

Note: Evacuation in response to a work area RAM or CAM alarm is standard procedure pending subsequent evaluation of the hazard. Deviations from standard procedure, such as for process alarms or multi-level CAMs, must be documented in technical work documents.

- Notify the IC in accordance with Section 4.1.
- Notify RP personnel and responsible management as soon as practical.
- Secure or isolate the affected area to prevent entry.
- Perform first aid on injured personnel, as appropriate. Do not delay first aid for serious or life-threatening injuries due to presence of contamination. Immediately notify health services and RP personnel of injuries to MOW with known or suspected contamination.
- Report to incident RP personnel (e.g., RCT for local response or IC) and provide as much information as possible regarding the incident/emergency.

4.2.2 Fire

Members of the Workforce shall perform the following in the event of a fire, in addition to the initial actions listed in Section 4.2.1:

- Take actions as required with any fire (e.g., pull fire alarm, warn others, and call

911).

- Fight small fires only if deemed safe to do so.
- Report the fire to incident RP personnel (e.g., RCT for local response of IC) and provide the description and quantity of the radioactive material present, if known.

4.2.3 Criticality Alarm

Members of the Workforce shall perform the following in the event of a criticality alarm in addition to the initial actions listed in Section 4.2.1:

- Evacuate the area immediately; do **not** stop to remove protective clothing or perform exit monitoring.
- Call 911 or pull a fire alarm.
- Proceed to the assigned assembly point.

4.2.4 Leaking or Damaged Radioactive Source

Members of the Workforce shall perform the following in the event of a leaking or damaged radioactive source in addition to the initial actions listed in Section 4.2.1:

- Control access to the immediate area or secure the source if necessary (e.g., bagging), to minimize the spread of contamination.

  Note: Minimize direct handling of the source.

- Notify RP personnel to remove the source from service.
- Notify the Source Registrar of the source status (see Chapter 9, "Control of Radioactive Sources").

4.2.5 Lost, Stolen, or Unaccounted-For Radioactive Material

Members of the Workforce shall perform the following in the event of lost, stolen, or unaccounted-for radioactive material, in addition to the initial actions listed in Section 4.2.1:

- Initiate a search for the material, with the assistance of RP personnel, until located or deemed unrecoverable.

- Advise Sandia management of status and potential hazards.

4.2.6 Radioactive Material in an Uncontrolled Area

Members of the Workforce shall perform the following if radioactive material is in an uncontrolled area, in addition to the initial actions listed in Section 4.2.1:

- Instruct another MOW to contact RP personnel while controlling access to the radioactive material, if possible.

- Assist RP personnel with establishing and posting a controlled or radiological area, if necessary, when the material cannot immediately be removed.

*4.2.7 Skin Contamination

Members of the Workforce shall perform the following in the event of skin contamination in addition to the initial actions listed in Section 4.2.1:

- Notify RP personnel for assistance with evaluating the extent of known or suspected contamination.

- Perform limited, non-abrasive decontamination in conjunction with RP personnel **only** for the cases where there is no injury. **[S]**

  Note: Discrete "hot particles," not directly associated with the injuries, should be removed by RP personnel as soon as possible, using tape or a similar nonabrasive method.

- Notify the appropriate health services organization of skin contamination and the efforts to remove the contamination.**[S]**

- Complete, in conjunction with the appropriate health services organization, form SF-2050-P.

4.2.8 Response to Damaged, Unresponsive, or Abnormally Reading Self-Reading Personnel Dosimeter

Members of the Workforce shall perform the following actions if wearing a self-reading personnel dosimeter that provides an unexpected result (i.e., abnormally high, off-scale, no reading):

- Stop work.
- Place work in a safe configuration.
- Inform co-workers of the problem and that you are leaving the area. Recommend that co-workers check their personal self-reading dosimeters.
- Leave the area.
- Notify the Radiation Protection Project Leader on the appropriate Division ES&H Team and responsible manager as soon as practicable.

Note: RP personnel may choose to perform a dose reconstruction and/or initiate a work restriction.

4.3 Incident Response

Requirements

Note: The incident commander, if responding, executes command and control of the incident in accordance with existing emergency plans. Emergency exposures authorized by 10 CFR 835.1302 may only be approved by the senior management representative in accordance with existing emergency plans.

Managers shall ensure that:

- All personnel are accounted for, if applicable.
- Nuclear accident dosimeters are screened (see Chapter 4, "Radiation Dosimetry") with assistance from RP personnel, to identify potentially exposed personnel during a criticality accident or incident.
- Exposed personnel are referred to their health services facility for evaluation.

- Personnel potentially exposed to significant levels of radiation, skin contamination, or airborne concentrations of radioactive material are reported to health services and RP personnel for assessment of potential radiation doses and consultation (see Chapter 4, "Radiation Dosimetry").

- Radiological area boundaries are established and entry control requirements are implemented as necessary and as soon as practical (this should be accomplished with coordination from the IC, if responding, and with the assistance of RP personnel).

- Required occurrence notifications are coordinated with the facility manager/ designee (see CPR400.1.1/MN471001, *ES&H Manual*, Section 18C, "Occurrence Reporting").

4.4 Incident Recovery

Requirements

Managers shall address incident recovery activities as routine operations.

Note: Recovery activities may include, but are not limited to, the use of work planning and controls, special planned exposures, posting and labeling of radiological areas, and entry control requirements.

4.5 Return to Operations

Requirements

Managers shall take the following actions for incidents that involve personnel exposures in excess of the limits specified in Chapter 1, Attachment 1-1, "10 CFR 835 Exposure Limits," prior to resuming operations or allowing personnel to return to work:

- Authorize personnel who received authorized emergency exposures to return to work in radiological areas during the current calendar year, provided that:
    - Prior approval is obtained from Sandia management and the DOE field organization NNSA/SSO **[10 CFR 835.1301(a)(1)]**
    - The individual receives counseling from radiological protection and health

services personnel regarding the potential consequences of receiving additional occupational doses during the year. **[10 CFR 835.1301(a)(2)]**

- The affected individual agrees to return to radiological work. **[10 CFR 835.1301(a)(3)]**

- Record all radiation doses, including authorized emergency and special planned exposures in excess of specified limits in each affected individual's occupational dose record. **[10 CFR 835.1301(b)]**

- Notify the DOE field organization NNSA/SSO through Sandia management when the conditions resulting in an individual receiving an emergency dose in excess of the specified limits have been eliminated. **[10 CFR 835.1301(c)]**

- Obtain DOE approval for resuming those operations that resulted in an authorized emergency dose above specified dose limits. **[10 CFR 835.1301(d)]**

  Note: Managers may need to take additional actions, such as readiness reviews, prior to resuming operations (see CPR400.1.1/MN471001, *ES&H Manual*, Chapter 13, "Hazards Identification/Analysis and Risk Management").

4.6 Post-Incident

Requirements

Managers shall:

- Ensure all necessary occurrence reporting requirements are completed (see CPR400.1.1/MN471001, *ES&H Manual*, Section 18C, "Occurrence Reporting").

- Identify any potential issues of nuclear safety noncompliance (see CPR400.1.1/MN471001, *ES&H Manual*, Section 18G, "Identifying, Reporting, and Correcting Nuclear Safety Nonconformances").

- Participate in any associated investigations or root cause analyses (see CPR400.1.1/MN471001, ES&H Manual, Section 22B, "Root Cause Analysis [RCA]").

5.0 RECORDS

Requirements

Members of the Workforce who generate occupational radiation protection related records shall use the special units of curie, roentgen, rad, and rem for activity, exposure, dose and dose equivalent respectively. Multiples and subdivisions of these units are allowed. SI units (becquerel [Bq], gray [Gy], and sievert [Sv])may be included in parenthesis after the special units. **[10 CFR 835.4]**

Managers shall be responsible for ensuring that records are maintained:

- To document compliance with Sandia's radiation protection record-keeping requirements as implemented in the *Sandia Records Retention and Disposition Schedule* by the Recorded Information Management Department (4912). **[10 CFR 835.701(a)]**
- Until final disposition is authorized by the National Archives and Records Administration (NARA) through DOE. **[10 CFR 835.701(b)]**

6.0 REFERENCES

6.1 Requirements Source Documents

10 CFR 835, *Occupational Radiation Protection.*

DOE O 151.1C, *Comprehensive Emergency Management System.*

DOE M 231.1-2, *Occurrence Reporting and Processing of Operations Information*.

6.2 Implementing Documents

SNL, CPR400.1.1/MN471001, *ES&H Manual*.

SNL, CPR400.1.1.11/GN470072, *Nuclear Criticality Safety*.

SNL, PN471011, *SNL/NM Emergency Plan,* Issue G, March 2006.

SNL/CA, *Emergency Plan,* Sandia National Laboratories, California, November 2005.

SNL/TTR, *Emergency Plan*, Sandia National Laboratories Tonopah Test Range, November 2005.

6.3 Related Documents

DOE G 441.1-1, *Management and Administration of Radiation Protection Programs Guide*.

DOE-STD-1098-99, *Radiological Control*.

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Corporate Process Requirement No: CPR400.1.1.32
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Revision Date: November 27, 2006

Radiological Protection Procedures Manual

CHAPTER 12 – RADIATION-MONITORING INSTRUMENTATION

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MN471016, Issue E
Effective Date: November 27, 2006; Replaces Document Dated: February 22, 2005
Review Date: October 19, 2006

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*Indicates a substantive change

1.0 PURPOSE

Implementation of this chapter ensures compliance with 10CFR835 requirements for radiation monitoring.

This chapter describes the processes that Members of the Workforce shall employ to select, use, maintain, and calibrate radiation-monitoring instruments.

2.0 SCOPE

This chapter applies to all Members of the Workforce who perform radiation **monitoring** using radiation-monitoring instruments. Examples of these instruments include those:

- Used for surveys of record:
  - RP owned instruments.
- Used for personal safety:
  - Radiation Area Monitors (RAMs).
  - Continuous Air Monitors (CAMs).
  - Whole Body monitors and friskers.
  - Electronic Pocket Dosimeters (EPDs).
  - Go/No-Go safety instruments.

This chapter does **not** apply to Members of the Workforce who **measure** or detect radiation using radiation-measuring instruments. Examples of these instruments include:

- Reactor instruments.
- Experimental instruments.
- Portal monitors.
- Waste monitors.
- Security radiological and nuclear instruments.
- MC+A instruments.
- TLDs and NADs.
- Laboratory diagnostic instruments.

Note: This chapter **does not** contain a complete set of instructions for RP Personnel

who have been qualified by the Radiation Protection Program to perform surveys of record or radiological work coverage to document compliance with DOE requirements. For these instructions, see Chapter 8, "Monitoring Areas and Material."

3.0 RESPONSIBILITIES

3.1 Managers

Managers of organizations that use radiation-monitoring instruments are responsible for ensuring that:

- The technical basis for selection and use of radiation-monitoring instruments is documented (see Section 4.2). **[R – 10 CFR 835.704(e)]**
- Members of the Workforce under their supervision who use radiation-monitoring instruments:
  - Are trained and qualified to operate the instruments (see Section 4.1). **[R – 10 CFR 835.901]**
  - Use only calibrated instruments. **[R – 10 CFR 401(b)(1)]**
  - Follow the procedures outlined in this chapter when selecting and purchasing radiation-monitoring instruments. **[R - 10 CFR 835.3 and 835.104] [S - CPR001.3.3 Formality of Operations Manual, Chapter 2, "Operating Practices," which includes the Sandia implementation of DOE-STD-1041-93, *Guide to Good Practices for Shift Routines and Operating Practices*]**
  - Have a TWD that includes the limitations on the use of the instrument by line personnel.
- TWDs are developed and revised as necessary to address:
  - Performance requirements for radiation-monitoring instruments.

- Changes in equipment, techniques, and procedures used for radiation monitoring in the workplace.

3.2 Instrumentation and Dosimetry Group (4121-1)

The Instrumentation and Dosimetry Group is responsible for:

- Developing and managing the Sandia Radiation Protection Instrumentation (RPI) Program.
- Providing calibration and maintenance services to organizations that use radiation-monitoring instruments.
- Providing assistance to organizations with the selection and procurement of radiation-monitoring instruments.

3.3 RP Personnel

3.3.1 RP personnel

RP personnel are responsible for assisting line organizations to:

- Assess the impact of and develop corrective actions in response to out-of-tolerance reports.
- Perform surveys of record, which are required to document compliance with DOE requirements.

3.3.2 RP Line Support Project Leaders

The RP Line Support Project Leaders are responsible for reviewing the Radiation Protection Instrument Requirements Evaluation Form and concurring with the intended use of the instrument.

3.4 Members of the Workforce Who Have Been Issued Radiation-Monitoring Instruments

Members of the Workforce who have been issued a radiation-monitoring instrument are

responsible for:

- Returning each instrument for recalibration and maintenance on or before the expiration date on the instrument's calibration sticker or label (see Section 4.6).
- Establishing operational performance check reference readings for instruments after they have been recalibrated (see Section 4.6).
- Providing and maintaining operational performance check log books or sheets used to record readings and results.
- Storing instruments in environments that comply with the manufacturer's specifications.

  Note: Most generally, storage should be an indoor office or laboratory environment to avoid extremes of temperature, pressure, humidity, shock, or vibration and accidental exposure to hazardous materials or radiation.
- Addressing out-of-tolerance reports for instruments assigned to them.
- Having radiation-monitoring instruments calibrated and maintained by the **RPI** Program or a contractor approved by the **RPI** Program.
- Contacting the **RPI** Program when an instrument is no longer needed (see Section 4.8).

3.5 Members of the Workforce Who Use Radiation-Monitoring Instruments

Members of the Workforce who use radiation-monitoring instruments are responsible for:

- Planning work so that the appropriate instruments will be available when needed.
- Knowing the limitations of the instruments they use (see Section 4.4) as well as how to:
  - Operate the instruments in the specified field conditions.

- Operate the instruments' controls.
- Read meter scales and interpret readings properly.
- Select appropriate scale multipliers.
- Select and apply appropriate instrument response times.

- Following all applicable procedures for using radiation-monitoring instruments.
- **Only,** using instruments with current, valid calibration stickers or labels.
- Using instruments within the calibration and manufacturer's specifications.
- Using instruments that are appropriate for:
  - The type, levels, and energies of radiation expected to be encountered. **[R - 10 CFR 835.401(b)(2)]**
  - Existing environmental conditions. **[R - 10 CFR 835.401(b)(3)]**
- Conducting operational performance tests when required and according to approved procedures (see Section 4.5).
- **Not** attempting to repair or modify any radiation-monitoring instrument.

  Note: Changing batteries or substituting equivalent cables on a portable radiation-monitoring instrument **is not** considered maintenance.
- Protecting instruments, used outside of normal office or laboratory conditions, from damage.
- Properly caring for instruments that they use so that the instruments:
  - Do not become contaminated or activated.
  - Are not exposed to toxic or hazardous chemicals or to high-strength, non-ionizing radiation fields.
- Following all applicable procedures and requirements when obtaining release of

instruments from areas where contamination or activation is possible (see Section 4.6).

- Ensuring that real-time air monitors have alarm capability and sufficient sensitivity to alert potentially exposed individuals that immediate action is necessary (i.e., to minimize or terminate inhalation exposures.) **[R - 10 CFR 835.403(b)]**

- Ensuring that instruments used for monitoring and contamination control are:

  - Appropriate for the types, levels, and energies of the radiation expected to be encountered. **[R - 10 CFR 835.401(b)(2)]**

  - Appropriate for existing environmental conditions. **[R - 10 CFR 835.401(b)(3)]**

4.0 PROCEDURE

4.1 Work Planning

Requirements

Members of the Workforce who are not from the Radiation Protection Program and who would like to use radiation-monitoring instruments shall:

Step	Action
1	Submit a completed SF 2001-IRE, Radiation Protection Instrument Requirements Evaluation Form (Word file /Acrobat file), to the **RPI** Program project leader to document the radiation-monitoring requirements (as determined from the evaluation discussed in the guidance below).
2	Obtain approval of purchase requisitions from the **RPI** Program project leader.

3	Upon receipt of newly procured instruments, submit them to the RPI Program so that they can be tested and calibrated prior to use.

Guidance

Members of the Workforce who are planning activities that require the use of radiation-monitoring instruments and who are not from the Radiation Protection Program should initiate the following process as soon as possible to ensure the availability of instruments.

Step	Action
1	Contact the RPI Program for a list of readily available standard instruments and the applications for which each is suited.
2	Determine, as much as possible, about the type of monitoring required and the environment in which the measurements will be taken, to include: • The reason for taking the measurements and the regulatory requirements that drive them. • The types and energies of radiation (including specific radionuclides) to be measured. • Required measurement accuracy and precision. • Measurement units required. • Expected range (maximum and minimum readings) of measurements to be taken. • Special calibration requirements required to prepare the instrument for use, if applicable. • Environmental conditions to which the instruments will be exposed (e.g., temperature, humidity, pressure, interfering ionizing or non-ionizing radiation fields, or magnetic fields). • Special design requirements (i.e., safety-class instrumentation required for a nuclear facility).

3	Determine the following: • How many instruments are required? • What special features are required (e.g., alarms, audio output)? • What interfaces are required between the instruments and external devices? • Are off-the-shelf instruments available that meet the requirements?

4.2 Radiation-Monitoring Instrument Selection and Procurement

Requirements

Members of the Workforce who select and procure radiation-monitoring instruments shall:

- Request radiation-monitoring instruments using the SF 2001-IRE, “Radiation Protection Instrumentation Requirements Evaluation Form” (Word file/Acrobat file).

  Note: All **REQUIRED INFORMATION** fields must be completed in order to process the request.

- Verify that the RP Line Support Project Leader concurs with the request for radiation-monitoring instrumentation.

4.3 Including Radiation-Monitoring Instruments in Technical Work Documents (TWDs)

Requirements [R – 10 CFR 835.704(e)]

Members of the Workforce shall develop a TWD for radiation monitoring instruments that covers, at a minimum:

- Proper use.
- Out of scope conditions.
- Concerns regarding the use of instrument in extreme environmental monitoring conditions to ensure valid readings.
- How operational performance tests are conducted and the acceptable range of response.

  Note: This can be accomplished by developing a specific instrument TWD or including the requirements above in another TWD.

Guidance

Members of the Workforce should consider the following when they compose TWDs:

- Type of radiation or contamination to be monitored.
- Radiation energies or radionuclides to be detected.
- Instrument indication range (minimum and maximum readings).
- Acceptable precision and accuracy.
- Measurement units required.
- Methods to limit interfering environmental conditions such as radiation background or temperature.
- Whether an instrument is part of a control system and, if so, how the instrument is used within the control system.

Note 1: When addressing these items in a TWD, it may be useful to reference the manufacturer's user manual.

Note 2: The RPI Program can provide assistance with developing TWDs.

4.4 Ensuring Valid Readings from Radiation-Monitoring

Instruments.

Requirements

Members of the Workforce who use radiation-monitoring instruments shall:

- Perform operational performance tests as required (see Section 4.5). **[R - 10 CFR 835.401(b)(4)]**
- Take special care of instruments used in extreme environments such as high or low temperatures. **[R - ANSI N323-1978 (3.5)]; [R - 10 CFR 830.122(e)(3)]**
- **Not** attempt to modify or repair instruments. **[R - ANSI N323-1978 (3.4)]; [R - 10 CFR 830.122(f)(4) & (5)]**

Guidance

Members of the Workforce should:

- Consult the RPI Program if instruments will be used where environmental conditions are other than those specified by the instrument manufacturer.
- Choose instrument scale multipliers to provide mid-scale readings, if possible.
- Handle and transport instruments in a manner appropriate for delicate laboratory equipment.
- Acquire background readings in the area where the instrument will be used but away from items to be measured and away from areas with elevated radiation fields that can bias survey readings.
- Factor in the following:
    - Possible over-range conditions.
    - Instrument response times.
    - Interfering environmental conditions (e.g., ionizing or non-ionizing radiation, magnetic fields, temperature, pressure, or humidity) that differ from

calibration conditions.

4.5 Radiation-Monitoring Instrument Operational Performance Tests

Requirements

Members of the Workforce who use radiation-monitoring instruments shall:

- Ensure that instruments used for monitoring are routinely tested for operability. **[R - 10 CFR 835.401(b)(4)]**

  Note: An operational performance test assists to ensure that the radiation-monitoring instrument is operating correctly and that any facility-specific devices that the instrument controls are performing correctly. Attachment 12-1 presents a generic process for performing and documenting an operational performance test.

- Conduct operational performance tests according to the generic process in Attachment 12-1 or a similar procedure that affords the same level of test accuracy.

  Note: The RPI Program can provide assistance in selecting appropriate check sources and developing operational performance tests.

Members of the Workforce who are issued a radiation-monitoring instrument shall obtain and record the following information prior to first use and after repair or recalibration of an instrument: **[R ANSI N323-1978(4.8)]**

- Reference readings used for operational performance tests.
- Background radiation readings in areas where the instrument is normally used.

Note: For instruments that have built-in check sources or electronic check circuits, the reference readings of the instruments to the check sources/circuits are supplied with the instruments when they are returned from recalibration.

Guidance

Members of the Workforce should conduct operational performance tests:

- Prior to each radiation measuring session (i.e., a work shift).
- Several times per day during continuous use.
- Periodically during intermittent use.
- Daily on continuous air monitors (CAMs).
- Monthly on criticality monitors.
- Quarterly on other installed monitors.

Members of the Workforce who perform operational performance tests should include a procedure or a reference to Attachment 12-1 for performing these tests in the applicable TWD. Procedures should include steps for obtaining the operational performance test reference readings (see Section 4.3).

Members of the Workforce who discover that an instrument has failed an operational performance test or that cannot be used, should remove it from service by completing the following:

- Attach a completed, Out-of-Service Tag (Attachment 12-2) to the instrument.
- Segregate the out-of-service instrument from functional instruments to prevent inadvertent use.
- Deliver the instrument to the RPI Program for repair and recalibration or arrange for onsite service as soon as possible.

Note: The preferred method to deliver the instrument to RPI is to use the Sandia shipment and movement process.

Note: If a replacement instrument will be used, be sure to choose an instrument that is equivalent and meets all operational specifications and requirements to that being replaced.

4.6 Radiation-Monitoring Instrument Calibration and

Maintenance

Requirements

Managers shall ensure that:

- Radiation-monitoring instruments used for monitoring and contamination control be periodically maintained and calibrated on a frequency established by the RPI Program. **[10 CFR 835.401(b)(1)]**

  Note 1: To assist instrument users with meeting recalibration requirements, the RPI Program maintains an instrument database and issues Calibration Recall Notices (Attachment 12-4) when radiation-monitoring instruments are due for recalibration.

  Note 2: Radiation-monitoring instruments that are calibrated have an affixed calibration label (Attachment 12-3) or equivalent documentation approved by the RPI Program to indicate the date of calibration and the date of calibration expiration. This label is affixed only by the RPI Program. **[R - ANSI N323-1978 (4.6.1)]**

Members of the Workforce who use radiation-monitoring instruments for monitoring activities shall:

- Follow all applicable procedures and requirements for obtaining release of instruments used in areas where contamination or activation is possible, including Chapter 6, "Control of Radioactive Material," and CPR400.1.1/MN471001, *ES&H Manual,* Section 19D, "Radioactive Material Management Areas (RMMAs)."

- **Not** use the instruments under the following conditions:

  - Without a valid calibration label. **[R 10CFR 830.122(e)(2), ANSI N323-1978 (4.6.1)]**

  - When the calibration is expired. **[R 10 CFR 835.401(b)(1)]**

Guidance

Members of the Workforce should complete the following when a radiation-monitoring instrument is due for calibration:

- Locate the indicated instrument.
- Attach the recall notice (if one was sent) to show that the instrument is out of service for calibration.
- Segregate the instrument from those calibrated for use to prevent inadvertent use.
- Return the instrument to the **RPI** Program using the Sandia shipping and equipment movement processes.

4.7 Radiation-Monitoring Instrument Out-of-Tolerance Reports

Requirements

Note: The RPI Program sends out-of-tolerance reports to users when radiation-monitoring instruments have been submitted for service because the instrument readings are out of tolerance.

Members of the Workforce who receive an out-of-tolerance report shall follow and complete the instructions included with the report, within 6 weeks of receipt of the report. **[S - CPR100.3.1]**

4.8 Radiation-Monitoring Instruments That Are No Longer Needed

4.8.1 Deactivation

Requirements

Members of the Workforce who own radiation-monitoring instruments that they no longer need shall:

- Send the instrument to the RPI Program and request a loop-closure calibration. **[S - CPR100.3.1]**

- Attach an out-of-service tag (Attachment 12-2), when the instrument is returned by the **RPI** Program. **[R - 10 CFR 830.122(e)(2)]**

  Note: Out-of-service tags can be obtained via JIT.

- Segregate the out-of-service instrument from other instruments to prevent inadvertent use. **[R - 10 CFR 830.122(e)(2)]**

Note: Prior to placing an out-of-service instrument back into service, it must be sent to the RPI Program for recalibration. **[R - 10 CFR 835.401(b)(1)]**

Guidance

Members of the Workforce who require a loop-closure calibration for radiation-monitoring instruments should have this completed prior to the calibration expiration and as soon as possible after the decision to place it out of service.

Members of the Workforce who own radiation-monitoring instruments that they no longer use should consider donating them to the RPI Program for reuse.

4.8.2 Reapplication of Radiation-Monitoring Instruments

Requirements

Members of the Workforce who have radiation-monitoring instruments for reapplication excess property/material pick up shall ensure that a loop-closure calibration is completed (see Section 4.8.1) prior to transferring ownership to reapplication.

Note 1: See CPR 500.2.3, Property/Assets User's Manual, "Identifying and Handling Excess Property," for information about sending items to reapplication.

Note 2: When radiation-monitoring instruments are borrowed from the **RPI** Program and are no longer needed, they shall be returned to the department from which they were originally borrowed along with a note indicating that they are no longer needed.

Guidance

Members of the Workforce who have a radiation-monitoring instrument that they no longer need should contact the RPI Program for assistance.

5.0 RADIATION-MONITORING INSTRUMENT RECORDS

Requirements

Managers shall:

- Maintain records that are generated when non-expected conditions are encountered (e.g., RAM, CAM or Personal Contamination Monitor alarms):
    - To document compliance with Sandia's radiation protection record-keeping requirements as implemented by the *Sandia Records Retention and Disposition Schedule.* **[10 CFR 835.701(a)]**
    - Until final disposition is authorized by the National Archives and Records Administration (NARA) through DOE. **[10 CFR 835.701(b)]**
- Ensure that records of radiation-monitoring instrument calibration and maintenance, not completed by the **RPI** Program, are forwarded to the RPI Program for retention. **[R - ANSI N323-1978(4.7)]**

Members of the Workforce who generate occupational radiation protection related records shall use the special units of curie, roentgen, rad, and rem for activity, exposure, dose and dose equivalent respectively. Multiples and subdivisions of these units are allowed. SI units (becquerel [Bq], gray [Gy], and sievert [Sv]) may be included in parenthesis after the special units. **[10 CFR 835.4]**

Members of the Workforce who use radiation-monitoring instruments shall maintain the following:

- Records of operational performance tests until the instrument is returned from repair or recalibration. **[R – 10 CFR 835.703(d)]**

  Note: Operational performance test records may assist with determining the

impact of an out-of-tolerance report. In these cases the operational performance test records are retained as part of the out-of-tolerance report.

- Completed out-of-tolerance reports. **[R - 10 CFR 830.122(d)(2)]]**

- Records of supplementary tests and checks completed for suspected overexposures, questionable indications, and unusual occurrences. **[R - 10 CFR 830.122(d)(2)]**

Note: The RPI Program maintains record copies of the SF 2001-IRE, Radiation Protection Instrumentation Requirements Evaluation Form (Word file/Acrobat file).

6.0 REFERENCES

6.1 Requirements Source Documents

10 CFR 835, *Occupational Radiation Protection.*

ANSI N323A-1979, *Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments.*

SNL, CPR001.3.3, *Formality of Operations Manual,* Chapter 2, “Operating Practices.”

6.2 Implementing Documents

SNL, CPR100.3.1, *Standards and Calibration.*

SNL, CPR400.1.1, MN471001, *ES&H Manual,* Section 19D, "Radioactive Material Management Areas (RMMAs)."

SNL, CPR500.2.3, *Property/Assets User's Manual,* "Identifying and Handling Excess Property."

6.3 Related Documents

DOE G 441.1-1, *Management and Administration of Radiation Protection Programs Guide.*

DOE-STD-1098-99, *Radiological Control.*

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Corporate Process Requirement No: CPR400.1.1.32
Sponsor: Dori Ellis, 4000, Acting

Revision Date: March 31, 2006

Radiological Protection Procedures Manual

CHAPTER 13 – FEEDBACK AND IMPROVEMENT

Subject Matter Expert: Ted Simmons, Shay Cawthon
MN471016, Issue G
Effective Date: March 31, 2006; Replaces Document Dated: July 18, 2005

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* Indicates a substantive change

1.0 PURPOSE

This chapter describes Sandia's processes for feedback and improvement of radiological operations, including the triennial self-assessment process and radiological protection improvement reports (RPIRs).

2.0 SCOPE

This chapter applies to all radiological activities performed by Members of the Workforce. Certain operations are outside the scope of this manual and do not require self-assessments. See the "Introduction" for exemptions to the requirements of this manual.

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*3.0 RESPONSIBILITIES

3.1 Line Managers

Managers shall ensure, for radiological operations they own, that:

- All nonconformances to the requirements of this manual resulting from radiological operations are reported through Radiological Process Improvement Reports (RPIRs) or the Occurrence Reporting and Processing System (ORPS).

- A causal analysis is performed for all findings that are specific to the owning radiological facilities and operations.

  Note: a causal analysis need not be performed in accordance with MN471001, *ES&H Manual*, Section 22B, "Root Cause Analysis (RCA)" unless being performed as a result an Occurrence Reporting & Processing System (ORPS) or Noncompliance Tracking System (NTS) report.

- Corrective actions related to findings are developed, tracked to completion, closed, and verified and validated in accordance with the *ES&H Manual,* Chapter 22D.

- Radiological activities are assessed over three years, per Section 4.3.

  Note: Nonconformances, **identified and reported** through a documented self-assessment (SA) process (e.g., the Triennial SA process), that have been recorded in a database the Nuclear Safety (PAAA)/DNFSB Liaison Department

can review for PAAA applicability, need not be reported through the RPIR process. For such nonconformances, no causal analysis is required; however, the corrective action(s) must be **reported and completed** within 30 calendar days of identification. In addition, evidence of completion of the corrective action must be sent to the Nuclear Safety (PAAA)/DNFSB Liaison Department. If the nonconformance(s) cannot be corrected within 30 days, an RPIR must be submitted and causal analysis conducted.

Note: Managers should coordinate reporting activities with the appropriate Division ES&H coordinator.

3.2 Member of the Workforce Identifying Nonconformance

Members of the workforce who identify a nonconformance with the requirements of this manual are responsible for:

- Reporting any nonconformance to the manager responsible for the work activity.
- Providing sufficient information so that the event can be reported as described in Section 4.1 of this chapter.

3.3 Radiological Protection Safety Committee (RPSC)

The RPSC is responsible for:

- Providing reports regarding the rollup of assessments of line implementation of radiation protection requirements.
- Ongoing tracking and trending of corporate radiological performance.
- Reviewing, analyzing, and summarizing the results of the self-assessment information from management, external auditors, DOE/NNSA audits, ORPs, reports, NTS reports, and RPIRs to identify corporate-wide root causes, develop corrective actions, track corrective actions to completion, and validate and verify corrective actions.
- Providing feedback and improvement advice to the Radiation Protection Program via the RPSC Feedback & Improvement (F&I) subcommittee.

3.4 ES&H, Quality, and Safeguards & Security Assessments

The ES&H, Quality, and Safeguards & Security Assessments Department manager is responsible for:

- Conducting and documenting independent assessments of the Radiation Protection Program and line implementation of the requirements in the Radiological Protection Procedures Manual (RPPM).
- Reporting the results of independent assessment activities to the Radiation Protection Safety Committee (RPSC) and to the Radiation Protection Department.

3.5 Nuclear Safety (PAAA)/DNFSB Liaison

The Nuclear Safety (PAAA)/DNFSB Liaison manager is responsible for:

- Reviewing the results of internal and external assessments to identify adverse trends and programmatic noncompliances.
- Reviewing Radiological Process Improvement Reports (RPIRs) for potential PAAA concerns and working with line organizations to submit information to the DOE NTS.

3.6 Radiation Protection Department

The Radiation Protection Department manager is responsible for:

- Conferring with the manager owning a nonconformance regarding reporting requirements, if contacted.
- Providing assistance with corrective action identification and implementation, as necessary. Assessing the content of the occupational Radiation Protection Program.
- Assessing the content of the occupational Radiation Protection Program.
- Assessing RP Line Support teams "line-like" radiation protection activities.

*4.0 PROCEDURE

*4.1 Radiological Process Improvement Report (RPIR)

Requirements

Nonconformances with this manual (excluding those identified through a documented self-assessment process) shall be reported using one of the following mechanisms:

- RPIRs, which are reported into the Integrated Reporting Management System (IRMS), or
- ORPS, if a nonconformance meets the threshold criteria for ORPS reporting (report in accordance with ES&H Manual, Section 18C, “Occurrence Reporting”).

Members of the Workforce submitting RPIRs shall:

- Ensure that RPIRs do not contain classified or UCI information.
- Complete RPIRs using IRMS. Initial RPIR reporting documentation shall contain:
    - Event title.
    - Event and reporting dates.
    - Event owner (Line manager).
    - Event location (tech area, building, and room).
    - Event description.
- Document causal analysis results and completion of all corrective actions prior to finalizing the RPIR in IRMS.

Guidance

Members of the Workforce submitting an RPIR should include in the RPIR reporting

documentation:

- Associated radiological postings.
- Applicable technical work documents (TWDs) and authorization basis documents (PHS).
- Applicable RPPM chapters.
- Individuals involved in the event.

  Note: Individual's names contained in RPIRs are only assessable to the RPIR author, the manager of the operation with the nonconformance, and the Radiation Protection Program Manager.

- Associated radiological surveys.
- Related events.
- Additional comments.

*4.2 Radiological Protection General Self-Assessments

Requirements

Members of the Workforce shall use the applicable checklists provided by the RPSC when performing self-assessments that are part of the Triennial self-assessment (see Section 4.3) of radiological operations. The checklists are posted on the RPSC Self-Assessment website.

Guidance

SNL personnel may use CPR400.1.1/MN471001, *ES&H Manual*, Attachment 22A-1, "ES&H Manual Self-Assessment Questions," when performing self-assessments that are not part of the triennial self-assessment of radiological operations.

*4.3 The Triennial Self-Assessment

10 CFR 835 requires that an internal assessment of the radiation protection program

content and implementation be conducted no less frequently than every 36 months. At Sandia, this self-assessment is referred to as the Triennial Self-Assessment.

The Triennial self-assessment process has the following elements:

- Self-assessments of the radiation protection program content conducted by the Radiation Protection Department.
- Self-assessments of Line implementation of the radiation protection program requirements conducted by division personnel utilizing checklists provided by the RPSC.
    - Assessments of Line implementation of the radiation protection program requirements are conducted on an established frequency during the Triennial period with each assessment focusing on a specific topical area (e. g., Radiological Work Permits (RWPs), Dosimetry, and Source & Device). The results are reported to the RPSC for consolidation into a report submitted at the conclusion of the Triennial period.

      Note: The single self-assessment checklist completed once every three years is replaced by multiple, focused checklists completed more frequently over a three-year period.
- Independent assessments of the radiation protection program content and implementation conducted by the ES&H, Quality, and Safeguards & Security Assessments Department.

Requirements

Managers of organizations conducting radiological operations shall ensure that:

- Radiological operations are assessed as required for compliance with the Triennial Self-Assessment Process described in this chapter.
- Results of Triennial Self-Assessments are reported into a database the Nuclear Safety (PAAA)/DNFSB Liaison department can review for PAAA applicability.
- Evidence of completion of corrective actions for identified non-conformances is sent to the Nuclear Safety (PAAA)/DNFSB Liaison department.

- Causal analyses are conducted and corrective actions are developed for identified non-conformances, if required.
- Activities for which a site visit is not appropriate are assessed without a site visit. Examples of these activities are situations in which:
    - The ALARA principal would be violated.
    - The safety of auditors, Members of the Workforce, or the public may be compromised.
    - Security may be compromised.
    - There are severe logistical problems in accomplishing the assessment (i.e., assessments conducted in the Former Soviet Union or the artic cap).
- Activities that are assessed without a site visit are documented and a justification for not visiting the activities is entered in the “Comments” section of the checklist.

The directions for conducting the Triennial Self-Assessments of Line implementation of the radiation protection program requirements are listed on the RPSC homepage under Self Assessment. The directions define:

- Process steps for conducting the assessment.
- Determination of sample size, if sampling is permitted.
- Checklists to be used (Checklists shall not be altered).
- Process steps for data submittal.
- Finding resolution and corrective action tracking processes.

Note: The next 36-month assessment period ends December 31, 2007.

Guidance

Division Radiation Protection Safety Committee (RPSC) representatives should participate in the division self-assessments. When possible, RP Department personnel should participate in the division self-assessments.

*4.4 Feedback and Improvement

Requirements

The Feedback and Improvement (F&I) Subcommittee of the RPSC shall:

- Review the results of the division Triennial self-assessments of implementation of RP requirements.
- Report the results of the review of the division self-assessments to the Radiation Protection Safety Committee (RPSC).
- Compile the results of division self-assessment reports and produce the Triennial Self-Assessment Report.
- Select and validate a sample of the Division Triennial self-assessment checklists.
- Develop and analyze metrics to monitor SNL radiological performance.
- Provide recommendations for improvement to the RPSC.
- Provide tools to Sandia line organizations to facilitate performance feedback.

Guidance

Note: The ES&H Lessons Learned Program, a component of the ES&H Feedback and Improvement (F&I) Programs and Services that are administered by the ES&H Assurance, Planning & Behavior Based Safety Department, develops and communicates lessons learned for the occupational radiation protection program.

Managers should use lessons learned information in accordance with CPR400.1.1/ MN471001, *ES&H Manual*, Section 22C, "Lessons Learned." This information is posted at the ES&H Lessons Learned website and email notification is available by subscription.

5.0 RECORDS

Requirements

SNL personnel who create occupational, radiation protection related records shall use the special units of curie, roentgen, rad, and rem for activity, exposure, dose and dose equivalent respectively. Multiples and subdivisions of these units are allowed. SI units (becquerel [Bq], gray [Gy], and sievert [Sv])may be included in parenthesis after the special units. **[10 CFR 835.4]**

Managers shall be responsible for ensuring that records are maintained:

- To document compliance with SNL's radiation protection record-keeping requirements as implemented in the *Sandia Records Retention and Disposition Schedule* by the Recorded Information Management Department (4912). **[10 CFR 835.701(a)]**

- Until final disposition is authorized by the National Archives and Records Administration (NARA) through DOE.**[10 CFR 835.701(b)]**

Division ES&H coordinators and management shall be responsible for maintaining records that document the results of their division triennial self-assessment in accordance with organization and corporate retention schedules. **[10 CFR 835.704(c)]**

Guidance

SNL personnel should consult the *Records Management Manual* for management of self-assessment records and division self-assessment plans.

Managers may fulfill their records management responsibilities by submitting records to an approved records management center.

6.0 REFERENCES

6.1 Requirements Source Documents

10 CFR 835, *Occupational Radiation Protection*.

6.2 Implementing Documents

SNL, CPR400.1.1/MN471001, *ES&H Manual*:

SNL, CPR400.1.1/MN471001, *ES&H Manual,* Chapter 22, "Feedback and Improvement Processes." SNL, *Records Management Manual*.

6.3 Related Documents

DOE G 441.1-1, *Management and Administration of Radiation Protection Programs Guide*.

DOE-STD-1098-99, *Radiological Control*.

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Corporate Process Requirement No: CPR400.1.1.32
Sponsor: Dori Ellis, 4000, Acting

Revision Date: April 16, 2004
Replaces Document Dated: January 11, 2000

Radiological Protection Procedures Manual

CHAPTER 14 – DECLARED PREGNANT WORKERS

Subject Matter Expert: Susan K. Vosburg
MN471016, Issue D
Effective Date: April 16, 2004, Replaces Document Dated: January 11, 2000
Administrative Changes: June 29, 2005

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* Indicates a substantive change

- SF 2001-WPG, Withdrawl of Pregnancy Declaration (Word File/Acrobat File)

1.0 PURPOSE

This chapter describes SNL's program for limiting ionizing radiation dose to the embryo/fetus of a worker who has voluntarily declared her pregnancy in writing.

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*2.0 SCOPE

This chapter applies to all declared pregnant workers (both employees and contractors) and provides information to those considering whether or not to declare pregnancy.

Additional information is provided in CPR400.1.1/MN471001, *ES&H Manual*, Chapter 16, "Benefits and Health Services," under the topic, "Reproductive Hazards/Expectant Parent Program."

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*3.0 RESPONSIBILITIES

3.1 Workers

A worker who is pregnant or planning a pregnancy is responsible for:

- Judging the amount of risk to her embryo/fetus from exposure to ionizing radiation.
- Deciding whether to declare her pregnancy in writing.

*3.2 Managers of Declared Pregnant Workers

Managers of SNL personnel who declare their pregnancy are responsible for:

- Signing SF 2001-PG, Declaration of Pregnancy for SNL Employees (Word file/

Acrobat file), and forwarding it to the responsible Radiation Protection Line Support Project Leader.

- Signing SF 2001-WPG, Withdrawl of Pregnancy Declaration (Word file/Acrobat file), and forwarding it to the responsible Radiation Protection Line Support Project Leader.

- Observing the requirements in Section 4.2, "Accommodating Declared Pregnant Workers."

Note: If a pregnant worker chooses not to declare her pregnancy in writing, her manager assumes no unique responsibilities for that worker (i.e., no additional responsibilities beyond those that affect all SNL personnel within their organization).

3.3 Radiation Protection (RP) Personnel

RP personnel are responsible for:

- Providing information and counseling on the subject of exposure of the embryo/fetus to ionizing radiation.

- Performing work area radiological hazard evaluations.

- Assisting workers who want to declare their pregnancy in writing.

- Providing personnel dosimetry to workers who wish to monitor the radiation exposure to their embryo/fetus, as requested by the responsible manager.

- Determining the dose equivalent to the embryo/fetus prior to the time a worker declares her pregnancy (i.e., from the estimated date of conception to the date of declaration).

- Not disclosing to anyone (including managers) the names of workers who are pregnant or planning a pregnancy unless a worker declares her pregnancy in writing.

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*4.0 PROCEDURE

4.1 Declaring Pregnancy

4.1.1 Assistance

Guidance

Pregnancy may be declared by a pregnant worker or a worker who is planning a pregnancy. Pregnant workers may contact RP personnel for consultation on declaration of pregnancy. Workers who are concerned about radiological hazards in their work areas may request a work area radiological hazard evaluation by contacting the appropriate Division ES&H Team. A work area radiological hazard evaluation is performed for all declared pregnant workers.

Pregnant workers may contact RP personnel for consultation on declaration of pregnancy.

4.1.2 Procedure

Requirements

Workers who want to declare their pregnancy shall do the following: **[S]**

SNL Employees	Contractors
Complete, date, and sign SF 2001-PG, Declaration of Pregnancy for SNL Employees (Word file/Acrobat file), and submit it to the responsible manager for signature. The manager is responsible for signing it and forwarding it to the RP Project Leader on the appropriate Division ES&H Team. **Note:** For assistance in completing SF 2001-PG, Declaration of Pregnancy for SNL Employees (Word	Submit a declaration of pregnancy to your employer (i.e., the contracting company). While Contractors do not use SF 2001-PG, Declaration of Pregnancy for SNL Employees, to declare pregnancy, your declaration should contain all of the information contained in SF 2001-PG, including your signature and the signature of the responsible contractor employer representative. **Note:** The contracting company will furnish a copy of the signed and dated declaration of pregnancy to its SNL point of contact (e.g.,

file/Acrobat file), consult the appropriate Division ES&H Team directly. **Note:** SNL is considered to have been notified of the declaration of pregnancy at the time a signed and dated SF 2001-PG, Declaration of Pregnancy for SNL Employees (Word file/Acrobat file), is received by the RP Project Leader on the appropriate Division ES&H Team.	Sandia Contracting Representative [SCR] or Sandia Delegated Representative [SDR]). The SNL point of contact will provide a copy of the declaration of pregnancy to the responsible SNL manager and the RP Project Leader on the appropriate Division ES&H Team. **Note:** SNL is considered to have been notified of the declaration of pregnancy at the time a copy of the signed and dated declaration of pregnancy is received by the RP Project Leader on the appropriate Division ES&H Team.

SNL employees who submit a declaration of pregnancy shall record the estimated date of conception: **[S]**

- When initially completing SF 2001-PG, Declaration of Pregnancy for SNL Employees (Word file/Acrobat file), if they are already pregnant. **[S]**

- As soon as possible following verification of pregnancy, if SF 2001-PG, Declaration of Pregnancy for SNL Employees (Word file/Acrobat file), was completed in advance of pregnancy.**[S]**

Note: An official declaration of pregnancy initiates a process that includes various actions to be performed by RP personnel and the responsible manager. This process is described in Attachment 14-1, "Actions Taken Following a Declaration of Pregnancy."

By declaring pregnancy, the worker is consenting to become subject to possible work restrictions or a possible work reassignment in order to satisfy the following criteria regarding radiation dose equivalent limits:

- The dose equivalent limit for the embryo/fetus from the period of conception to birth, as a result of occupational exposure of a declared pregnant worker, is 0.5 rem (0.005 sievert). **[10 CFR 835.206(a)]**

- Substantial variation above a uniform exposure rate that would satisfy the above-stated limit is to be avoided. **[10 CFR 835.206(b)]**

- If the dose equivalent to the embryo/fetus is determined to have already exceeded 0.5 rem (0.005 sievert) by the time a worker declares her pregnancy, the declared pregnant worker is not to be assigned to tasks where additional occupational exposure is likely during the remaining gestation period. **[10 CFR 835.206(c)]**

  Note: The dose limit and radiological work restrictions for limiting radiation dose to the embryo/fetus (see examples in Attachment 14-1, "Actions Taken Following a Declaration of Pregnancy") apply only to declared pregnant workers. A worker who does not declare her pregnancy in writing will not be restricted in her work or in the radiation dose that she or her embryo/fetus receives, other than restrictions that apply to all workers.

Guidance

Workers should declare their pregnancies in writing (as described above) if they want to limit the dose equivalent to their embryo/fetus to 0.5 rem. The declaration of pregnancy should be made as early as possible.

Note: Non-radiological workers at SNL have an administrative control level of 0.1 rem (0.001 sievert) per year, which is lower than the dose equivalent limit of 0.5 rem to the embryo/fetus of declared pregnant workers. Thus, the potential for an embryo/fetus to receive 0.5 rem typically exists only for radiological workers. However, the option to declare pregnancy in writing is available to all workers at SNL who are pregnant or planning a pregnancy.

Workers may submit SF 2001-RDR, Radiation Dosimeter Request Form (Word file/ Acrobat file) (signed by the responsible manager), to request a personnel dosimeter.

Note: A worker is not required to declare her pregnancy in order to request or receive a personal dosimeter.

4.2 Accommodating Declared Pregnant Workers

Managers of declared pregnant workers shall be responsible for ensuring that:

- The dose equivalent to the embryo/fetus from the period of conception to birth, as a result of occupational exposure of a declared pregnant worker, does not exceed 0.5 rem (0.005 sievert) during the entire gestation period. **[10 CFR 835.206(a)]**

- Substantial variation above a uniform exposure rate that would satisfy the above-stated limit is avoided. **[10 CFR 835.206(b)]**

- If the dose equivalent to the embryo/fetus is determined to have already exceeded 0.5 rem (0.005 sievert) by the time a worker declares her pregnancy, the declared pregnant worker is not assigned to tasks where additional occupational exposure is likely during the remaining gestation period. **[10 CFR 835.206(c)]**

- Personnel dosimetry is provided to and used by declared pregnant workers who are likely to receive from external sources a dose equivalent to the embryo/fetus in excess of 10% of the applicable limit stated above. **[10 CFR 835.402(a)(2)]**

- Internal dose evaluation programs (including routine bioassay programs) are conducted for declared pregnant workers likely to receive an intake resulting in a dose equivalent to the embryo/fetus in excess of 10% of the applicable limit stated above. **[10 CFR 835.402(c)(2)]**

- Radiological work restrictions are negotiated or, if available, the option of a mutually agreeable work assignment is provided, such that further occupational exposures to ionizing radiation will not result in a violation of the dose equivalent limit for the embryo/fetus.

- Dose reports for declared pregnant workers are reviewed.

- RP personnel are consulted concerning possible initiation or tightening of work restrictions for the remainder of a declared pregnant worker's pregnancy term when it appears that the worker may approach the dose equivalent limit for the embryo/fetus.

4.3 Withdrawing a Declaration of Pregnancy

Requirements [S]

Workers who want to withdraw their declarations of pregnancy shall do the following:

SNL Employees	Contractors

Complete, date, and sign SF 2001-WPG, Withdrawal of Pregnancy Declaration for SNL Employees (Word file/Acrobat file), and submit it to the responsible manager. The manager is responsible for signing it and forwarding it to the RP Project Leader on the appropriate Division ES&H Team. **Note:** SNL is considered to have been notified of the withdrawal at the time a signed and dated SF 2001-WPG, Withdrawal of Pregnancy Declaration for SNL Employees (Word file/Acrobat file) is received by the RP Project Leader on the appropriate Division ES&H Team.	Submit a withdrawal of declaration of pregnancy to your employer (i.e., the contracting company). While Contractors do not use SF 2001-WPG, Withdrawal of Pregnancy Declaration for SNL Employees, to withdraw their declaration of pregnancy, your declaration should contain all of the information contained in SF 2001-WPG, including your signature and the signature of the responsible employer. **Note:** The contracting company will furnish a copy of the signed and dated withdrawal to its SNL point of contact (e.g., Sandia Contracting Representative [SCR] or Sandia Delegated Representative [SDR]). The SNL point of contact will provide a copy of the withdrawal of declaration of pregnancy to the responsible SNL manager and the RP Project leader on the appropriate Division ES&H Team. **Note:** SNL is considered to have been notified of the withdrawal of declaration of pregnancy at the time a copy of the signed and dated withdrawal is received by the RP Project Leader on the appropriate Division ES&H Team.

Guidance

Declared pregnant workers may withdraw their declarations at any time during pregnancy without explanation or justification.

Note: Withdrawal of a declaration of pregnancy will end any radiation dose equivalent limit or work restrictions that were imposed as a result of the declaration of pregnancy. If a declared pregnant worker does not withdraw her declaration of pregnancy, the declaration terminates when radiation protection personnel receive notification from the worker or from a Sandia health services facility organization that the worker is no longer pregnant.

5.0 RECORDS

Requirements

SNL personnel who generate occupational radiation protection related records shall use the special units of curie, roentgen, rad, and rem for activity, exposure, dose and dose equivalent respectively. Multiples and subdivisions of these units are allowed. SI units (becquerel [Bq], gray [Gy], and sievert [Sv])may be included in parenthesis after the special units. **[10 CFR 835.4]**

Managers shall be responsible for ensuring that records are maintained:

- To document compliance with SNL's radiation protection record-keeping requirements as implemented in the *Sandia Records Retention and Disposition Schedule* by the Recorded Information Management Department. **[10 CFR 835.701(a)]**
- Until final disposition is authorized by the National Archives and Records Administration (NARA) through DOE. **[10 CFR 835.701(b)]**

Radiation Protection (RP) personnel shall be responsible for ensuring that the following records are maintained:

- Records to document doses received by all individuals for whom monitoring was required pursuant to 10 CFR 835.402 and doses received during planned special exposures, accidents, and emergency conditions. **[10 CFR 835.702(a)]**
- Records of dose equivalents to the embryos/fetuses of declared pregnant workers. **[10 CFR 835.702(c)(6)]**.
- Written declarations of pregnancy. **[10 CFR 835.704(d)]**
- Written withdrawals of declaration of pregnancy.

Unless otherwise specified in this subpart, records shall be retained until final disposition is authorized by DOE. **[10 CFR 835.701(b)]**

6.0 REFERENCES

6.1 Requirements Source Documents

10 CFR 835, *Occupational Radiation Protection.*

6.2 Related Documents

DOE G 441.1-1, *Management and Administation of Radiation Protection Programs Guide*.

DOE-STD-1098-99, *Radiological Control*.

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Radiological Protection Procedures Manual

GLOSSARY

Subject Matter Expert: Theodore N. Simmons
MN471016, Issue S
Effective Date: May 24, 2007; Replaces Document Dated: September 21, 2006

*Indicates a substantive change

A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z

Terms defined in the Atomic Energy Act and not defined in this manual are used consistent with the meanings given in the Act. As used in this manual, words in the singular also include the plural and words in the masculine gender also include the feminine and vice versa, as the case may be.

A

Absorbed dose (D) - The energy absorbed by matter from ionizing radiation per unit mass of irradiated material at the place of interest in that material. The absorbed dose is expressed in units of rad (or gray) (1 rad = 0.01 gray).

Accelerator - A device employing electrostatic or electromagnetic fields to impart kinetic energy to molecular, atomic or sub-atomic particles and capable of creating a radiological area. The following devices are excluded:

- Unmodified commercially available units that are acceptable for industrial applications, including (but not limited to) electron microscopes, ion implant devices, and x-ray generators.
- Non-medical x-ray devices with the capability of accelerating particles to energies

not greater than 10 MeV, which are operated in accordance with American National Standards Institute (ANSI) N43.3-1993, *General Radiation Safety-Installations Using Non-Medical X-Ray and Sealed Gamma-Ray Sources, Energies Up to 10 MeV*, or in accordance with another applicable consensus standard as directed by the cognizant Field Element manager. [At Sandia, operations conducted under the Radiological Protection Procedures Manual, chapter 10 meet this requirement.]

- Low-voltage neutron generators incapable of creating a radiological area and which are operated in accordance with National Council on Radiation Protection (NCRP) Report 72-1983, *Radiation Protection and Measurements for Low-Voltage Neutron Generators*, or in accordance with another applicable consensus standard as directed by the cognizant Field Element manager. For the purpose of this Order, a low-voltage neutron generator is defined as a bench-top scale, single-purpose device generating neutrons by accelerating deuterons or tritons into targets through a maximum accelerating potential not greater than 600 kV.

Accountable radioactive source (ARS) - A radioactive source having a half-life equal to or greater than 30 days and an isotopic activity equal to or greater than the corresponding value provided in Appendix E. (ARSs include: sealed sources, unsealed sources, liquid sources, and gaseous sources).

Note: Where there is a combination of radionuclides in known quantities, derive the value for the combination as follows: determine for each radionuclide in the combination, the ratio between the quantity present in the combination and the value otherwise established for the specific radionuclide when not in combination. If the sum of such ratios for all radionuclides in the combination exceeds unity (1), then the accountability criterion has been exceeded.

Accountable sealed radioactive source - A sealed radioactive source having a half-life equal to or greater than 30 days and an isotopic activity equal to or greater than the corresponding value provided in Appendix E (Word file/Acrobat file) of this manual.

ACL - Administrative Control Level.

Acquire - To gain possession of by purchasing, leasing, renting, or borrowing.

Administrative control - Method of controlling exposure of SNL personnel by job rotation, work assignment, or time periods away from a hazard. Work planning

documents and work-related training and certifications, which are two key areas of requirements and standards tailoring, are examples of administrative controls.

Administrative control level - A numerical dose constraint established at a level below the occupational exposure limits in Chapter 1, Radiological Work Planning and Controls, to administratively control and help reduce individual and collective dose.

***Affected manager (affected by a radiological operation) -** A manager who has members of the workforce, space, equipment, real property or operations that could be impacted by radiological work for which they are not responsible.

Airborne radioactive material or airborne radioactivity - Radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases.

Airborne radioactivity area - Any area, accessible to individuals, where:

1. The concentration of airborne radioactivity, above natural background, exceeds or is likely to exceed the derived air concentration (DAC) values listed in Appendix A (Word file/Acrobat file) or Appendix C (Word file/Acrobat file) of this manual; or

2. An individual present in the area without respiratory protection could receive an intake exceeding 12 DAC-hours in a week.

ALARA - As low as reasonably achievable.

ALI - Annual limit on intake.

Ambient air - The general air in the area of interest (e.g., the general room atmosphere), as distinct from a specific stream or volume of air that may have different properties.

Annual - 365 days from the month and day the activity (e.g., survey, leak test, inventory) was last performed.

Annual limit on intake (ALI) - The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man (ICRP Publication 23) that would result in a committed effective dose equivalent of 5 rems (0.05 sievert) or a committed dose equivalent of 50 rems (0.5 sievert) to any individual

organ or tissue. ALI values for intake by ingestion and inhalation of selected radionuclides are based on Table 1 of the U.S. Environmental Protection Agency's Federal Guidance Report No. 11, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion*, published September 1988. This document is available from the National Technical Information Service, Springfield, VA.

ANSI - American National Standards Institute.

ARS - Accountable radioactive source.

As low as reasonably achievable (ALARA) - The approach to radiation protection to manage and control exposures (both individual and collective) to the work force and to the general public to as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations. As used in this manual, ALARA is not a dose limit but a process that has the objective of attaining doses as far below the applicable limits of this part as is reasonably achievable.

B

Background - Radiation from:

i. Naturally occurring radioactive materials that have not been technologically enhanced;

ii. Cosmic sources;

iii. Global fallout as it exists in the environment (such as from the testing of nuclear explosive devices);

iv. Radon and its progeny in concentrations or levels existing in buildings or the environment that have not been elevated as a result of current or prior activities; and

v. Consumer products containing nominal amounts of radioactive material or producing nominal amounts of radiation.

Biennial - 730 days from the month and day the activity (e.g., survey, leak test, inventory) was last performed.

Bioassay - The determination of kinds, quantities, or concentrations, and, in some cases, locations of radioactive material in the human body, whether by direct measurement or by analysis and evaluation of radioactive materials excreted or removed from the human body.

C

Calibration - To adjust and/or determine either:

i. The response or reading of an instrument relative to a standard (e.g., primary, secondary, or tertiary) or to a series of conventionally true values; or

ii. The strength of a radiation source relative to a standard (e.g., primary, secondary, or tertiary) or conventionally true value.

CAM - Continuous air monitor.

CEDE - Committed effective dose equivalent.

CFR - Code of Federal Regulations.

Collective dose - The sum of the total effective dose equivalent values for all individuals in a specified population. Collective dose is expressed in units of person-rem (or person-sievert).

Committed dose equivalent ($H_{T,50}$) - The dose equivalent calculated to be received by a tissue or organ over a 50-year period after the intake of a radionuclide into the body. It does not include contributions from radiation sources external to the body. Committed dose equivalent is expressed in units of rem (or sievert).

Committed effective dose equivalent ($H_{E,50}$) - The sum of the committed dose equivalents to various tissues in the body ($H_{T,50}$), each multiplied by the appropriate weighting factor (w_T), i.e., $H_{E,50} = Sw_T H_{T,50}$. Committed effective dose equivalent is expressed in units of rem (or sievert).

Consumer product - A product containing radioactive material that (1) is commercially available and (2) can be purchased by a member of the general public without a license,

permit, or registration. Any product exempt from licensing by the Nuclear Regulatory Commission (NRC) or an agreement state is a consumer product. Products generally licensed or specifically licensed by the NRC or an Agreement State are not consumer products.

Note: This definition applies only to this manual.

Contamination - The unwanted presence of radioactive material, as debris, dust, or liquids on surfaces.

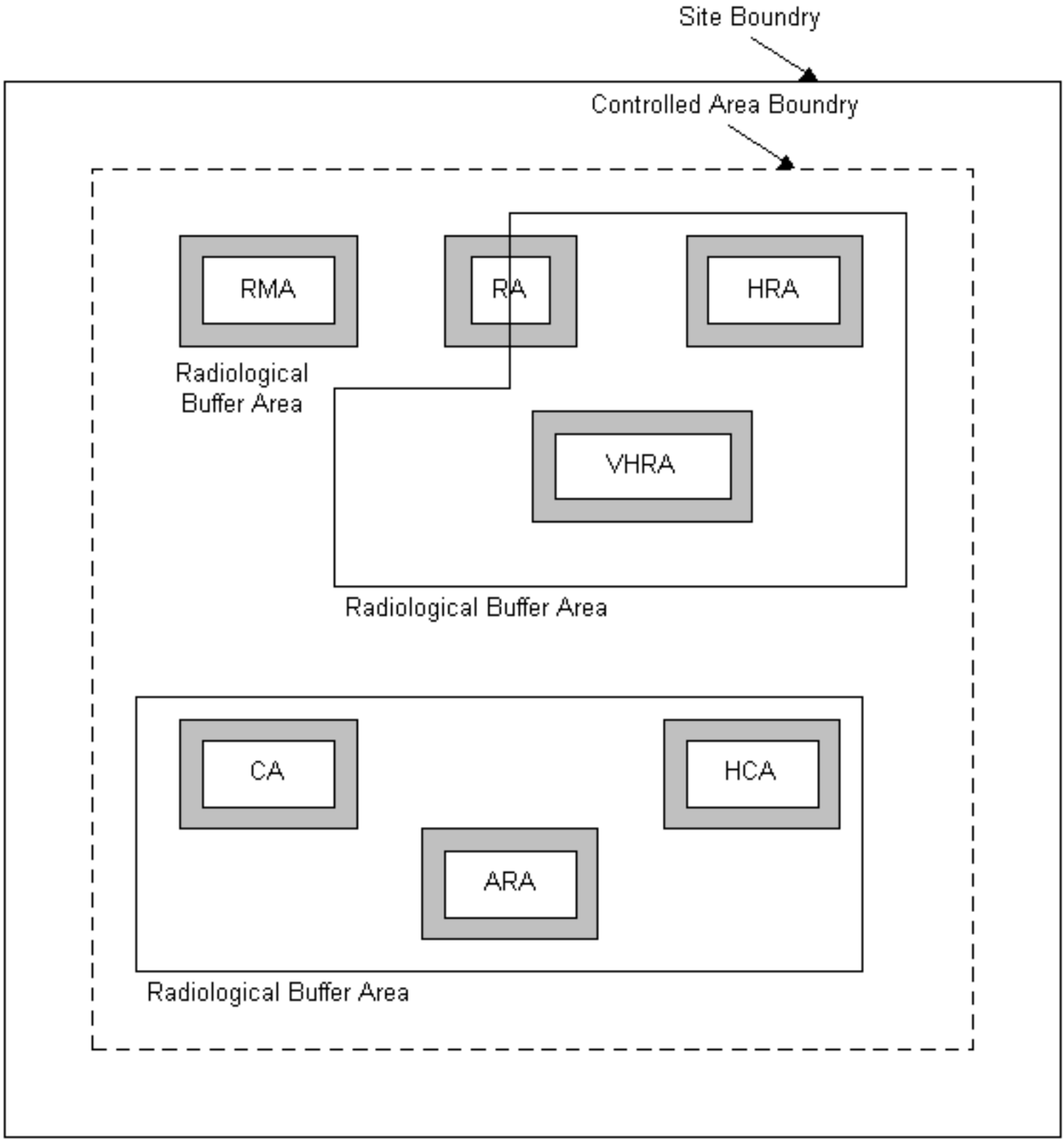
Contamination area - Means any area, accessible to individuals, where removable surface contamination levels exceed or are likely to exceed the removable surface contamination values specified in Appendix D of this manual, but do not exceed 100 times those values.

Continuous air monitor (CAM) - An instrument that continuously samples and measures the levels of airborne radioactive materials on a "real-time" basis and has alarm capabilities at preset levels.

Contractor - Any entity under contract with the Department of Energy with the responsibility to perform activities at a DOE site or facility. (Sandia Corporation is a prime contractor to the DOE.) **Note:** This definition applies only to this manual.

Contractor management - SNL management at the director or vice president level.

Controlled area - Any area to which access is managed by or for DOE to protect individuals from exposure to radiation and/or radioactive material. See Figure GLO-1.



HRA	-	High Radiation Area
VHRA	-	Very High Radiation Area
CA	-	Contamination Area
HCA	-	High Contamination Area
ARA	-	Airborne Radioactivity Area

Figure GLO-1. Establishing Controlled and Radiological Areas

Corrective action - An action identified to correct a finding that, when completed, fixes the problem or prevents recurrence.

Critique - Meeting of personnel involved in or knowledgeable about an event (either a success or an abnormal event) to document a chronological account of the facts.

Cumulative total effective dose equivalent - The sum of all total effective dose equivalent values recorded for an individual, where available, for each year occupational dose was received, beginning January 1, 1989.

D

DAC - Derived air concentration.

DAC-hr - Derived air concentration hour.

Declared pregnant worker - A woman who has voluntarily declared to her employer, in writing, her pregnancy for the purpose of being subject to the occupational exposure limits to the embryo/fetus as provided in 10 CFR 835.206. This declaration may be revoked, in writing, at any time by the declared pregnant worker. This form is SF 2001-PG (Word file/Acrobat file).

Deep dose equivalent - The dose equivalent derived from external radiation at a depth of 1 cm in tissue.

Derived air concentration (DAC) - For the radionuclides listed in Appendix A (Word file/ Acrobat file) of this manual, the airborne concentration that equals the ALI divided by the volume of air breathed by an average worker for a working year of 2000 hours (assuming a breathing volume of 2400 m^3). For the radionuclides listed in appendix C of this manual, the air immersion DACs were calculated for a continuous, non-shielded exposure via immersion in a semi-infinite atmospheric cloud. The value is based upon the derived airborne concentration found in Table 1 of the U.S. Environmental Protection Agency's Federal Guidance Report No. 11, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion*, published September 1988. This document is available from the National Technical Information Service, Springfield, VA.

Derived air concentration-hour (DAC-hour) - The product of the concentration of radioactive material in air (expressed as a fraction or multiple of the DAC for each radionuclide) and the time of exposure to that radionuclide, in hours.

Discrete particle - Radiological contamination that exists as distinct insoluble particles, less than about 1 mm in diameter, often highly mobile, characterized by complete collection on a swipe or tape press.

Disintegration per minute (dpm) - The rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrument.

DOE - The United Stated Department of Energy.

DOE activity - An activity taken for or by DOE in a DOE operation or facility that has the potential to result in the occupational exposure of an individual to radiation or radioactive material. The activity may be, but is not limited to, design, construction, operation, or decommissioning. To the extent appropriate, the activity may involve a single DOE facility or operation or a combination of facilities and operations, possibly including an entire site or multiple DOE sites.

DOELAP - Department of Energy Laboratory Accreditation Program (for personnel dosimetry).

Dose - A general term for absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent as defined in this manual.

Dose equivalent (H) - The product of absorbed dose (D) in rad (or gray) in tissue, a quality factor (Q), and other modifying factors (N). Dose equivalent is expressed in units of rem (or sievert) (1 rem = 0.01 sievert).

DOE activities - An activity taken for or by the DOE that has the potential to result in the occupational exposure of an individual to radiation or radioactive material. The activity may be, but is not limited to, design, construction, operation, or decommissioning. To the extent appropriate, the activity may involve a single DOE facility or operation or a combination of facilities and operations, possibly including an entire site.

dpm (disintegrations per minute) – The rate of emission by radioactive material as

determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation

D.U. - depleted uranium.

E

Effective dose equivalent (H_E) - The summation of the products of the dose equivalent received by specified tissues of the body (H_T) and the appropriate weighting factor (w_T)--that is, $H_E = Ew_TH_T$. It includes the dose from radiation sources internal and/or external to the body. For purposes of compliance with this part, deep dose equivalent to the whole body may be used as effective dose equivalent for external exposures. The effective dose equivalent is expressed in units of rem (or sievert).

Engineering controls - Use of components and systems to reduce airborne radioactivity, the spread of contamination, and prevent external exposure by using equipment such as containment, ventilation, filtration, barriers, interlocks and shielding. **Note:** this definition only applies to this manual.

Entrance or access point - Any location through which an individual could gain access to areas controlled for the purposes of radiation protection. This includes entry or exit portals of sufficient size to permit human entry, irrespective of their intended use.

ER - environmental restoration.

ES&H - Environment, safety and health.

Exclusion area (or radius) - An area restricted from personnel entry during radiation-producing activities. Exclusion areas are commonly used to heighten personnel awareness of the ALARA concept. Demarcation as an exclusion area does not preclude other required radiological postings.

External dose or exposure - That portion of the dose equivalent received from radiation sources (e.g., "external sources") outside the body.

Extremity - The area of the hands and arms below the elbow or feet and legs below the knee.

F

Facility modification - A physical change to a radiological or nuclear facility that may increase the amount of radioactive material present or the amount of ionizing radiation emitted, or change the nature of radiation or radioactive material in a way that may measurably increase personnel exposure, increase the level of posting, or increase or change monitoring requirements.

Facility threshold - A level below that which is likely to cause any individual to receive a TEDE in excess of 0.1 rem in a year.

FAX - Facsimile transmission.

Finding - A statement of fact based on objective evidence documenting an act or condition that does not meet requirements, policies, or procedures required by law, a regulatory agency, DOE, Sandia CPR, or a formally-invoked, site-specific, standard.

Fixed contamination - Radioactive material that cannot be readily removed from surfaces by nondestructive means, such as casual contact, wiping, brushing, or laundering.

Fixed contamination area - Areas located outside of radiological areas (i.e., Contamination & High Contamination Areas) having measured removable contamination less than the removable contamination values specified in Chapter 6, Attachment 6-1, "Radioactive Contamination Limits" and total contamination levels exceeding the total surface contamination values specified in Chapter 6, Attachment 6-1, "Radioactive Contamination Limits".

Frisk or frisking - Process of monitoring personnel for contamination. Frisking can be done by oneself with hand-held survey instruments, automated monitoring devices, or aided by a radiological control technician (RCT).

G

General employee - An individual who is either a DOE or DOE contractor employee; an employee of a subcontractor to a DOE contractor; or an individual who performs work for or in conjunction with DOE or who uses DOE facilities.

Generally licensed - Product(s) owned, possessed or used pursuant to a general

license established by the Nuclear Regulatory Commission (NRC) in Part 10 of the Code of Federal Regulations.

H

HASD - Health and Safety Department (at SNL/CA).

HEPA - High efficiency particulate.

High contamination area - Any area, accessible to individuals, where removable surface contamination levels exceed or are likely to exceed 100 times the removable surface contamination values specified in Appendix D of this manual.

High radiation area - Any area, accessible to individuals, in which radiation levels could result in an individual receiving a deep dose equivalent in excess of 0.1 rem (0.001 sievert) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

Hold point -That radiation level, contamination level, or process/procedure step at which work shall not proceed until the radiological controls/conditions have been assessed and additional controls have been implemented as needed.

Hot particle - A discrete particle having total activity equal to or greater than 100,000 dpm. Typically, hot particles are activation or fission products, commonly ^{60}Co, or $^{90}Sr/Y$ and ^{137}Cs, although other nuclides may be abundant, particularly in recently generated material.

Hot spot - A radiological area where a specific spot has a dose rate five times or more than the general area dose rate and the dose rate is greater than 100 mrem/hr, on contact.

Hot spot area - A location where one or more hot spots are present.

HT - A molecule composed of one atom of protium and one atom of **tritium** (both are isotopes of hydrogen).

HTO - Tritiated water.

I

IG - Implementation guide.

IH - Industrial hygiene.

Inaccessible (related to radioactive material including radiological sources) - Under intended conditions of handling, storage maintenance, or use of a device or item, the contained radioactive material will not be released or inadvertently removed. It is unlikely that any person will receive, in one year, an effective dose equivalent (whole body) in excess of 10 mrem or a dose equivalent in excess of 10 mrem to any extremity.

***Inaccessible area (applies only to radiological area posting) -** An area that cannot reasonably be occupied by a major portion of an individual's whole body (head, trunk (including male gonads), arms above the elbow, or legs above the knee). Examples of areas that do not need to be posted as entrances are the man way to a tank or vessel that has its cover bolted in place or an opening in a shield wall that is physically difficult to access without a ladder or mobile platform.

Note: Openings in physical barriers around a radiological area are not required to be posted as entrances if exceptional measures are needed to access them.

Inaccessible ARS - An ARS is considered to be inaccessible if it is located in an area that is inaccessible to individuals due to operational or environmental constraints. Inaccessible sources include sources contained within equipment that does not allow direct access to the source, provided that:

- For ARSs requiring integrity testing (see Section 4.8 of RPPM-9, Radioactive Source Control), a current integrity test (within the last 6 months) at any accessible region of the equipment detects radioactive material leakage less than 0.005 µCi.

- A current radiation survey (within the last 2 years) shows the deep dose equivalent to the whole body at any accessible region 2 inches (5 cm) from the outside surface of the equipment or from any other surface that the radiation penetrates under worst case credible operating conditions to be less than 0.5 mrem in any 1 hour.

- The equipment containing the ARS is being operated under conditions intended by the manufacturer.

Industrial radiography - The examination of the macroscopic structure of materials by nondestructive methods, using sources of ionizing radiation to produce radiographic images. Sources of radiation typically include such things as C0-60, Cs-137, or Ir-192 source cameras, or x-ray devices.

Individual - Any human being.

Integrity test - Same as source integrity test.

Internal dose or exposure - That portion of the dose equivalent received from radioactive material taken into the body (e.g., "internal sources").

Intrusive work - Work at an SNL/NM SCA that involves digging in the soil to a depth greater than 6 inches, handling contaminated material fragments or artifacts, trapping burrowing animals, or walking or driving over wet soil that sticks to shoes or tires.

J

Job Coordinator – The person, designated by the manager owning the work, who is most knowledgeable about the work to be performed.

K

L

Leak test - Same as source integrity test.

Legacy radioactive material - Radioactive material or radioactive contamination, resulting from historical operations, that is unrelated to current activities.

Lens of the eye dose equivalent - The external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 cm.

Lessons learned - Good work practices or innovative approaches that are captured and shared to promote repeat application. Lessons learned may also be adverse work practices or experiences that are captured and shared to avoid recurrence.

LINAC - Linear accelerator.

LIWG - Line Implementation Working Group.

Low activity source (LAS) licensing - LAS licensing allows a person to obtain and use (or transfer) a specified quantity of material, provided that the project does not possess more than 10 such quantities.

M

Member of the public - An individual who is not a general employee. An individual is not a "member of the public" during any period in which the individual receives occupational dose.

Minor - An individual less than 18 years of age.

Monitoring - The measurement of radiation levels, airborne radioactivity concentrations, radioactive contamination levels, quantities of radioactive material, or individual doses and the use of the results of these measurements to evaluate radiological hazards or potential and actual doses resulting from exposures to ionizing radiation.

Movement - A routine relocation of property or material within a building or within the access-controlled boundaries of a facility necessary to support "work in progress," or the day-to-day operations or activities of an organization. A movement generally does not involve the transfer of responsibility or accountability for the property or material being moved and usually does not need to be done by trained personnel from one of the transportation organizations.

mrem (millirem) – - One thousandth of a rem.

MS - Mail stop.

N

N/A - Not applicable.

Non-accountable radioactive source - A radioactive source having an activity less than the applicable value in Appendix E, "Values for Establishing Sealed Radioactive Source Accountability and Radioactive Material Posting and Labeling Requirements," (Word file/Acrobat file).

Non-exempt radioactive material - Any radioactive material that does not meet the definition of exempt radioactive material.

Nonintrusive work - Work at SNL/NM or SNL/CA that involves driving or walking over dry soil or conducting environmental sampling that does not involve digging deeper than 6 inches into the soil. This includes hands-off observation of another person who is performing intrusive work.

Nonstochastic effects - Effects due to radiation exposure for which the severity varies with the dose and for which a threshold normally exists (e.g., radiation-induced opacities within the lens of the eye).

NORM - Naturally occurring radioactive material and products containing only naturally occurring radioactive material. To be considered NORM, the natural isotopic composition of the radioactive material component cannot have been altered.

NRC - The United States Nuclear Regulatory Commission.

NTS - Noncompliance tracking system. A centralized DOE database that allows Sandia to report noncompliances promptly and take advantage of the mitigation provision outlined in the Price-Anderson Enforcement Program's enforcement policy. Any potential noncompliance will be reviewed before entering it into the NTS by the PAAA Program Manager, legal staff, the facility/activity owner, and the responsible individual (RI). Input to the NTS reporting system will be managed by the PAAA Program Integration Department

O

Observation - A statement of fact based on objective evidence documenting an act or condition that does not violate a requirement but may need improvement.

Occupational dose - An individual's ionizing radiation dose (external and internal) as a result of that individual's work assignment. Occupational dose does not include doses received as a medical patient or doses resulting from background radiation or participation as a subject in medical research programs.

Offsite - Any location that does not satisfy the criteria of Sandia-controlled premises.

Onsite - Any location that satisfies the criteria of Sandia-controlled premises.

OI - Operating instruction.

Operating procedure (OP) - An operating procedure (OP) is a document that provides step-by-step instructions for specific operations (normal, postulated abnormal, and emergency operations) to ensure that activities are performed correctly, safely, and consistently. Typically, organizations develop their own OPs for internal use within the organization. OPs may exist as independent documents, unless they describe operations involving hazards which require the development of ES&H SOPs. OPs may not substitute for ES&H SOPs, although they may supplement them.

Operating management - SNL management at the team supervisor, department manager, or director level.

ORPS - DOE Occurrence Reporting and Processing System.

Out of Service (for a Radiation-Generating Device) - Out of Service means documented in the device control database as being not in use.

\

P

P^2 - Pollution prevention.

PAS - Personal air sampling.

Person - Any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, government agency, any state or political subdivision of, or any political entity within a state, any foreign government or nation or other entity, and any legal successor, representative, agent or agency of the foregoing; provided that person does not include the Department or the United States Nuclear Regulatory Commission.

Personal protective equipment (PPE) - Equipment such as respirators, face shields, and safety glasses used to protect workers from exposure to radioactive or hazardous materials. **Note:** this definition only applies to this manual.

Personnel dosimetry - Devices designed to be worn by an individual for the assessment of dose equivalent such as film badges, thermoluminescent dosimeters (TLDs), and pocket ionization chambers.

Primary hazard screening (PHS) - The hazard analysis process and the documented output of the process in which one or more people familiar with an operation answer questions posed by the Integrated Safety Management System (ISMS) Software, which subsequently identifies the hazards, the major requirements for hazards controls, and the operation's hazard category. For example:

- Business occupancy (office).
- Standard industrial hazard.
- Low hazard nonnuclear.
- Moderate hazard nonnuclear.
- Accelerator.
- Category 3 nuclear.
- Category 2 nuclear.

Note: SNL does not currently operate any high-hazard nonnuclear, category A reactor, or category 1 nuclear operations.

The PHS is part of every operation's authorization basis. The hazard category determines if additional analyses and documents are also required for the authorization basis.

PMLS - Personnel Monitoring and Laboratory Services (Department).

PPE - Personal protective equipment.

PSE - Planned special exposure.

Q

QA - Quality assurance.

Qualified escort - A knowledgeable individual who accompanies a visitor in a Controlled Area and prevents the visitor from receiving occupational exposure.

Quality factor - The modifying factor used to calculate the dose equivalent from the absorbed dose; the absorbed dose (expressed in rad or gray) is multiplied by the appropriate quality factor (Q).

i. The quality factors to be used for determining dose equivalent in rem are shown below:

QUALITY FACTORS

RADIATION TYPE	QUALITY FACTOR
X-rays, gamma rays, positrons, electrons (including tritium beta particles)	1
Neutrons, ≤10 keV	3
Neutrons, >10 keV	10
Protons and singly charged particles of unknown energy with rest mass greater than one atomic mass unit	10
Alpha particles and multiple-charged particles (and particles of unknown charge) of unknown energy	20

ii. When spectral data are insufficient to identify the energy of the neutrons, a quality factor of 10 shall be used.

iii. When spectral data are sufficient to identify the energy of the neutrons, the following mean quality factor values may be used:

QUALITY FACTORS FOR NEUTRONS

[Mean quality factors, Q (maximum value in a 30-cm dosimetry phantom), and values of neutron flux density that deliver in 40 hours, a maximum dose equivalent of 100 mrem (0.001 sievert).]

NEUTRON ENERGY (MeV)	MEAN QUALITY FACTOR	NEUTRON FLUX DENSITY ($cm^{-2}s^{-1}$)
2.5×10^{-8} thermal	2	680
1×10^{-7}	2	680
1×10^{-6}	2	560
1×10^{-5}	2	560
1×10^{-4}	2	580
1×10^{-3}	2	680
1×10^{-2}	2.5	700
1×10^{-1}	7.5	115
5×10^{-1}	11	27
1	11	19
2.5	9	20
5	8	16
7	7	17
10	6.5	17
14	7.5	12
20	8	11
40	7	10
60	5.5	11
1×10^{2}	4	14
2×10^{2}	3.5	13
3×10^{2}	3.5	11
4×10^{2}	3.5	10

R

Radiation - Ionizing radiation: alpha particles, beta particles, gamma rays, X-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation as used in this manual, does not include non-ionizing radiation, such as radio- or micro-waves, or visible, infrared, or ultraviolet light.

Radiation area - Any area accessible to individuals in which radiation levels could result in an individual receiving a deep dose equivalent in excess of 0.005 rem (0.05 millisievert) in 1 hour at 30 centimeters from the source or from any surface that the radiation penetrates.

Radiation-measuring instrument(s) - an instrument(s) that is used to measure ionizing radiation for any purpose.

Radiation-monitoring instrument(s) - a radiation-measuring instrument(s) that is used for monitoring purposes.

Radiation-generating device (RGD) - Certain devices that produce ionizing radiation, including sealed radioactive sources, particle accelerators, electron generating devices that produce x-rays incidentally, and laser systems that produce ionizing radiation, subject to the exemptions stated in Chapter 10, "Radiation-Generating Devices (RGDs)."

Radiation Protection Safety Committee (RPSC) - An advisory committee that provides corporate oversight of the radiation protection operation including:

- 10 CFR 835 compliance,
- Review of occurrence and non-compliance metrics,
- Review of ALARA activities,
- Review of the implementation of this manual,
- Guidance for implementing Radiological Conduct of Operations, and
- Identified radiological issues.

Radioactive contamination - See contamination.

Radioactive material - includes any material, equipment, or system component determined to be contaminated or suspected of being contaminated. Radioactive material also includes activated material, sealed and unsealed sources, and material that emits ionizing radiation. **Note:** this definition only applies to occupational radiation protection.

Radioactive material area (RMA) - Any area within a controlled area, accessible to individuals, in which items or containers of radioactive material exist and the total activity of radioactive material exceeds the applicable values provided in Appendix E (Word file/ Acrobat file) of this manual. (Note that a RMA is not an RMMA.)

Radioactive material management area (RMMA) - (1) An area where the reasonable potential exists for radioactive contamination of RCRA/TSCA hazardous waste due to the presence of unconfined or unencapsulated radioactive material or (2) an area that is exposed to radiation beams or other sources of particles (e.g., neutrons, protons) capable of causing activation of the RCRA/TSCA hazardous waste.

Radioactive material transportation - The movement of radioactive material by aircraft, rail, vessel, or highway vehicle when such movement is subject to Department of Transportation regulations or DOE Orders that govern such movements. Radioactive material transportation does not include preparation of material or packagings for transportation, monitoring required by this part, storage of material awaiting transportation, or application of markings and labels required for transportation.

Radioactive source bank - A list of excess and reapplicable, radioactive sealed sources.

Radioactive source - Radioactive material manufactured, obtained or retained for the purpose of utilizing the emitted radiation. Radioactive sources do not include:

- reactor fuel elements
- nuclear explosive devices
- radioisotope thermoelectric generators
- materials in process (such as liquid sources that will consumed in processes or experiments).
- other materials not used as sources of radiation (e.g., activated shielding materials, depleted uranium used as shielding, and tritium contained in neutron tubes and generators).

Radioactivity - A natural and spontaneous process by which the unstable atoms of an element emit or radiate excess energy from their nuclei and, thus, change (or decay) to

atoms of a different element or to a lower energy state of the same element.

Radiological activity - A facility, operation or project with radioactive material or a radiation-generating device(s).

Radiological area - Any area within a controlled area which must be posted as a "radiation area," "high radiation area," "very high radiation area," "contamination area," "high contamination area," or "airborne radioactivity area" per this manual. See Figure GLO-1.

Radiological buffer area (RBA) - An intermediate area contamination reduction zone or transition zone established to prevent the spread of radioactive contamination and to protect personnel from radiation exposure.

Radiological control technician (RCT) - A radiological worker whose primary job assignment involves monitoring of workplace radiological conditions, specification of protective measures, and provision of assistance and guidance to other individuals in implementation of radiological controls.

Radiological posting - Sign, marking, or label that indicates the presence or potential presence of radiation or radioactive materials.

Radiological Process Improvement Report (RPIR) - A report written as part of Sandia's feedback and improvement process to promote continuous improvement of radiological processes and programs at SNL.

Radiological work - Any activity that involves the operation of a radiation generating-device or that involves working with radioactive materials, or that is likely to result in routine occupational exposure above 0.1 rem (0.001 sievert) per year total effective dose equivalent.

Radiological worker - A general employee whose job assignment involves operation of radiation-generating devices or working with radioactive materials or who is likely to be routinely occupationally exposed above 0.1 rem (0.001 sievert) per year total effective dose equivalent.

Radiological work permit (RWP) - An authorization to conduct work involving exposure to radiation or radioactive materials that identifies radiological conditions, establishes worker protection and monitoring requirement and contains specific approvals.

RBA - Radiological buffer area.

RCT - Radiological control technician.

Real-time air monitoring - Measurement of the concentrations or quantities of airborne radioactive materials on a continuous basis.

Recommendation - Alternative, efficient and effective approaches that may enhance program performance but that may not be directly associated with a regulatory requirement.

rem - Unit of dose equivalent. Dose equivalent in rem is numerically equal to the absorbed dose in rad multiplied by a quality factor, distribution factor, and any other necessary modifying factor (1 rem = 0.01 sievert).

Removable contamination - Radioactive material that can be removed from surfaces by non-destructive means, such as casual contact, wiping brushing, or washing.

Representative - As applied to the sampling of radioactive material, means sampling in such a manner that the sample closely approximates both the amount of activity and the physical and chemical properties of the material (e.g., particle size and solubility in the case of air sampling of the aerosol to which workers may be exposed).

Respiratory protective device - An apparatus, such as a respirator, worn by an individual for the purpose of reducing the individual's intake of airborne radioactive materials.

Respiratory protective equipment - Same as respiratory protective device.

RGD - Radiation-generating device.

RMA - Radioactive material area.

RMMA - Radioactive material management area.

Root cause - The cause that, if corrected, would prevent recurrence of this and similar occurrences. The root cause does not apply to this occurrence only but has generic implications to a broad group of possible occurrences, and it is the most fundamental aspect of the cause that can logically be identified and corrected. There may be a series

of causes that can be identified, one leading to another. This series should be pursued until the fundamental, correctable cause has been identified.

Roving personnel - Any SNL personnel whose duties require entry into areas with operations controlled by others.

RP - Radiation protection.

RPID - Radiation Protection Internal Dosimetry (Project).

RPIR - Radiological Process Improvement Report.

RPP - Sandia National Laboratories' Radiation Protection Plan.

RP personnel - Project Leaders, Radiological Engineers, Radiological Control Technicians , or persons qualified and authorized to perform limited scope RP duties, who are directly assigned, or matrixed, to the Radiation Protection Program and, whose duties support the SNL Radiation Protection Program.

RPPM - *Radiological Protection Procedures Manual.*

RPSC - Radiation Protection Safety Committee.

RSCP - Radioactive Source Control Program.

RWI - Radiological Worker I (training).

RWII - Radiological Worker II (training).

RWP - Radiological Work Permit.

S

Sandia-controlled premises - Real property or buildings (or portions thereof) owned, leased, or withdrawn by or permitted to DOE and designated for Sandia National Laboratories. Includes leased or permitted commercial space (e.g., Research Park in Albuquerque, NM). It does **not** include sites where Sandia National Laboratories performs work but DOE has no legal interest (e.g., a courtesy office provided to a visitor on the premises of a technology transfer partner).

SCA - Soil contamination area.

SE - Safety engineering.

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

Semiannual - 180 days from the month and day the activity (e.g., survey, leak test, inventory) was last performed.

SF - Sandia form.

Shallow dose equivalent - The dose equivalent deriving from external radiation at a depth of 0.007 cm in tissue.

Shipment - Any off site transportation of hazardous or nonhazardous property or material requiring compliance with DOT regulations. In addition to the actual transportation by any mode of transport, a shipment may include:

- Material identification and verification.
- Packaging.
- Marking and labeling.
- Ensuring cargo security.
- Placarding.
- Preparing shipping documents.
- Tendering the package to a carrier or transporter, as appropriate.

SNCSC - Sandia Nuclear Criticality Safety Committee

SNL - Sandia National Laboratories.

SNL personnel - SNL employees and contract personnel who are subject to the *ES&H Manual* (see Section 1B, "What Is the Scope," "SNL's ES&H Program").

Note: The term "SNL personnel" is used to refer to both employees and employees of contractors to SNL who are required to follow the rules contained in the *ES&H Manual* and should not be interpreted as conferring SNL employee status on contractor personnel. Requirements in the *ES&H Manual*, as they pertain to contractor personnel, are administered through and are governed by the terms of the subject contract.

Soil contamination area - An area where the soil contains contamination that is equal to or exceeds the DOE 5400.5 unrestricted release limit.

Source integrity test - A test to determine if a sealed radioactive source is leaking radioactive material.

Source leak test - Same as source integrity test.

Specifically licensed - Product(s) manufactured, produced, transferred, received, acquired, owned, possessed, or used pursuant to specific license issued by the Nuclear Regulatory Commission (NRC) or an Agreement State.

SRSC - Sandia Reactor Safety Committee.

SSN - Social Security Number.

Stochastic effects - Malignant and hereditary diseases for which the probability of an effect occurring, rather than its severity, is regarded as a function of dose without a threshold for radiation protection purposes.

Storage (of an accountable radioactive source) - Storage means documented in the radioactive source control database as being either (1) out of service or (2) available for reapplication.

Survey - An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation. When appropriate, such an evaluation includes a physical

survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

SWP - Safe Work Permit.

T

TA - Technical area.

Technical work document (TWD) - A formally approved document used to identify activity-level work hazards and their associated work control measures. TWDs are developed as part of implementation of the Integrated Safety Management System (ISMS). TWDs provide an administrative control to communicate to Members of the Workforce the activity-level work hazards and associated work controls during normal activities or foreseeable emergencies. The following are examples of TWDs used at SNL to control hazardous work:

- ES&H standard operating procedures (ES&H SOPs).
- Health and safety plans (HASPs).
- Operating procedures (OPs).
- Safe work permits (SWPs).
- Data packages for pressure and vacuum systems.
- Safety and health programs for hazardous waste operations (HAZWOPER).
- Plans, such as emergency response plans and facility- or building-specific evacuation/emergency plans.

Note: For the purposes of the RPPM, RWPs are **NOT** considered TWDs.

See Chapter 21, "Technical Work Documents (TWDs)," of the *ES&H Manual* for more information on TWDs.

TEDE - Total effective dose equivalent.

TEDS - Training, education, and development system.

TIDBITS - Sandia's ES&H Training Information System.

TLD - Thermoluminescent dosimeter.

Total effective dose equivalent (TEDE) -The sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

Tour - Individuals (including minors and members of the public, SNL employees, contractors, visiting scientists, and DOE personnel) participating in a tour of an SNL facility for the purposes of observing either the facility or an equipment/material demonstration within the facility. These individuals shall not perform work for, or in conjunction with, DOE or use DOE facilities.

Thermoluminescent dosimeter (TLD) - Radiation monitoring device used to record the radiological exposure of personnel or areas to certain types of radiation.

Training - Material, guidelines, and instructions that provide basic knowledge of the proper use and protection of business information or processes. On-the-job training is that portion of a qualification program in which the trainee receives training on project or facility-specific tasks within the job environment and with as much hands-on experience as possible.

Transfer - The relocation of property or material within a DOE site, generally across the access-controlled boundary of a facility. In addition to the actual transportation, a transfer may include the following:

- Identifying and verifying material
- Packaging, marking and labeling
- Ensuring cargo security
- Preparing the transfer documents, as appropriate
- A change of ownership or of accountability for the item being transferred.

TTR - Tonopah Test Range.

TWD - Technical work document.

U

Underground radioactive material area - These areas shall be established to indicate the presence of underground items that contain radioactive materials.

Unsealed radioactive source - Any radioactive source that does not meet the definition of a sealed radioactive sealed source.

V

Very high radiation area - Any area accessible to individuals in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in one hour at 1 meter from a radiation source or from any surface that the radiation penetrates.

Visitor - An individual who may need access to an area but is not assigned routine access by the cognizant line manager. An individual requesting access to controlled areas who has not been trained to the level required to permit unescorted access is also considered a visitor.

Note: this definition only applies to this manual.

***Void point** - Stoppage in a work process when radiological controls or other conditions specified are inadequate. Affected operations may not proceed until the process is revised. However, work may proceed to place the operation in a safe and stable state.

W

Week - A period of 7 consecutive days.

Weighting factor (w_T) - The fraction of the overall health risk, resulting from uniform, whole body irradiation, attributable to specific tissue (T). The dose equivalent to tissue, H_T, is multiplied by the appropriate weighting factor to obtain the effective dose equivalent contribution from that tissue. The weighting factors are as follows:

WEIGHTING FACTORS FOR VARIOUS TISSUES

ORGANS OR TISSUES, T	WEIGHTING FACTOR, W_T
Gonads	0.25
Breasts	0.15
Red bone marrow	0.12
Lungs	0.12
Thyroid	0.03
Bone surfaces	0.03
Remainder[1]	0.30
Whole body[2]	1.00

[1] "Remainder" means the five other organs or tissues with the highest dose (e.g., liver, kidney, spleen, thymus, adrenal, pancreas, stomach, small intestine, and upper large intestine). The weighting factor for each remaining organ or tissue is 0.06.
[2] For the case of uniform external irradiation of the whole body, a weighting factor (w_T) equal to 1 may be used in determination of the effective dose equivalent.

Whole body - For the purposes of external exposure, the head, trunk (including male gonads), arms above and including the elbow, or legs above and including the knee.

X

Y

Year - Means the period of time beginning on or near January 1 and ending on or near December 31 of that same year used to determine compliance with the provisions of this part. The starting and ending date of the year used to determine compliance may be changed provided that the change is made at the beginning of the year and that no day is omitted or duplicated in consecutive years.

Z

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*APPENDIX A - DERIVED AIR CONCENTRATIONS (DAC) FOR CONTROLLING RADIATION EXPOSURE TO WORKERS AT DOE FACILITIES

Subject Matter Expert: 10 CFR 835, *Occupational Radiation Protection*
MN471016, Issue C
Revision Date: January 11, 2000, Replaces Document Dated: December 13, 1996

The data presented in appendix A are to be used for controlling individual internal doses in accordance with § 835.209, identifying the need for air monitoring in accordance with § 835.403, and identifying the need for posting of airborne radioactivity areas in accordance with § 835.603(d).

The DAC values are given for individual radionuclides. For known mixtures of radionuclides, determine the sum of the ratio of the observed concentration of a particular radionuclide and its corresponding DAC for all radionuclides in the mixture. If this sum exceeds unity (1), then the DAC has been exceeded. For unknown radionuclides, the most restrictive DAC (lowest value) for those isotopes not known to be absent shall be used.

The derived air concentrations (DAC) for limiting radiation exposures through inhalation of radionuclides by workers are listed in this appendix. The values are based on either a stochastic (committed effective dose equivalent) dose limit of 5 rems (0.05 Sv) or a nonstochastic (organ) dose limit of 50 rems (0.5 Sv) per year, whichever is more limiting.

Note: the 15 rems (0.15 Sv) dose limit for the lens of eye does not appear as a critical organ dose limit.)

The columns in this appendix contain the following information: (1) Radionuclide; (2) inhaled air DAC for lung retention class D, W, and Y in units of μCi/ml; (3) inhaled air DAC for lung retention class D, W, and Y in units of Bq/m^3; and (4) an indication of whether or not the DAC for each class is controlled by the stochastic (effective dose equivalent) or nonstochastic (tissue) dose. The classes D, W, and Y have been established to describe the clearance of inhaled radionucides from the lung. This classification refers to the approximate length of retention in the pulmonary region. Thus, the range of half-times for retention in the pulmonary region is less than 10 days for class D (days), from 10 to 100 days for class W (weeks), and greater than 100 days for class Y (years). The DACs are listed by radionuclide, in order of increasing atomic mass, and are based on the assumption that the particle size distribution of the inhaled material is unknown and an assumed particle size distribution of 1 μm is used. For situations where the particle size distribution is known to differ significantly from 1 μm, appropriate corrections can be made to both the estimated dose to workers and the DACs.

*APPENDIX A - DERIVED AIR CONCENTRATIONS (DAC) FOR CONTROLLING RADIATION EXPOSURE TO WORKERS AT DOE FACILITIES (Cont'd)

Subject Matter Expert: 10 CFR 835, *Occupational Radiation Protection*
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Radionuclide	Inhaled air-lung retention class[3] µCi/ml			Inhaled air-lung retention class[3] Bq/m[3]			Stochastic or organ[1]
	D	W	Y	D	W	Y	(D/ W/ Y)
H-3 (Water)[2]	2.E−05	2.E−05	2.E−05	8.E+05	8.E+05	8.E+05	St/St/St
H-3 (Elemental)[2]	5.E−01	5.E−01	5.E−01	2.E+10	2.E+10	2.E+10	St/St/St
Be-7	–	9.E−06	8.E−06	–	3.E+05	3.E+05	/St/St
Be-10	–	6.E−08	6.E−09	–	2.E+03	2.E+02	/St/St
C-11 (Org)[2]	2.E−04	2.E−04	2.E−04	6.E+06	6.E+06	6.E+06	St/St/St
C-11 (CO)[2]	5.E−04	5.E−04	5.E−04	2.E+07	2.E+07	2.E+07	St/St/St
C-11 (CO_2)[2]	3.E−04	3.E−04	3.E−04	1.E+07	1.E+07	1.E+07	St/St/St
C-14 (Org)[2]	1.E−06	1.E−06	1.E−06	4.E+07	4.E+04	4.E+07	St/St/St
C-14 (CO)[2]	7.E−04	7.E−04	7.E−04	3.E+07	3.E+07	3.E+07	St/St/St
C-14 (CO_2)[2]	9.E−05	9.E−05	9.E−05	3.E+06	3.E+06	3.E+06	St/St/St
F-18	3.E−05	4.E−05	3.E−05	1.E+06	1.E+06	1.E+06	St/St/St
Na-22	3.E−07	–	–	1.E+04	–	–	St/ /
Na-24	2.E−06	–	–	8.E+04	–	–	St/ /
Mg-28	7.E−07	5.E−07	–	3.E+04	2.E+04	–	St/St/
Al-26	3.E−08	3.E−08	–	1.E+03	1.E+03	–	St/St/
Si-31	1.E−05	1.E−05	1.E−05	4.E+05	5.E+05	4.E+05	St/St/St
Si-32	1.E−07	5.E−08	2.E−09	4.E+03	2.E+03	8.E+01	St/St/St
P-32	4.E−07	2.E−07	–	1.E+04	6.E+03	–	St/St/
P-33	3.E−06	1.E−06	–	1.E+05	4.E+04	–	St/St/
S-35	7.E−06	9.E−07	–	3.E+05	3.E+04	–	St/St/
S-35 (Gas)	–	6.E−06	–	–	2.E+05	–	/St/
Cl-36	1.E−06	1.E−07	–	4.E+04	4.E+03	–	St/St/
Cl-38	2.E−05	2.E−05	–	6.E+05	7.E+05	–	St/St/
Cl-39	2.E−05	2.E−05	–	8.E+05	9.E+05	–	St/St/
K-40	2.E−07	–	–	6.E+03	–	–	St/ /
K-42	2.E−06	–	–	7.E+04	–	–	St/ /
K-43	4.E−06	–	–	1.E+05	–	–	St/ /
K-44	3.E−05	–	–	1.E+06	–	–	St/ /
K-45	5.E−05	–	–	2.E+06	–	–	St/ /
Ca-41	–	2.E−06	–	–	6.E+04	–	/E/
Ca-45	–	3.E−07	–	–	1.E+04	–	/St/

*APPENDIX A - DERIVED AIR CONCENTRATIONS (DAC) FOR CONTROLLING RADIATION EXPOSURE TO WORKERS AT DOE FACILITIES (Cont'd)

Subject Matter Expert: 10 CFR 835, *Occupational Radiation Protection*
MN471016, Issue C
Revision Date: January 11, 2000, Replaces Document Dated: December 13, 1996

Radionuclide	Inhaled air-lung retention class [3] µCi/ml			Inhaled air-lung retention class [3] Bq/m [3]			Stochastic or organ [1]
	D	W	Y	D	W	Y	(D/ W/ Y)
Ca-47	–	4.E – 07	–	–	1.E + 04	–	/St/
Sc-43	–	–	1.E – 05	–	–	4.E + 05	/ /St
Sc-44m	–	–	3.E – 07	–	–	1.E + 04	/ /St
Sc-44	–	–	5.E – 06	–	–	2.E + 05	/ /St
Sc-46	–	–	1.E – 07	–	–	4.E + 03	/ /St
Sc-47	–	–	1.E – 06	–	–	5.E + 04	/ /St
Sc-48	–	–	6.E – 07	–	–	2.E + 04	/ /St
Sc-49	–	–	2.E – 05	–	–	8.E + 05	/ /St
Ti-44	5.E – 09	1.E – 08	2.E – 09	2.E + 02	4.E + 02	9.E + 01	St/St/St
Ti-45	1.E – 05	1.E – 05	1.E – 05	4.E + 05	5.E + 05	5.E + 05	St/St/St
V-47	4.E – 05	4.E – 05	–	1.E + 06	1.E + 06	–	St/St/
V-48	4.E – 07	3.E – 07	–	2.E + 04	1.E + 04	–	St/St/
V-49	1.E – 05	7.E – 06	–	5.E + 05	3.E + 05	–	BS/St/
Cr-48	5.E – 06	3.E – 06	3.E – 06	2.E + 05	1.E + 05	1.E + 05	St/St/St
Cr-49	3.E – 05	4.E – 05	4.E – 05	1.E + 06	2.E + 06	1.E + 06	St/St/St
Cr-51	2.E – 05	1.E – 05	8.E – 06	7.E + 05	4.E + 05	3.E + 05	St/St/St
Mn-51	2.E – 05	2.E – 05	–	8.E + 05	9.E + 05	–	St/St/
Mn-52m	4.E – 05	4.E – 05	–	1.E + 06	2.E + 06	–	St/St/
Mn-52	5.E – 07	4.E – 07	–	2.E + 04	1.E + 04	–	St/St/
Mn-53	5.E – 06	5.E – 06	–	2.E + 05	2.E + 05	–	BS/St/
Mn-54	4.E – 07	3.E – 07	–	1.E + 04	1.E + 04	–	St/St/
Mn-56	6.E – 06	9.E – 06	–	2.E + 05	3.E + 05	–	St/St/
Fe-52	1.E – 06	1.E – 06	–	5.E + 04	4.E + 04	–	St/St/
Fe-55	8.E – 07	2.E – 06	–	3.E + 04	6.E + 04	–	St/St/
Fe-59	1.E – 07	2.E – 07	–	5.E + 03	8.E + 03	–	St/St/
Fe-60	3.E – 09	8.E – 09	–	1.E + 02	3.E + 02	–	St/St/
Co-55	–	1.E – 06	1.E – 06	–	4.E + 04	4.E + 04	/St/St
Co-56	–	1.E – 07	8.E – 08	–	5.E + 03	3.E + 03	/St/St
Co-57	–	1.E – 06	3.E – 07	–	4.E + 04	1.E + 04	/St/St
Co-58m	–	4.E – 05	3.E – 05	–	1.E + 06	1.E + 06	/St/St
Co-58	–	5.E – 07	3.E – 07	–	2.E + 04	1.E + 04	/St/St
Co-60m	–	2.E – 03	1.E – 03	–	6.E + 07	4.E + 07	/St/St
Co-60	–	7.E – 08	1.E – 08	–	3.E + 03	5.E + 02	/St/St
Co-61	–	3.E – 05	2.E – 05	–	1.E + 06	9.E + 05	/St/St
Co-62m	–	7.E – 05	7.E – 05	–	3.E + 06	2.E + 06	/St/St
Ni-56 (Inorg)	8.E – 07	5.E – 07	–	3.E + 04	2.E + 04	–	St/St/
Ni-56 (Vapor)	–	5.E – 07	–	–	2.E + 04	–	/St/
Ni-57 (Inorg)	2.E – 06	1.E – 06	–	7.E + 04	5.E + 04	–	St/St/
Ni-57 (Vapor)	–	3.E – 06	–	–	1.E + 05	–	/St/
Ni-59 (Inorg)	2.E – 06	3.E – 06	–	6.E + 04	1.E + 05	–	St/St/
Ni-59 (Vapor)	–	8.E – 07	–	–	3.E + 04	–	/St/
Ni-63 (Inorg)	7.E – 07	1.E – 06	–	3.E + 04	4.E + 04	–	St/St/
Ni-63 (Vapor)	–	3.E – 07	–	–	1.E + 04	–	/St/
Ni-65 (Inorg)	1.E – 05	1.E – 05	–	4.E + 05	5.E + 05	–	St/St/
Ni-65 (Vapor)	–	7.E – 06	–	–	3.E + 05	–	/St/
Ni-66 (Inorg)	7.E – 07	3.E – 07	–	3.E + 04	1.E + 04	–	St/St/
Ni-66 (Vapor)	–	1.E – 06	–	–	5.E + 04	–	/St/
Cu-60	4.E – 05	5.E – 05	4.E – 05	1.E + 06	2.E + 06	2.E + 06	St/St/St
Cu-61	1.E – 05	2.E – 05	1.E – 05	5.E + 05	6.E + 05	5.E + 05	St/St/St
Cu-64	1.E – 05	1.E – 05	9.E – 06	5.E + 05	4.E + 05	3.E + 05	St/St/St
Cu-67	3.E – 06	2.E – 06	2.E – 06	1.E + 05	8.E + 04	7.E + 04	St/St/St
Zn-62	–	–	1.E – 06	–	–	4.E + 04	/ /St
Zn-63	–	–	3.E – 05	–	–	1.E + 06	/ /St
Zn-65	–	–	1.E – 07	–	–	4.E + 03	/ /St
Zn-69m	–	–	3.E – 06	–	–	1.E + 05	/ /St
Zn-69	–	–	6.E – 05	–	–	2.E + 06	/ /St
Zn-71m	–	–	7.E – 06	–	–	3.E + 05	/ /St
Zn-72	–	–	5.E – 07	–	–	2.E + 04	/ /St
Ga-65	7.E – 05	6.E – 05	–	3.E + 06	3.E + 06	–	St/St/
Ga-66	1.E – 06	1.E – 06	–	5.E + 04	5.E + 04	–	St/St/
Ga-67	6.E – 06	4.E – 06	–	2.E + 05	2.E + 05	–	St/St/
Ga-68	2.E – 05	2.E – 05	–	6.E + 05	8.E + 05	–	St/St/
Ga-70	7.E – 05	8.E – 05	–	3.E + 06	3.E + 06	–	St/St/
Ga-72	2.E – 06	1.E – 06	–	6.E + 04	5.E + 04	–	St/St/
Ga-73	6.E – 06	6.E – 06	–	2.E + 05	2.E + 05	–	St/St/
Ge-66	1.E – 05	8.E – 06	–	4.E + 05	3.E + 05	–	St/St/
Ge-67	4.E – 05	4.E – 05	–	1.E + 06	2.E + 06	–	St/St/

*APPENDIX A - DERIVED AIR CONCENTRATIONS (DAC) FOR CONTROLLING RADIATION EXPOSURE TO WORKERS AT DOE FACILITIES (Cont'd)

Subject Matter Expert: 10 CFR 835, *Occupational Radiation Protection*
MN471016, Issue C
Revision Date: January 11, 2000, Replaces Document Dated: December 13, 1996

Radionuclide	Inhaled air-lung retention class [3] µCi/ml			Inhaled air-lung retention class [3] Bq/m [3]			Stochastic or organ [1]
	D	W	Y	D	W	Y	(D/ W/ Y)
Ge-75	3.E-05	3.E-05	-	1.E+06	1.E+06	-	St/St/
Ge-77	4.E-06	2.E-06	-	2.E+05	9.E+04	-	St/St/
Ge-78	9.E-06	9.E-06	-	4.E+05	3.E+05	-	St/St/
As-69	-	5.E-05	-	-	2.E+06	-	/St/
As-70	-	2.E-05	-	-	6.E+05	-	/St/
As-71	-	2.E-06	-	-	7.E+04	-	/St/
As-72	-	6.E-07	-	-	2.E+04	-	/St/
As-73	-	7.E-07	-	-	3.E+04	-	/St/
As-74	-	3.E-07	-	-	1.E+04	-	/St/
As-76	-	6.E-07	-	-	2.E+04	-	/St/
As-77	-	2.E-06	-	-	8.E+04	-	/St/
As-78	-	9.E-06	-	-	3.E+05	-	/St/
Se-70	1.E-05	2.E-05	-	6.E+05	7.E+05	-	St/St/
Se-73m	6.E-05	6.E-05	-	2.E+06	2.E+06	-	St/St/
Se-73	6.E-06	7.E-06	-	2.E+05	2.E+05	-	St/St/
Se-75	3.E-07	3.E-07	-	1.E+04	9.E+03	-	St/St/
Se-79	3.E-07	2.E-07	-	1.E+04	9.E+03	-	St/St/
Se-81m	3.E-05	3.E-05	-	1.E+06	1.E+06	-	St/St/
Se-81	9.E-05	1.E-04	-	3.E+06	4.E+06	-	St/St/
Se-83	5.E-05	5.E-05	-	2.E+06	2.E+06	-	St/St/
Br-74m	1.E-05	2.E-05	-	6.E+05	6.E+05	-	St/St/
Br-74	3.E-05	3.E-05	-	1.E+06	1.E+06	-	St/St/
Br-75	2.E-05	2.E-05	-	7.E+05	8.E+05	-	St/St/
Br-76	2.E-06	2.E-06	-	7.E+04	7.E+04	-	St/St/
Br-77	1.E-05	8.E-06	-	4.E+05	3.E+05	-	St/St/
Br-80m	7.E-06	6.E-06	-	3.E+05	2.E+05	-	St/St/
Br-80	8.E-05	9.E-05	-	3.E+06	3.E+06	-	St/St/
Br-82	2.E-06	2.E-06	-	6.E+04	6.E+04	-	St/St/
Br-83	3.E-05	3.E-05	-	1.E+06	1.E+06	-	St/St/
Br-84	2.E-05	3.E-05	-	9.E+05	1.E+06	-	St/St/
Rb-79	5.E-05	-	-	2.E+06	-	-	St/ /
Rb-81m	1.E-04	-	-	5.E+06	-	-	St/ /
Rb-81	2.E-05	-	-	8.E+05	-	-	St/ /
Rb-82m	7.E-06	-	-	3.E+05	-	-	St/ /
Rb-83	4.E-07	-	-	2.E+04	-	-	St/ /
Rb-84	3.E-07	-	-	1.E+04	-	-	St/ /
Rb-86	3.E-07	-	-	1.E+04	-	-	St/ /
Rb-87	6.E-07	-	-	2.E+04	-	-	St/ /
Rb-88	3.E-05	-	-	1.E+06	-	-	St/ /
Rb-89	6.E-05	-	-	2.E+06	-	-	St/ /
Sr-80	5.E-06	-	5.E-06	2.E+05	-	2.E+05	St/ /St
Sr-81	3.E-05	-	3.E-05	1.E+06	-	1.E+06	St/ /St
Sr-83	3.E-06	-	2.E-06	1.E+05	-	5.E+04	St/ /St
Sr-85m	3.E-04	-	3.E-04	9.E+06	-	1.E+07	St/ /St
Sr-85	1.E-06	-	7.E-07	4.E+04	-	2.E+04	St/ /St
Sr-87m	5.E-05	-	6.E-05	2.E+06	-	2.E+06	St/ /St
Sr-89	3.E-07	-	6.E-08	1.E+04	-	2.E+03	St/ /St
Sr-90	8.E-09	-	2.E-09	3.E+02	-	6.E+01	BS/ /St
Sr-91	2.E-06	-	1.E-06	9.E+04	-	5.E+04	St/ /St
Sr-92	4.E-06	-	3.E-06	1.E+05	-	1.E+05	St/ /St
Y-86m	-	2.E-05	2.E-05	-	9.E+05	9.E+05	/St/St
Y-86	-	1.E-06	1.E-06	-	5.E+04	5.E+04	/St/St
Y-87	-	1.E-06	1.E-06	-	5.E+04	5.E+04	/St/St
Y-88	-	1.E-07	1.E-07	-	4.E+03	4.E+03	/St/St
Y-90m	-	5.E-06	5.E-06	-	2.E+05	2.E+05	/St/St
Y-90	-	3.E-07	2.E-07	-	1.E+04	9.E+03	/St/St
Y-91m	-	1.E-04	7.E-05	-	4.E+06	3.E+06	/St/St
Y-91	-	7.E-08	5.E-08	-	3.E+03	2.E+03	/St/St
Y-92	-	3.E-06	3.E-06	-	1.E+05	1.E+05	/St/St
Y-93	-	1.E-06	1.E-06	-	4.E+04	4.E+04	/St/St
Y-94	-	3.E-05	3.E-05	-	1.E+06	1.E+06	/St/St
Y-95	-	6.E-05	6.E-05	-	2.E+06	2.E+06	/St/St
Zr-86	2.E-06	1.E-06	1.E-06	6.E+04	4.E+04	4.E+04	St/St/St
Zr-88	9.E-08	2.E-07	1.E-07	3.E+03	7.E+03	5.E+03	St/St/St
Zr-89	2.E-06	1.E-06	1.E-06	5.E+04	4.E+04	4.E+04	St/St/St
Zr-93	3.E-09	1.E-08	2.E-08	1.E+02	4.E+02	9.E+02	BS/BS/BS
Zr-95	6.E-08	2.E-07	1.E-07	2.E+03	6.E+03	4.E+03	BS/St/St

*APPENDIX A - DERIVED AIR CONCENTRATIONS (DAC) FOR CONTROLLING RADIATION EXPOSURE TO WORKERS AT DOE FACILITIES (Cont'd)

Subject Matter Expert: 10 CFR 835, *Occupational Radiation Protection*
MN471016, Issue C
Revision Date: January 11, 2000, Replaces Document Dated: December 13, 1996

Radionuclide	Inhaled air-lung retention class [3] µCi/ml			Inhaled air-lung retention class [3] Bq/m [3]			Stochastic or organ [1]
	D	W	Y	D	W	Y	(D/ W/ Y)
Nb-89 (122 min)	–	8.E–06	7.E–06	–	3.E+05	2.E+05	/St/St
Nb-90	–	1.E–06	1.E–06	–	4.E+04	4.E+04	/St/St
Nb-93m	–	5.E–07	7.E–08	–	2.E+04	3.E+03	/St/St
Nb-94	–	8.E–08	6.E–09	–	3.E+03	2.E+02	/St/St
Nb-95m	–	1.E–06	9.E–07	–	4.E+04	4.E+04	/St/St
Nb-95	–	5.E–07	5.E–07	–	2.E+04	2.E+04	/St/St
Nb-96	–	1.E–06	1.E–06	–	4.E+04	4.E+04	/St/St
Nb-97	–	3.E–05	3.E–05	–	1.E+06	1.E+06	/St/St
Nb-98	–	2.E–05	2.E–05	–	8.E+05	8.E+05	/St/St
Mo-90	3.E–06	–	2.E–06	1.E+05	–	7.E+04	St/ /St
Mo-93m	7.E–06	–	6.E–06	3.E+05	–	2.E+05	St/ /St
Mo-93	2.E–06	–	7.E–08	8.E+04	–	3.E+03	St/ /St
Mo-99	1.E–06	–	6.E–07	4.E+04	–	2.E+04	St/ /St
Mo-101	6.E–05	–	6.E–05	2.E+06	–	2.E+06	St/ /St
Tc-93m	7.E–05	1.E–04	–	2.E+06	5.E+06	–	St/St/
Tc-93	3.E–05	4.E–05	–	1.E+06	2.E+06	–	St/St/
Tc-94m	2.E–05	2.E–05	–	7.E+05	9.E+05	–	St/St/
Tc-94	8.E–06	1.E–05	–	3.E+05	4.E+05	–	St/St/
Tc-96m	1.E–04	1.E–04	–	4.E+06	4.E+06	–	St/St/
Tc-96	1.E–06	9.E–07	–	5.E+04	3.E+04	–	St/St/
Tc-97m	3.E–06	5.E–07	–	1.E+05	2.E+04	–	SW/St/
Tc-97	2.E–05	2.E–06	–	8.E+05	9.E+04	–	St/St/
Tc-98	7.E–07	1.E–07	–	3.E+04	5.E+03	–	St/St/
Tc-99m	6.E–05	1.E–04	–	2.E+06	4.E+06	–	St/St/
Tc-99	2.E–06	3.E–07	–	8.E+04	1.E+04	–	SW/St/
Tc-101	1.E–04	2.E–04	–	5.E+06	6.E+06	–	St/St/
Tc-104	3.E–05	4.E–05	–	1.E+06	1.E+06	–	St/St/
Ru-94	2.E–05	3.E–05	2.E–05	7.E+05	1.E+06	9.E+05	St/St/St
Ru-97	8.E–06	5.E–06	5.E–06	3.E+05	2.E+05	2.E+05	St/St/St
Ru-103	7.E–07	4.E–07	3.E–07	3.E+04	2.E+04	1.E+04	St/St/St
Ru-105	6.E–06	6.E–06	5.E–06	2.E+05	2.E+05	2.E+05	St/St/St
Ru-106	4.E–08	2.E–08	5.E–09	1.E+03	8.E+02	2.E+02	St/St/St
Rh-99m	2.E–05	3.E–05	3.E–05	9.E+05	1.E+06	1.E+06	St/St/St
Rh-99	1.E–06	9.E–07	8.E–07	5.E+04	3.E+04	3.E+04	St/St/St
Rh-100	2.E–06	2.E–06	2.E–06	8.E+04	6.E+04	6.E+04	St/St/St
Rh-101m	5.E–06	3.E–06	3.E–06	2.E+05	1.E+05	1.E+05	St/St/St
Rh-101	2.E–07	3.E–07	7.E–08	8.E+03	1.E+04	2.E+03	St/St/St
Rh-102m	2.E–07	2.E–07	5.E–08	8.E+03	6.E+03	2.E+03	St/St/St
Rh-102	4.E–08	7.E–08	2.E–08	1.E+03	3.E+03	9.E+02	St/St/St
Rh-103m	4.E–04	5.E–04	5.E–04	2.E+07	2.E+07	2.E+07	St/St/St
Rh-105	5.E–06	3.E–06	2.E–06	2.E+05	1.E+05	9.E+04	St/St/St
Rh-106m	1.E–05	1.E–05	1.E–05	4.E+05	6.E+05	5.E+05	St/St/St
Rh-107	1.E–04	1.E–04	1.E–04	4.E+06	4.E+06	4.E+06	St/St/St
Pd-100	6.E–07	5.E–07	6.E–07	2.E+04	2.E+04	2.E+04	St/St/St
Pd-101	1.E–05	1.E–05	1.E–05	5.E+05	5.E+05	5.E+05	St/St/St
Pd-103	3.E–06	2.E–06	1.E–06	1.E+05	7.E+04	5.E+04	St/St/St
Pd-107	9.E–06	3.E–06	2.E–07	3.E+05	1.E+05	6.E+03	K /St/St
Pd-109	3.E–06	2.E–06	2.E–06	1.E+05	8.E+04	7.E+04	St/St/St
Ag-102	8.E–05	9.E–05	8.E–05	3.E+06	3.E+06	3.E+06	St/St/St
Ag-103	4.E–05	6.E–05	5.E–05	2.E+06	2.E+06	2.E+06	St/St/St
Ag-104m	4.E–05	5.E–05	5.E–05	2.E+06	2.E+06	2.E+06	St/St/St
Ag-104	3.E–05	6.E–05	6.E–05	1.E+06	2.E+06	2.E+06	St/St/St
Ag-105	4.E–07	7.E–07	7.E–07	2.E+04	3.E+04	3.E+04	St/St/St
Ag-106m	3.E–07	4.E–07	4.E–07	1.E+04	1.E+04	1.E+04	St/St/St
Ag-106	7.E–05	8.E–05	8.E–05	3.E+06	3.E+06	3.E+06	St/St/St
Ag-108m	8.E–08	1.E–07	1.E–08	3.E+03	4.E+03	4.E+02	St/St/St
Ag-110m	6.E–08	8.E–08	4.E–08	2.E+03	3.E+03	1.E+03	St/St/St
Ag-111	7.E–07	4.E–07	4.E–07	2.E+04	1.E+04	1.E+04	L /St/St
Ag-112	3.E–06	4.E–06	4.E–06	1.E+05	2.E+05	1.E+05	St/St/St
Ag-115	4.E–05	4.E–05	3.E–05	1.E+06	1.E+06	1.E+06	St/St/St
Cd-104	3.E–05	5.E–05	5.E–05	1.E+06	2.E+06	2.E+06	St/St/St
Cd-107	2.E–05	2.E–05	2.E–05	8.E+05	9.E+05	8.E+05	St/St/St
Cd-109	1.E–08	5.E–08	5.E–08	5.E+02	2.E+03	2.E+03	K /K /St
Cd-113m	1.E–09	4.E–09	5.E–09	4.E+01	1.E+02	2.E+02	K /K /St
Cd-113	9.E–10	3.E–09	6.E–09	4.E+01	1.E+02	2.E+02	K /K /St
Cd-115m	2.E–08	5.E–08	6.E–08	8.E+02	2.E+03	2.E+03	K /St/St

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Subject Matter Expert: 10 CFR 835, *Occupational Radiation Protection*
MN471016, Issue C
Revision Date: January 11, 2000, Replaces Document Dated: December 13, 1996

Radionuclide	Inhaled air-lung retention class[a] µCi/ml			Inhaled air-lung retention class[a] Bq/m³			Stochastic or organ[1]
	D	W	Y	D	W	Y	(D/ W/ Y)
In-110 (69 min)	2.E−05	2.E−05	–	7.E+05	9.E+05	–	St/St/
In-110 (5 h)	7.E−06	8.E−06	–	3.E+05	3.E+05	–	St/St/
In-111	3.E−06	3.E−06	–	1.E+05	1.E+05	–	St/St/
In-112	3.E−04	3.E−04	–	1.E+07	1.E+07	–	St/St/
In-113m	6.E−05	8.E−05	–	2.E+06	3.E+06	–	St/St/
In-114m	3.E−08	4.E−08	–	1.E+03	2.E+03	–	St/St/
In-115m	2.E−05	2.E−05	–	7.E+05	7.E+05	–	St/St/
In-115	6.E−10	2.E−09	–	2.E+01	8.E+01	–	St/St/
In-116m	3.E−05	5.E−05	–	1.E+06	2.E+06	–	St/St/
In-117m	1.E−05	2.E−05	–	5.E+05	7.E+05	–	St/St/
In-117	7.E−05	9.E−05	–	3.E+06	3.E+06	–	St/St/
In-119m	5.E−05	6.E−05	–	2.E+06	2.E+06	–	St/St/
Sn-110	5.E−06	5.E−06	–	2.E+05	2.E+05	–	St/St/
Sn-111	9.E−05	1.E−04	–	4.E+06	4.E+06	–	St/St/
Sn-113	5.E−07	2.E−07	–	2.E+04	9.E+03	–	St/St/
Sn-117m	5.E−07	6.E−07	–	2.E+04	2.E+04	–	BS/St/
Sn-119m	1.E−06	4.E−07	–	4.E+04	1.E+04	–	St/St/
Sn-121m	4.E−07	2.E−07	–	1.E+04	9.E+03	–	St/St/
Sn-121	6.E−06	5.E−06	–	2.E+05	2.E+05	–	St/St/
Sn-123m	5.E−05	6.E−05	–	2.E+06	2.E+06	–	St/St/
Sn-123	3.E−07	7.E−08	–	1.E+04	3.E+03	–	St/St/
Sn-125	4.E−07	2.E−07	–	1.E+04	5.E+03	–	St/St/
Sn-126	2.E−08	3.E−08	–	9.E+02	1.E+03	–	St/St/
Sn-127	8.E−06	8.E−06	–	3.E+05	3.E+05	–	St/St/
Sn-128	1.E−05	1.E−05	–	4.E+05	6.E+05	–	St/St/
Sb-115	1.E−04	1.E−04	–	4.E+06	5.E+06	–	St/St/
Sb-116m	3.E−05	6.E−05	–	1.E+06	2.E+06	–	St/St/
Sb-116	1.E−04	1.E−04	–	4.E+06	5.E+06	–	St/St/
Sb-117	9.E−05	1.E−04	–	3.E+06	4.E+06	–	St/St/
Sb-118m	8.E−06	9.E−06	–	3.E+05	3.E+05	–	St/St/
Sb-119	2.E−05	1.E−05	–	7.E+05	4.E+05	–	St/St/
Sb-120 (16 min)	2.E−04	2.E−04	–	7.E+06	8.E+06	–	St/St/
Sb-120 (6 d)	9.E−07	6.E−07	–	3.E+04	2.E+04	–	St/St/
Sb-122	1.E−06	4.E−07	–	4.E+04	2.E+04	–	St/St/
Sb-124m	3.E−04	3.E−04	–	1.E+07	9.E+06	–	St/St/
Sb-124	4.E−07	1.E−07	–	1.E+04	4.E+03	–	St/St/
Sb-125	1.E−06	2.E−07	–	4.E+04	8.E+03	–	St/St/
Sb-126m	8.E−05	8.E−05	–	3.E+06	3.E+06	–	St/St/
Sb-126	4.E−07	2.E−07	–	2.E+04	8.E+03	–	St/St/
Sb-127	9.E−07	4.E−07	–	3.E+04	1.E+04	–	St/St/
Sb-128 (9 h)	2.E−06	1.E−06	–	6.E+04	5.E+04	–	St/St/
Sb-128 (10 min)	2.E−04	2.E−04	–	6.E+06	7.E+06	–	St/St/
Sb-129	4.E−06	4.E−06	–	1.E+05	1.E+05	–	St/St/
Sb-130	3.E−05	3.E−05	–	1.E+06	1.E+06	–	St/St/
Sb-131	1.E−05	1.E−05	–	4.E+05	4.E+05	–	T /T /
Te-116	9.E−06	1.E−05	–	3.E+05	5.E+05	–	St/St/
Te-121m	8.E−08	2.E−07	–	3.E+03	6.E+03	–	BS/St/
Te-121	2.E−06	1.E−06	–	7.E+04	5.E+04	–	St/St/
Te-123m	9.E−08	2.E−07	–	3.E+03	8.E+03	–	BS/St/
Te-123	8.E−08	2.E−07	–	3.E+03	7.E+03	–	BS/BS/
Te-125m	2.E−07	3.E−07	–	7.E+03	1.E+04	–	BS/St/
Te-127m	1.E−07	1.E−07	–	4.E+03	4.E+03	–	BS/St/
Te-127	9.E−06	7.E−06	–	4.E+05	3.E+05	–	St/St/
Te-129m	3.E−07	1.E−07	–	1.E+04	4.E+03	–	St/St/
Te-129	3.E−05	3.E−05	–	1.E+06	1.E+06	–	St/St/
Te-131m	2.E−07	2.E−07	–	6.E+03	6.E+03	–	T /T /
Te-131	2.E−06	2.E−06	–	8.E+04	8.E+04	–	T /T /
Te-132	9.E−08	9.E−08	–	4.E+03	3.E+03	–	T /T /
Te-133m	2.E−06	2.E−06	–	8.E+04	8.E+04	–	T /T /
Te-133	9.E−06	9.E−06	–	4.E+05	4.E+05	–	T /T /
Te-134	1.E−05	1.E−05	–	4.E+05	4.E+05	–	T /T /
I-120m	9.E−06	–	–	3.E+05	–	–	St/ /
I-120	4.E−06	–	–	1.E+05	–	–	T / /
I-121	7.E−06	–	–	3.E+05	–	–	T / /
I-123	3.E−06	–	–	1.E+05	–	–	T / /
I-124	3.E−08	–	–	1.E+03	–	–	T / /
I-125	3.E−08	–	–	1.E+03	–	–	T / /

*APPENDIX A - DERIVED AIR CONCENTRATIONS (DAC) FOR CONTROLLING RADIATION EXPOSURE TO WORKERS AT DOE FACILITIES (Cont'd)

Subject Matter Expert: 10 CFR 835, *Occupational Radiation Protection*
MN471016, Issue C
Revision Date: January 11, 2000, Replaces Document Dated: December 13, 1996

Radionuclide	Inhaled air-lung retention class [3] µCi/ml			Inhaled air-lung retention class [3] Bq/m [3]			Stochastic or organ [1]
	D	W	Y	D	W	Y	(D/ W/ Y)
I-130	3.E-07	–	–	1.E+04	–	–	T / /
I-131	2.E-08	–	–	7.E+02	–	–	T / /
I-132m	4.E-06	–	–	1.E+05	–	–	T / /
I-132	3.E-06	–	–	1.E+05	–	–	T / /
I-133	1.E-07	–	–	4.E+03	–	–	T / /
I-134	2.E-05	–	–	7.E+05	–	–	E / /
I-135	7.E-07	–	–	2.E+04	–	–	T / /
Cs-125	6.E-05	–	–	2.E+06	–	–	St/ /
Cs-127	4.E-05	–	–	2.E+06	–	–	St/ /
Cs-129	1.E-05	–	–	5.E+05	–	–	St/ /
Cs-130	8.E-05	–	–	3.E+06	–	–	St/ /
Cs-131	1.E-05	–	–	5.E+05	–	–	St/ /
Cs-132	2.E-06	–	–	6.E+04	–	–	St/ /
Cs-134m	6.E-05	–	–	2.E+06	–	–	St/ /
Cs-134	4.E-08	–	–	2.E+03	–	–	St/ /
Cs-135m	8.E-05	–	–	3.E+06	–	–	St/ /
Cs-135	5.E-07	–	–	2.E+04	–	–	St/ /
Cs-136	3.E-07	–	–	1.E+04	–	–	St/ /
Cs-137	7.E-08	–	–	2.E+03	–	–	St/ /
Cs-138	2.E-05	–	–	9.E+05	–	–	St/ /
Ba-126	6.E-06	–	–	2.E+05	–	–	St/ /
Ba-128	7.E-07	–	–	3.E+04	–	–	St/ /
Ba-131m	6.E-04	–	–	2.E+07	–	–	St/ /
Ba-131	3.E-06	–	–	1.E+05	–	–	St/ /
Ba-133m	4.E-06	–	–	1.E+05	–	–	St/ /
Ba-133	3.E-07	–	–	1.E+04	–	–	St/ /
Ba-135m	5.E-06	–	–	2.E+05	–	–	St/ /
Ba-139	1.E-05	–	–	5.E+05	–	–	St/ /
Ba-140	6.E-07	–	–	2.E+04	–	–	St/ /
Ba-141	3.E-05	–	–	1.E+06	–	–	St/ /
Ba-142	6.E-05	–	–	2.E+06	–	–	St/ /
La-131	5.E-05	7.E-05	–	2.E+06	3.E+06	–	St/St/
La-132	4.E-06	5.E-06	–	2.E+05	2.E+05	–	St/St/
La-135	4.E-05	4.E-05	–	2.E+06	2.E+06	–	St/St/
La-137	3.E-08	1.E-07	–	1.E+03	4.E+03	–	L /E /
La-138	2.E-09	6.E-09	–	5.E+01	2.E+02	–	St/St/
La-140	6.E-07	5.E-07	–	2.E+04	2.E+04	–	St/St/
La-141	4.E-06	5.E-06	–	1.E+05	2.E+05	–	St/St/
La-142	9.E-06	1.E-05	–	4.E+05	5.E+05	–	St/St/
La-143	4.E-05	4.E-05	–	2.E+06	1.E+06	–	St/St/
Ce-134	–	3.E-07	3.E-07	–	1.E+04	1.E+04	/St/St
Ce-135	–	2.E-06	2.E-06	–	6.E+04	5.E+04	/St/St
Ce-137m	–	2.E-06	2.E-06	–	7.E+04	6.E+04	/St/St
Ce-137	–	6.E-05	5.E-05	–	2.E+06	2.E+06	/St/St
Ce-139	–	3.E-07	3.E-07	–	1.E+04	1.E+04	/St/St
Ce-141	–	3.E-07	2.E-07	–	1.E+04	9.E+03	/St/St
Ce-143	–	8.E-07	7.E-07	–	3.E+04	2.E+04	/St/St
Ce-144	–	1.E-08	6.E-09	–	4.E+02	2.E+02	/St/St
Pr-136	–	1.E-04	9.E-05	–	4.E+06	4.E+06	/St/St
Pr-137	–	6.E-05	6.E-05	–	2.E+06	2.E+06	/St/St
Pr-138m	–	2.E-05	2.E-05	–	8.E+05	7.E+05	/St/St
Pr-139	–	5.E-05	5.E-05	–	2.E+06	2.E+06	/St/St
Pr-142m	–	7.E-05	6.E-05	–	3.E+06	2.E+06	/St/St
Pr-142	–	8.E-07	8.E-07	–	3.E+04	3.E+04	/St/St
Pr-143	–	3.E-07	3.E-07	–	1.E+04	1.E+04	/St/St
Pr-144	–	5.E-05	5.E-05	–	2.E+06	2.E+06	/St/St
Pr-145	–	4.E-06	3.E-06	–	1.E+05	1.E+05	/St/St
Pr-147	–	8.E-05	8.E-05	–	3.E+06	3.E+06	/St/St
Nd-136	–	2.E-05	2.E-05	–	9.E+05	8.E+05	/St/St
Nd-138	–	3.E-06	2.E-06	–	1.E+05	8.E+04	/St/St
Nd-139m	–	7.E-06	6.E-06	–	3.E+05	2.E+05	/St/St
Nd-139	–	1.E-04	1.E-04	–	5.E+06	4.E+06	/St/St
Nd-141	–	3.E-04	3.E-04	–	1.E+07	9.E+06	/St/St
Nd-147	–	4.E-07	3.E-07	–	2.E+04	1.E+04	/St/St
Nd-149	–	1.E-05	1.E-05	–	4.E+05	4.E+05	/St/St
Nd-151	–	8.E-05	8.E-05	–	3.E+06	3.E+06	/St/St
Pm-141	–	8.E-05	7.E-05	–	3.E+06	3.E+06	/St/St

*APPENDIX A - DERIVED AIR CONCENTRATIONS (DAC) FOR CONTROLLING RADIATION EXPOSURE TO WORKERS AT DOE FACILITIES (Cont'd)

Subject Matter Expert: 10 CFR 835, *Occupational Radiation Protection*
MN471016, Issue C
Revision Date: January 11, 2000, Replaces Document Dated: December 13, 1996

Radionuclide	Inhaled air-lung retention class[3] µCi/ml			Inhaled air-lung retention class[3] Bq/m[3]			Stochastic or organ[1]
	D	W	Y	D	W	Y	(D/ W/ Y)
Pm-146	–	2.E−08	2.E−08	–	8.E+02	7.E+02	/St/St
Pm-147	–	6.E−08	6.E−08	–	2.E+03	2.E+03	/BS/St
Pm-148m	–	1.E−07	1.E−07	–	5.E+03	5.E+03	/St/St
Pm-148	–	2.E−07	2.E−07	–	8.E+03	8.E+03	/St/St
Pm-149	–	8.E−07	8.E−07	–	3.E+04	3.E+04	/St/St
Pm-150	–	8.E−06	7.E−06	–	3.E+05	3.E+05	/St/St
Pm-151	–	2.E−06	1.E−06	–	6.E+04	5.E+04	/St/St
Sm-141m	–	4.E−05	–	–	2.E+06	–	/St/
Sm-141	–	7.E−05	–	–	3.E+06	–	/St/
Sm-142	–	1.E−05	–	–	4.E+05	–	/St/
Sm-145	–	2.E−07	–	–	8.E+03	–	/St/
Sm-146	–	1.E−11	–	–	6.E−01	–	/BS/
Sm-147	–	2.E−11	–	–	6.E−01	–	/BS/
Sm-151	–	4.E−08	–	–	2.E+03	–	/BS/
Sm-153	–	1.E−06	–	–	4.E+04	–	/St/
Sm-155	–	9.E−05	–	–	3.E+06	–	/St/
Sm-156	–	4.E−06	–	–	1.E+05	–	/St/
Eu-145	–	8.E−07	–	–	3.E+04	–	/St/
Eu-146	–	5.E−07	–	–	2.E+04	–	/St/
Eu-147	–	7.E−07	–	–	3.E+04	–	/St/
Eu-148	–	2.E−07	–	–	6.E+03	–	/St/
Eu-149	–	1.E−06	–	–	5.E+04	–	/St/
Eu-150 (12 h)	–	3.E−06	–	–	1.E+05	–	/St/
Eu-150 (34 yr)	–	8.E−09	–	–	3.E+02	–	/St/
Eu-152m	–	3.E−06	–	–	1.E+05	–	/St/
Eu-152	–	1.E−08	–	–	4.E+02	–	/St/
Eu-154	–	8.E−09	–	–	3.E+02	–	/St/
Eu-155	–	4.E−08	–	–	1.E+03	–	/BS/
Eu-156	–	2.E−07	–	–	7.E+03	–	/St/
Eu-157	–	2.E−06	–	–	7.E+04	–	/St/
Eu-158	–	2.E−05	–	–	9.E+05	–	/St/
Gd-145	7.E−05	7.E−05	–	2.E+06	3.E+06	–	St/St/
Gd-146	5.E−08	1.E−07	–	2.E+03	4.E+03	–	St/St/
Gd-147	2.E−06	2.E−06	–	6.E+04	5.E+04	–	St/St/
Gd-148	3.E−12	1.E−11	–	1.E−01	5.E−01	–	BS/BS/
Gd-149	9.E−07	1.E−06	–	3.E+04	4.E+04	–	St/St/
Gd-151	2.E−07	5.E−07	–	6.E+03	2.E+04	–	BS/St/
Gd-152	4.E−12	2.E−11	–	2.E−01	6.E−01	–	BS/BS/
Gd-153	6.E−08	3.E−07	–	2.E+03	9.E+03	–	BS/St/
Gd-159	3.E−06	2.E−06	–	1.E+05	9.E+04	–	St/St/
Tb-147	–	1.E−05	–	–	5.E+05	–	/St/
Tb-149	–	3.E−07	–	–	1.E+04	–	/St/
Tb-150	–	9.E−06	–	–	3.E+05	–	/St/
Tb-151	–	4.E−06	–	–	1.E+05	–	/St/
Tb-153	–	3.E−06	–	–	1.E+05	–	/St/
Tb-154	–	2.E−06	–	–	7.E+04	–	/St/
Tb-155	–	3.E−06	–	–	1.E+05	–	/St/
Tb-156m (24 h)	–	3.E−06	–	–	1.E+05	–	/St/
Tb-156m (5 h)	–	1.E−05	–	–	4.E+05	–	/St/
Tb-156	–	6.E−07	–	–	2.E+04	–	/St/
Tb-157	–	1.E−07	–	–	5.E+03	–	/BS/
Tb-158	–	8.E−09	–	–	3.E+02	–	/St/
Tb-160	–	1.E−07	–	–	4.E+03	–	/St/
Tb-161	–	7.E−07	–	–	2.E+04	–	/St/
Dy-155	–	1.E−05	–	–	4.E+05	–	/St/
Dy-157	–	3.E−05	–	–	1.E+06	–	/St/
Dy-159	–	1.E−06	–	–	4.E+04	–	/St/
Dy-165	–	2.E−05	–	–	7.E+05	–	/St/
Dy-166	–	3.E−07	–	–	1.E+04	–	/St/
Ho-155	–	7.E−05	–	–	2.E+06	–	/St/
Ho-157	–	6.E−04	–	–	2.E+07	–	/St/
Ho-159	–	4.E−04	–	–	2.E+07	–	/St/
Ho-161	–	2.E−04	–	–	7.E+06	–	/St/
Ho-162m	–	1.E−04	–	–	4.E+06	–	/St/
Ho-162	–	1.E−03	–	–	4.E+07	–	/St/
Ho-164m	–	1.E−04	–	–	5.E+06	–	/St/
Ho-164	–	3.E−04	–	–	1.E+07	–	/St/

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Subject Matter Expert: 10 CFR 835, *Occupational Radiation Protection*
MN471016, Issue C
Revision Date: January 11, 2000, Replaces Document Dated: December 13, 1996

Radionuclide	Inhaled air-lung retention class[3] µCi/ml			Inhaled air-lung retention class[3] Bq/m[3]			Stochastic or organ[1]
	D	W	Y	D	W	Y	(D/ W/ Y)
Er-161	–	3.E−05	–	–	1.E+06	–	/St/
Er-165	–	8.E−05	–	–	3.E+06	–	/St/
Er-169	–	1.E−06	–	–	4.E+04	–	/St/
Er-171	–	4.E−06	–	–	2.E+05	–	/St/
Er-172	–	6.E−07	–	–	2.E+04	–	/St/
Tm-162	–	1.E−04	–	–	4.E+06	–	/St/
Tm-166	–	6.E−06	–	–	2.E+05	–	/St/
Tm-167	–	8.E−07	–	–	3.E+04	–	/St/
Tm-170	–	9.E−08	–	–	3.E+03	–	/St/
Tm-171	–	1.E−07	–	–	5.E+03	–	/BS/
Tm-172	–	5.E−07	–	–	2.E+04	–	/St/
Tm-173	–	5.E−06	–	–	2.E+05	–	/St/
Tm-175	–	1.E−04	–	–	4.E+06	–	/St/
Yb-162	–	1.E−04	1.E−04	–	5.E+06	4.E+06	/St/St
Yb-166	–	8.E−07	8.E−07	–	3.E+04	3.E+04	/St/St
Yb-167	–	3.E−04	3.E−04	–	1.E+07	1.E+07	/St/St
Yb-169	–	3.E−07	3.E−07	–	1.E+04	1.E+04	/St/St
Yb-175	–	1.E−06	1.E−06	–	5.E+04	5.E+04	/St/St
Yb-177	–	2.E−05	2.E−05	–	8.E+05	7.E+05	/St/St
Yb-178	–	2.E−05	1.E−05	–	6.E+05	6.E+05	/St/St
Lu-169	–	2.E−06	2.E−06	–	7.E+04	7.E+04	/St/St
Lu-170	–	9.E−07	8.E−07	–	3.E+04	3.E+04	/St/St
Lu-171	–	8.E−07	8.E−07	–	3.E+04	3.E+04	/St/St
Lu-172	–	5.E−07	5.E−07	–	2.E+04	2.E+04	/St/St
Lu-173	–	1.E−07	1.E−07	–	4.E+03	4.E+03	/BS/St
Lu-174m	–	1.E−07	9.E−08	–	4.E+03	3.E+03	/BS/St
Lu-174	–	5.E−08	7.E−08	–	2.E+03	2.E+03	/BS/St
Lu-176m	–	1.E−05	1.E−05	–	4.E+05	4.E+05	/St/St
Lu-176	–	2.E−09	3.E−09	–	7.E+01	1.E+02	/BS/St
Lu-177m	–	5.E−08	3.E−08	–	2.E+03	1.E+03	/BS/St
Lu-177	–	9.E−07	9.E−07	–	3.E+04	3.E+04	/St/St
Lu-178m	–	8.E−06	7.E−06	–	3.E+06	3.E+06	/St/St
Lu-178	–	5.E−06	5.E−06	–	2.E+06	2.E+06	/St/St
Lu-179	–	8.E−06	6.E−06	–	3.E+05	2.E+05	/St/St
Hf-170	2.E−06	2.E−06	–	9.E+04	7.E+04	–	St/St/
Hf-172	4.E−09	2.E−08	–	1.E+02	6.E+02	–	BS/BS/
Hf-173	5.E−06	5.E−06	–	2.E+05	2.E+05	–	St/St/
Hf-175	4.E−07	5.E−07	–	2.E+04	2.E+04	–	BS/St/
Hf-177m	2.E−05	4.E−05	–	9.E+05	1.E+06	–	St/St/
Hf-178m	6.E−10	2.E−09	–	2.E+01	8.E+01	–	BS/BS/
Hf-179m	1.E−07	3.E−07	–	5.E+03	9.E+03	–	BS/St/
Hf-180m	9.E−06	1.E−05	–	3.E+05	4.E+05	–	St/St/
Hf-181	7.E−08	2.E−07	–	3.E+03	7.E+03	–	BS/St/
Hf-182m	4.E−05	6.E−05	–	1.E+06	2.E+06	–	St/St/
Hf-182	3.E−10	1.E−09	–	1.E+01	5.E+01	–	BS/BS/
Hf-183	2.E−05	2.E−05	–	7.E+05	8.E+05	–	St/St/
Hf-184	3.E−06	3.E−06	–	1.E+05	1.E+05	–	St/St/
Ta-172	–	5.E−05	4.E−05	–	2.E+06	2.E+06	/St/St
Ta-173	–	8.E−06	7.E−06	–	3.E+05	3.E+05	/St/St
Ta-174	–	4.E−05	4.E−05	–	1.E+06	1.E+06	/St/St
Ta-175	–	7.E−06	6.E−06	–	3.E+05	2.E+05	/St/St
Ta-176	–	5.E−06	5.E−06	–	2.E+05	2.E+05	/St/St
Ta-177	–	8.E−06	7.E−06	–	3.E+05	3.E+05	/St/St
Ta-178	–	4.E−05	3.E−05	–	1.E+06	1.E+06	/St/St
Ta-179	–	2.E−06	4.E−07	–	8.E+04	1.E+04	/St/St
Ta-180m	–	3.E−05	2.E−05	–	1.E+06	9.E+05	/St/St
Ta-180	–	2.E−07	1.E−08	–	7.E+03	4.E+02	/St/St
Ta-182m	–	2.E−04	2.E−04	–	8.E+06	6.E+06	/St/St
Ta-182	–	1.E−07	6.E−08	–	5.E+03	2.E+03	/St/St
Ta-183	–	5.E−07	4.E−07	–	2.E+04	2.E+04	/St/St
Ta-184	–	2.E−06	2.E−06	–	8.E+04	7.E+04	/St/St
Ta-185	–	3.E−05	3.E−05	–	1.E+06	1.E+06	/St/St
Ta-186	–	1.E−04	9.E−05	–	4.E+06	3.E+06	/St/St
W-176	2.E−05	–	–	8.E+05	–	–	St/ /
W-177	4.E−05	–	–	1.E+06	–	–	St/ /
W-178	8.E−06	–	–	3.E+05	–	–	St/ /
W-179	7.E−04	–	–	3.E+07	–	–	St/ /

*APPENDIX A - DERIVED AIR CONCENTRATIONS (DAC) FOR CONTROLLING RADIATION EXPOSURE TO WORKERS AT DOE FACILITIES (Cont'd)

Subject Matter Expert: 10 CFR 835, *Occupational Radiation Protection*
MN471016, Issue C
Revision Date: January 11, 2000, Replaces Document Dated: December 13, 1996

Radionuclide	Inhaled air-lung retention class[3] µCi/ml			Inhaled air-lung retention class[3] Bq/m[3]			Stochastic or organ[1]
	D	W	Y	D	W	Y	(D/ W/ Y)
W-188	5.E−07	–	–	2.E+04	–	–	St/ /
Re-177	1.E−04	2.E−04	–	4.E+06	5.E+06	–	St/St/
Re-178	1.E−04	1.E−04	–	4.E+06	4.E+06	–	St/St/
Re-181	4.E−06	4.E−06	–	1.E+05	1.E+05	–	St/St/
Re-182 (64 h)	1.E−06	9.E−07	–	4.E+04	3.E+04	–	St/St/
Re-182 (12 h)	5.E−06	6.E−06	–	2.E+05	2.E+05	–	St/St/
Re-184m	1.E−06	2.E−07	–	5.E+04	7.E+03	–	St/St/
Re-184	2.E−06	6.E−07	–	6.E+04	2.E+04	–	St/St/
Re-186m	7.E−07	6.E−08	–	3.E+04	2.E+03	–	SW/St/
Re-186	1.E−06	7.E−07	–	5.E+04	3.E+04	–	St/St/
Re-187	3.E−04	4.E−05	–	1.E+07	2.E+06	–	SW/St/
Re-188m	6.E−05	6.E−05	–	2.E+06	2.E+06	–	St/St/
Re-188	1.E−06	1.E−06	–	4.E+04	4.E+04	–	St/St/
Re-189	2.E−06	2.E−06	–	8.E+04	7.E+04	–	St/St/
Os-180	2.E−04	2.E−04	2.E−04	6.E+06	8.E+06	7.E+06	St/St/St
Os-181	2.E−05	2.E−05	2.E−05	7.E+05	7.E+05	7.E+05	St/St/St
Os-182	2.E−06	2.E−06	2.E−06	9.E+04	7.E+04	6.E+04	St/St/St
Os-185	2.E−07	3.E−07	3.E−07	8.E+03	1.E+04	1.E+04	St/St/St
Os-189m	1.E−04	9.E−05	7.E−05	4.E+06	3.E+06	3.E+06	St/St/St
Os-191m	1.E−05	9.E−06	7.E−06	4.E+05	3.E+05	3.E+05	St/St/St
Os-191	9.E−07	7.E−07	6.E−07	3.E+04	3.E+04	2.E+04	St/St/St
Os-193	2.E−06	1.E−06	1.E−06	7.E+04	5.E+04	4.E+04	St/St/St
Os-194	2.E−08	2.E−08	3.E−09	7.E+02	9.E+02	1.E+02	St/St/St
Ir-182	6.E−05	6.E−05	5.E−05	2.E+06	2.E+06	2.E+06	St/St/St
Ir-184	1.E−05	1.E−05	1.E−05	4.E+05	5.E+05	4.E+05	St/St/St
Ir-185	5.E−06	5.E−06	4.E−06	2.E+05	2.E+05	2.E+05	St/St/St
Ir-186	3.E−06	3.E−06	2.E−06	1.E+05	1.E+05	9.E+04	St/St/St
Ir-187	1.E−05	1.E−05	1.E−05	5.E+05	5.E+05	4.E+05	St/St/St
Ir-188	2.E−06	2.E−06	1.E−06	7.E+04	6.E+04	5.E+04	St/St/St
Ir-189	2.E−06	2.E−06	2.E−06	7.E+04	6.E+04	6.E+04	St/St/St
Ir-190m	8.E−05	9.E−05	8.E−05	3.E+06	3.E+06	3.E+06	St/St/St
Ir-190	4.E−07	4.E−07	4.E−07	1.E+04	2.E+04	1.E+04	St/St/St
Ir-192m	4.E−08	9.E−08	6.E−09	1.E+03	3.E+03	2.E+02	St/St/St
Ir-192	1.E−07	2.E−07	9.E−08	4.E+03	6.E+03	3.E+03	St/St/St
Ir-194m	4.E−08	7.E−08	4.E−08	2.E+03	3.E+03	2.E+03	St/St/St
Ir-194	1.E−06	8.E−07	8.E−07	5.E+04	3.E+04	3.E+04	St/St/St
Ir-195m	1.E−05	1.E−05	9.E−06	4.E+05	4.E+05	3.E+05	St/St/St
Ir-195	2.E−05	2.E−05	2.E−05	6.E+05	8.E+05	7.E+05	St/St/St
Pt-186	2.E−05	–	–	6.E+05	–	–	St/ /
Pt-188	7.E−07	–	–	3.E+04	–	–	St/ /
Pt-189	1.E−05	–	–	4.E+05	–	–	St/ /
Pt-191	3.E−06	–	–	1.E+05	–	–	St/ /
Pt-193m	2.E−06	–	–	9.E+04	–	–	St/ /
Pt-193	1.E−05	–	–	4.E+05	–	–	St/ /
Pt-195m	2.E−06	–	–	7.E+04	–	–	St/ /
Pt-197m	2.E−05	–	–	7.E+05	–	–	St/ /
Pt-197	4.E−06	–	–	2.E+05	–	–	St/ /
Pt-199	6.E−05	–	–	2.E+06	–	–	St/ /
Pt-200	1.E−06	–	–	5.E+04	–	–	St/ /
Au-193	1.E−05	8.E−06	8.E−06	4.E+05	3.E+05	3.E+05	St/St/St
Au-194	3.E−06	2.E−06	2.E−06	1.E+05	9.E+04	8.E+04	St/St/St
Au-195	5.E−06	6.E−07	2.E−07	2.E+05	2.E+04	6.E+03	St/St/St
Au-198m	1.E−06	5.E−07	5.E−07	4.E+04	2.E+04	2.E+04	St/St/St
Au-198	2.E−06	7.E−07	7.E−07	6.E+04	3.E+04	3.E+04	St/St/St
Au-199	4.E−06	2.E−06	2.E−06	1.E+05	6.E+04	6.E+04	St/St/St
Au-200m	1.E−06	1.E−06	1.E−06	5.E+04	4.E+04	4.E+04	St/St/St
Au-200	3.E−05	3.E−05	3.E−05	1.E+06	1.E+06	1.E+06	St/St/St
Au-201	9.E−05	1.E−04	9.E−05	3.E+06	4.E+06	4.E+06	St/St/St
Hg-193m (Org)	6.E−06	–	–	2.E+05	–	–	St/ /
Hg-193m (Inorg)	4.E−06	3.E−06	–	1.E+05	1.E+05	–	St/St/
Hg-193m (Vapor)	–	4.E−06	–	–	1.E+05	–	/St/
Hg-193 (Org)	3.E−05	–	–	1.E+06	–	–	St/ /
Hg-193 (Inorg)	2.E−05	2.E−05	–	7.E+05	6.E+05	–	St/St/
Hg-193 (Vapor)	–	1.E−05	–	–	5.E+05	–	/St/
Hg-194 (Org)	1.E−08	–	–	4.E+02	–	–	St/ /
Hg-194 (Inorg)	2.E−08	5.E−08	–	7.E+02	2.E+03	–	St/St/
Hg-194 (Vapor)	–	1.E−08	–	–	5.E+02	–	/St/

*APPENDIX A - DERIVED AIR CONCENTRATIONS (DAC) FOR CONTROLLING RADIATION EXPOSURE TO WORKERS AT DOE FACILITIES (Cont'd)

Subject Matter Expert: 10 CFR 835, *Occupational Radiation Protection*
MN471016, Issue C
Revision Date: January 11, 2000, Replaces Document Dated: December 13, 1996

Radionuclide	Inhaled air-lung retention class [3] µCi/ml			Inhaled air-lung retention class [3] Bq/m³			Stochastic or organ [1]
	D	W	Y	D	W	Y	(D/ W/ Y)
Hg-195 (Org)	2.E−05	–	–	7.E+05	–	–	St/ /
Hg-195 (Inorg)	1.E−05	1.E−05	–	5.E+05	5.E+05	–	St/St/
Hg-195 (Vapor)	–	1.E−05	–	–	5.E+05	–	/St/
Hg-197m (Org)	4.E−06	–	–	1.E+05	–	–	St/ /
Hg-197m (Inorg)	3.E−06	2.E−06	–	1.E+05	8.E+04	–	St/St/
Hg-197m (Vapor)	–	2.E−06	–	–	8.E+04	–	/St/
Hg-197 (Org)	6.E−06	–	–	2.E+05	–	–	St/ /
Hg-197 (Inorg)	5.E−06	4.E−06	–	2.E+05	1.E+05	–	St/St/
Hg-197 (Vapor)	–	3.E−05	–	–	1.E+05	–	/St/
Hg-199m (Org)	7.E−05	–	–	3.E+06	–	–	St/ /
Hg-199m (Inorg)	6.E−05	7.E−05	–	2.E+06	3.E+06	–	St/St/
Hg-199m (Vapor)	–	3.E−05	–	–	1.E+06	–	/St/
Hg-203 (Org)	3.E−07	–	–	1.E+04	–	–	St/ /
Hg-203 (Inorg)	5.E−07	5.E−07	–	2.E+04	2.E+04	–	St/St/
Hg-203 (Vapor)	–	3.E−07	–	–	1.E+04	–	/St/
Tl-194m	6.E−05	–	–	2.E+06	–	–	St/ /
Tl-194	3.E−04	–	–	9.E+06	–	–	St/ /
Tl-195	5.E−05	–	–	2.E+06	–	–	St/ /
Tl-197	5.E−05	–	–	2.E+06	–	–	St/ /
Tl-198m	2.E−05	–	–	9.E+05	–	–	St/ /
Tl-198	1.E−05	–	–	5.E+05	–	–	St/ /
Tl-199	3.E−05	–	–	1.E+06	–	–	St/ /
Tl-200	5.E−06	–	–	2.E+05	–	–	St/ /
Tl-201	9.E−06	–	–	3.E+05	–	–	St/ /
Tl-202	2.E−06	–	–	8.E+04	–	–	St/ /
Tl-204	9.E−07	–	–	3.E+04	–	–	St/ /
Pb-195m	8.E−05	–	–	3.E+06	–	–	St/ /
Pb-198	3.E−05	–	–	1.E+06	–	–	St/ /
Pb-199	3.E−05	–	–	1.E+06	–	–	St/ /
Pb-200	3.E−06	–	–	1.E+05	–	–	St/ /
Pb-201	9.E−06	–	–	3.E+05	–	–	St/ /
Pb-202m	1.E−05	–	–	4.E+05	–	–	St/ /
Pb-202	2.E−08	–	–	8.E+02	–	–	St/ /
Pb-203	4.E−06	–	–	2.E+05	–	–	St/ /
Pb-205	6.E−07	–	–	2.E+04	–	–	St/ /
Pb-209	2.E−05	–	–	9.E+05	–	–	St/ /
Pb-210	1.E−10	–	–	4.E+00	–	–	BS/ /
Pb-211	3.E−07	–	–	1.E+04	–	–	St/ /
Pb-212	1.E−08	–	–	5.E+02	–	–	St/ /
Pb-214	3.E−07	–	–	1.E+04	–	–	St/ /
Bi-200	3.E−05	4.E−05	–	1.E+06	2.E+06	–	St/St/
Bi-201	1.E−05	2.E−05	–	4.E+05	6.E+05	–	St/St/
Bi-202	2.E−05	3.E−05	–	6.E+05	1.E+06	–	St/St/
Bi-203	3.E−06	2.E−06	–	1.E+05	9.E+04	–	St/St/
Bi-205	1.E−06	5.E−07	–	4.E+04	2.E+04	–	St/St/
Bi-206	6.E−07	4.E−07	–	2.E+04	1.E+04	–	St/St/
Bi-207	7.E−07	2.E−07	–	3.E+04	5.E+03	–	St/St/
Bi-210m	2.E−09	3.E−10	–	7.E+01	1.E+01	–	K /St/
Bi-210	1.E−07	1.E−08	–	4.E+03	4.E+02	–	K /St/
Bi-212	1.E−07	1.E−07	–	4.E+03	4.E+03	–	St/St/
Bi-213	1.E−07	2.E−07	–	5.E+03	5.E+03	–	St/St/
Bi-214	3.E−07	4.E−07	–	1.E+04	1.E+04	–	St/St/
Po-203	3.E−05	4.E−05	–	1.E+06	1.E+06	–	St/St/
Po-205	2.E−05	3.E−05	–	6.E+05	1.E+06	–	St/St/
Po-207	1.E−05	1.E−05	–	4.E+05	4.E+05	–	St/St/
Po-210	3.E−10	3.E−10	–	1.E+01	1.E+01	–	E /St/
At-207	1.E−06	9.E−07	–	4.E+04	3.E+04	–	St/St/
At-211	3.E−08	2.E−08	–	1.E+03	8.E+02	–	St/St/
Rn-220	8.E−09 [4]	⌐┘	⌐┘	3.E+02 [4]	⌐┘	⌐┘	⌐┘
Rn-222	3.E−08 [4]	⌐┘	⌐┘	1.E+03 [4]	⌐┘	⌐┘	⌐┘
Fr-222	2.E−07	–	–	7.E+03	–	–	St/ /
Fr-223	3.E−07	–	–	1.E+04	–	–	St/ /
Ra-223	–	3.E−10	–	–	1.E+01	–	/St/
Ra-224	–	7.E−10	–	–	3.E+01	–	/St/
Ra-225	–	3.E−10	–	–	1.E+01	–	/St/
Ra-226	–	3.E−10	–	–	1.E+01	–	/St/
Ra-227	–	6.E−06	–	–	2.E+05	–	/BS/

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Subject Matter Expert: 10 CFR 835, *Occupational Radiation Protection*
MN471016, Issue C
Revision Date: January 11, 2000, Replaces Document Dated: December 13, 1996

Radionuclide	Inhaled air-lung retention class[3] µCi/ml			Inhaled air-lung retention class[3] Bq/m^3			Stochastic or organ[1]
	D	W	Y	D	W	Y	(D/ W/ Y)
Ac-226	1.E−09	2.E−09	2.E−09	5.E+01	8.E+01	7.E+01	BS/St/St
Ac-227	2.E−13	7.E−13	2.E−12	7.E−03	3.E−02	6.E−02	BS/BS/St
Ac-228	4.E−09	2.E−08	2.E−08	2.E+02	6.E+02	7.E+02	BS/BS/St
Th-226	–	7.E−08	6.E−08	–	2.E+03	2.E+03	/St/St
Th-227	–	1.E−10	1.E−10	–	5.E+00	5.E+00	/St/St
Th-228	–	4.E−12	7.E−12	–	2.E−01	3.E−01	/BS/St
Th-229	–	4.E−13	1.E−12	–	1.E−02	4.E−02	/BS/BS
Th-230	–	3.E−12	7.E−12	–	9.E−02	2.E−01	/BS/BS
Th-231	–	3.E−06	3.E−06	–	1.E+05	1.E+05	/St/St
Th-232	–	5.E−13	1.E−12	–	2.E−02	4.E−02	/BS/BS
Th-234	–	9.E−08	6.E−08	–	3.E+03	2.E+03	/St/St
Pa-227	–	5.E−08	4.E−08	–	2.E+03	2.E+03	/St/St
Pa-228	–	5.E−09	5.E−09	–	2.E+02	2.E+02	/BS/St
Pa-230	–	2.E−09	1.E−09	–	7.E+01	5.E+01	/St/St
Pa-231	–	7.E−13	2.E−12	–	2.E−02	6.E−02	/BS/BS
Pa-232	–	9.E−09	2.E−08	–	3.E+02	9.E+02	/BS/BS
Pa-233	–	3.E−07	2.E−07	–	1.E+04	9.E+03	/St/St
Pa-234	–	3.E−06	3.E−06	–	1.E+05	1.E+05	/St/St
U-230	2.E−10	1.E−10	1.E−10	6.E+00	5.E+00	4.E+00	BS/St/St
U-231	3.E−06	2.E−06	2.E−06	1.E+05	9.E+04	7.E+04	St/St/St
U-232	9.E−11	2.E−10	3.E−12	3.E+00	6.E+00	1.E−01	BS/St/St
U-233	5.E−10	3.E−10	2.E−11	2.E+01	1.E+01	6.E−01	BS/St/St
U-234	5.E−10	3.E−10	2.E−11	2.E+01	1.E+01	6.E−01	BS/St/St
U-235	6.E−10	3.E−10	2.E−11	2.E+01	1.E+01	6.E−01	BS/St/St
U-236	6.E−10	3.E−10	2.E−11	2.E+01	1.E+01	6.E−01	BS/St/St
U-237	1.E−06	7.E−07	6.E−07	4.E+04	3.E+04	2.E+04	St/St/St
U-238	6.E−10	3.E−10	2.E−11	2.E+01	1.E+01	6.E−01	BS/St/St
U-239	8.E−05	7.E−05	6.E−05	3.E+06	3.E+06	2.E+06	St/St/St
U-240	2.E−06	1.E−06	1.E−06	6.E+04	4.E+04	4.E+04	St/St/St
Np-232	–	1.E−06[5]	–	–	4.E+04[5]	–	/BS/
Np-233	–	1.E−03[5]	–	–	5.E+07[5]	–	/St/
Np-234	–	1.E−06[5]	–	–	4.E+04[5]	–	/St/
Np-235	–	5.E−07[5]	–	–	2.E+04[5]	–	/BS/
Np-236 (1.E+05 yr)	–	1.E−11[5]	–	–	4.E−01[5]	–	/BS/
Np-236 (22 h)	–	2.E−08[5]	–	–	6.E+02[5]	–	/BS/
Np-237	–	2.E−12[5]	–	–	9.E−02[5]	–	/BS/
Np-238	–	4.E−08[5]	–	–	1.E+03[5]	–	/BS/
Np-239	–	1.E−06[5]	–	–	4.E+04[5]	–	/St/
Np-240	–	3.E−05[5]	–	–	1.E+06[5]	–	/St/
Pu-234	–	9.E−08[5]	8.E−08[5]	–	3.E+03[5]	3.E+03[5]	/St/St
Pu-235	–	1.E−03[5]	1.E−03[5]	–	5.E+07[5]	4.E+07[5]	/St/St
Pu-236	–	7.E−12[5]	1.E−11[5]	–	3.E−01[5]	6.E−01[5]	/BS/St
Pu-237	–	1.E−06[5]	1.E−06[5]	–	5.E+04[5]	5.E+04[5]	/St/St
Pu-238	–	3.E−12[5]	7.E−12[5]	–	9.E−02[5]	3.E−01[5]	/BS/BS
Pu-239	–	2.E−12[5]	6.E−12[5]	–	8.E−02[5]	2.E−01[5]	/BS/BS
Pu-240	–	2.E−12[5]	6.E−12[5]	–	8.E−02[5]	2.E−01[5]	/BS/BS
Pu-241	–	1.E−10[5]	3.E−10[5]	–	4.E+00[5]	1.E+01[5]	/BS/BS
Pu-242	–	2.E−12[5]	6.E−12[5]	–	9.E−02[5]	2.E−01[5]	/BS/BS
Pu-243	–	1.E−05[5]	1.E−05[5]	–	5.E+05[5]	6.E+05[5]	/St/St
Pu-244	–	2.E−12[5]	6.E−12[5]	–	9.E−02[5]	2.E−01[5]	/BS/BS
Pu-245	–	2.E−06[5]	2.E−06[5]	–	7.E+04[5]	6.E+04[5]	/St/St
Am-237	–	1.E−04[5]	–	–	4.E+06[5]	–	/St/
Am-238	–	1.E−06[5]	–	–	4.E+04[5]	–	/BS/
Am-239	–	5.E−06[5]	–	–	2.E+05[5]	–	/St/
Am-240	–	1.E−06[5]	–	–	4.E+04[5]	–	/St/
Am-241	–	2.E−12[5]	–	–	8.E−02[5]	–	/BS/
Am-242m	–	2.E−12[5]	–	–	8.E−02[5]	–	/BS/
Am-242	–	3.E−08[5]	–	–	1.E+03[5]	–	/BS/
Am-243	–	2.E−12[5]	–	–	8.E−02[5]	–	/BS/
Am-244m	–	2.E−06[5]	–	–	6.E+04[5]	–	/BS/
Am-244	–	7.E−08[5]	–	–	3.E+03[5]	–	/BS/
Am-245	–	3.E−05[5]	–	–	1.E+06[5]	–	/St/
Am-246m	–	7.E−05[5]	–	–	3.E+06[5]	–	/St/
Am-246	–	4.E−05[5]	–	–	2.E+06[5]	–	/St/
Cm-238	–	4.E−07[5]	–	–	2.E+04[5]	–	/St/
Cm-240	–	2.E−10[5]	–	–	8.E+00[5]	–	/BS/
Cm-241	–	9.E−09[5]	–	–	4.E+02[5]	–	/BS/

*APPENDIX A - DERIVED AIR CONCENTRATIONS (DAC) FOR CONTROLLING RADIATION EXPOSURE TO WORKERS AT DOE FACILITIES (Cont'd)

Subject Matter Expert: 10 CFR 835, *Occupational Radiation Protection*
MN471016, Issue C
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Radionuclide	Inhaled air-lung retention class[3] µCi/ml			Inhaled air-lung retention class[3] Bq/m[3]			Stochastic or organ[1]
	D	W	Y	D	W	Y	(D/ W/ Y)
Cm-245	–	2.E−12[5]	–	–	8.E−02[5]	–	/BS/
Cm-246	–	2.E−12[5]	–	–	8.E−02[5]	–	/BS/
Cm-247	–	2.E−12[5]	–	–	9.E−02[5]	–	/BS/
Cm-248	–	6.E−13[5]	–	–	2.E−02[5]	–	/BS/
Cm-249	–	6.E−06[5]	–	–	2.E+05[5]	–	/BS/
Bk-245	–	5.E−07	–	–	2.E+04	–	/St/
Bk-246	–	1.E−06	–	–	5.E+04	–	/St/
Bk-247	–	2.E−12	–	–	8.E−02	–	/BS/
Bk-249	–	9.E−10	–	–	3.E+01	–	/BS/
Bk-250	–	2.E−07	–	–	7.E+03	–	/BS/
Cf-244	–	2.E−07[5]	2.E−07[5]	–	9.E+03[5]	9.E+03[5]	/St/St
Cf-246	–	4.E−09[5]	4.E−09[5]	–	2.E+02[5]	1.E+02[5]	/St/St
Cf-248	–	4.E−11[5]	5.E−11[5]	–	1.E+00[5]	2.E+00[5]	/BS/St
Cf-249	–	2.E−12[5]	6.E−12[5]	–	8.E−02[5]	2.E−01[5]	/BS/BS
Cf-250	–	5.E−12[5]	1.E−11[5]	–	2.E−01[5]	4.E−01[5]	/BS/St
Cf-251	–	2.E−12[5]	5.E−12[5]	–	8.E−02[5]	2.E−01[5]	/BS/BS
Cf-252	–	1.E−11[5]	2.E−11[5]	–	4.E−01[5]	6.E−01[5]	/BS/St
Cf-253	–	8.E−10[5]	7.E−10[5]	–	3.E+01[5]	3.E+01[5]	/St/St
Cf-254	–	9.E−12[5]	7.E−12[5]	–	3.E−01[5]	3.E−01[5]	/St/St
Es-250	–	3.E−07	–	–	1.E+04	–	/BS/
Es-251	–	4.E−07	–	–	2.E+04	–	/BS/
Es-253	–	6.E−10	–	–	2.E+01	–	/St/
Es-254m	–	4.E−09	–	–	2.E+02	–	/St/
Es-254	–	4.E−11	–	–	2.E+00	–	/BS/
Fm-252	–	6.E−09	–	–	2.E+02	–	/St/
Fm-253	–	4.E−09	–	–	2.E+02	–	/St/
Fm-254	–	4.E−08	–	–	2.E+03	–	/St/
Fm-255	–	9.E−09	–	–	3.E+02	–	/St/
Fm-257	–	1.E−10	–	–	4.E+00	–	/E /
Md-257	–	4.E−08	–	–	2.E+03	–	/St/
Md-258	–	1.E−10	–	–	4.E+00	–	/BS/

Footnotes for Appendix A

[1] A determination of whether the DACs are controlled by stochastic (St) or nonstochastic (organ) dose, or if they both give the same result (E), for each lung retention class, is given in this column. The key to the organ notation for nonstochastic dose is: BS=Bone surface, K=Kidney, L=Liver, SW=Stomach wall, and T=Thyroid. A blank indicates that no calculations were performed for the lung retention class shown.

[2] The ICRP identifies tritiated water and carbon as having immediate uptake and distribution; therefore no solubility classes are designated. For the purposes of this table, the DAC values are shown as being constant, independent of solubility class. For tritiated water, the inhalation DAC values allow for an additional 50% absorption through the skin, as described in ICRP Publication No. 30: Limits for Intakes of Radionuclides by Workers. For elemental tritium, the DAC values are based solely on consideration of the dose-equivalent rate to the tissues of the lung from inhaled tritium gas contained within the lung, without absorption in the tissues.

[3] A dash indicates no values given for this data category.

[4] These values are appropriate for protection from radon combined with its short-lived daughters and are based on information given in ICRP Publication 32: Limits for Inhalation of Radon Daughters by Workers and Federal Guidance Report No. 11: Limiting Values of Radionuclide Intake and Air Concentrations, and Dose Conversion Factors for Inhalation, Submersion, and Ingestion (EPA 520/1−88−020). The values given are for 100% equilibrium concentration conditions of the radon daughters with the parent. To allow for an actual measured equilibrium concentration or a demonstrated equilibrium concentration, the values given in this table should be multiplied by the ratio (100%/actual %) or (100%/demonstrated %), respectively. Alternatively, the DAC values for Rn-220 and Rn-222 may be replaced by 1 WL* and 1/3 WL*, respectively, for appropriate limiting of daughter concentrations. Because of the dosimetric considerations for radon, no f_1 or lung clearance values are listed.

*A "Working Level" (WL) is any combination of short-lived radon daughters, in one liter of air without regard to the degree of equilibrium, that will result in the ultimate emission of 1.3 E+05 MeV of alpha energy.

*APPENDIX C - DERIVED AIR CONCENTRATION (DAC) FOR WORKERS FROM EXTERNAL EXPOSURE DURING IMMERSION IN A CONTAMINATED ATMOSPHERIC CLOUD

Subject Matter Expert: 10 CFR 835, *Occupational Radiation Protection*
MN471016, Issue C
Revision Date: January 11, 2000, Replaces Document Dated: December 13, 1996

a. The data presented in appendix C are to be used for controlling occupational exposures in accordance with § 835.209, identifying the need for air monitoring in accordance with § 835.403, and identifying the need for posting of airborne radioactivity areas in accordance with § 835.603(d).

b. The air immersion DAC values shown in this appendix are based on a stochastic dose limit of 5 rems (0.05 Sv) per year or a nonstochastic (organ) dose limit of 50 rems (0.5 Sv) per year. Four columns of information are presented: (1) Radionuclide; (2) half-life in units of seconds (s), minutes (min), hours (h), days (d), or years (yr); (3) air immersion DAC in units of μCi/ml; and (4) air immersion DAC in units of $Bq/m^{3.}$ The data are listed by radionuclide in order of increasing atomic mass. The air immersion DACs were calculated for a continuous, nonshielded exposure via immersion in a semi-infinite atmospheric cloud. The DACs listed in this appendix may be modified to allow for submersion in a cloud of finite dimensions.

c. The DAC value for air immersion listed for a given radionuclide is determined either by a yearly limit on effective dose equivalent, which provides a limit on stochastic radiation effects, or by a limit on yearly dose equivalent to any organ, which provides a limit on nonstochastic radiation effects. For most of the radionuclides listed, the DAC value is determined by the yearly limit on effective dose equivalent. Thus, the few cases where the DAC value is determined by the yearly limit on shallow dose equivalent to the skin are indicated in the table by an appropriate footnote. Again, the DACs listed in this appendix account only for immersion in a semi-infinite cloud and do not account for inhalation or ingestion exposures.

d. Three classes of radionuclides are included in the air immersion DACs as described below.

(1) Class 1. The first class of radionuclides includes selected noble gases and short-lived activation products that occur in gaseous form. For these radionuclides, inhalation doses are negligible compared to the external dose from immersion in an atmospheric cloud.

(2) *Class 2.* The second class of radionuclides includes those for which a DAC value for inhalation has been calculated, but for which the DAC value for external exposure to a contaminated atmospheric cloud is more restrictive (i.e., results in a lower DAC value). These radionuclides generally have half-lives of a few hours or less, or are eliminated from the body following inhalation sufficiently rapidly to limit the inhalation dose.

(3) *Class 3.* The third class of radionuclides includes selected isotopes with relatively short half-lives. These radionuclides typically have half-lives that are less than 10 minutes, they do not occur as a decay product of a longer lived radionuclide, or they lack sufficient decay data to permit internal dose calculations. These radionuclides are also typified by a radioactive emission of highly intense, high-energy photons and rapid removal from the body following inhalation.

e. The DAC values are given for individual radionuclides. For known mixtures of radionuclides, determine the sum of the ratio of the observed concentration of a particular radionuclide and its corresponding DAC for all radionuclides in the mixture. If this sum exceeds unity (1), then the DAC has been exceeded. For unknown radionuclides, the most restrictive DAC (lowest value) for those isotopes not known to be absent shall be used.

Radio-nuclide	Half-Life	Air Immersion DAC	
		(μCi/ml)	(Bq/m^3)
C–11	20.48 min	4.E–06	1.E+05
N–13	9.97 min	4.E–06	1.E+05

*APPENDIX C - DERIVED AIR CONCENTRATION (DAC) FOR WORKERS FROM EXTERNAL EXPOSURE DURING IMMERSION IN A CONTAMINATED ATMOSPHERIC CLOUD (Cont'd)

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Radio-nuclide	Half-Life	Air Immersion DAC	
		(µCi/ml)	(Bq/m³)
N–16	7.13 s	7.E–07	3.E+04
O–15	122.24 s	4.E–06	1.E+05
F–18[1]	109.74 min	4.E–06	1.E+05
Na–24[1]	15.00 h	9.E–07	3.E+04
Mg–27[2]	9.458 min	5.E–06	2.E+05
Al–28[2]	2.240 min	2.E–06	7.E+04
Cl–38[1]	37.21 min	3.E–06	1.E+05
Ar–37	35.02 d	3.E+00	1.E+11
Ar–39	269 yr	2.E–04[3]	7.E+06[3]
Ar–41	1.827 h	3.E–06	1.E+05
K–43[1]	22.6 h	5.E–06	2.E+05
Ca–492	8.719 min	1.E–06	4.E+04
Sc–44[1]	3.927 h	2.E–06	7.E+04
Sc–46m[2]	18.72 s	5.E–05	2.E+06
Ti–45[1]	3.08 h	5.E–06	2.E+05
Ti–51[2]	5.752 min	1.E–05	4.E+05
V–52[2]	3.75 min	3.E–06	1.E+05
Cr–49[1]	42.09 min	5.E–06	2.E+05
Mn–52m[1]	21.4 min	2.E–06	7.E+04
Mn–56[1]	2.5785 h	2.E–06	7.E+04
Mn–57[2]	1.47 min	6.E–05	2.E+06
Co–60m[1]	10.47 min	1.E–03	4.E+07
Ni–57[1,4]	36.08 h	2.E–06	7.E+04
Ni–65[1,5]	2.520 h	8.E–06	3.E+05
Cu–61[1]	3.408 h	5.E–06	2.E+05
Cu–62[2]	9.74 min	5.E–06	2.E+05
Ga–66[1]	9.40 h	2.E–06	7.E+04
Ga–68[1]	68.0 min	5.E–06	2.E+05
Ga–72[1]	14.1 h	1.E–06	4.E+04
Se–73[1]	7.15 h	4.E–06	1.E+05
Br–77[1]	57.04 h	1.E–05[6]	4.E+05[6]
Br–80[1]	17.4 min	5.E–05	2.E+06
Br–82[1]	35.30 h	1.E–06	4.E+04
Br–84[1]	31.80 min	2.E–06	7.E+04
Br–85[2]	172 s	5.E–05	2.E+06
Kr–79	35.04 h	2.E–05	7.E+05
Kr–81	2.1E+05 yr	5.E–04	2.E+07
Kr–83m	1.83 h	5.E–02	2.E+09
Kr–85	10.72 yr	1.E–04[3]	4.E+06[3]
Kr–85m	4.48 h	3.E–05	1.E+06
Kr–87	76.3 min	5.E–06	2.E+05
Kr–88	2.84 h	2.E–06	7.E+04
Kr–89	3.16 min	2.E–06	7.E+04
Kr–90	32.32 s	3.E–06	1.E+05
Rb–81[1]	4.58 h	8.E–06	3.E+05
Rb–82[2]	1.25 min	2.E–06	7.E+04
Rb–88[1]	17.8 min	7.E–06	3.E+05
Rb–89[1]	15.44 min	2.E–06	7.E+04
Rb–90[2]	157 s	2.E–06	7.E+04
Rb–90m[2]	258 s	1.E–06	4.E+04
Sr–85m[1]	67.66 min	2.E–05	7.E+04
Sr–87m[1]	2.805 h	6.E–05	2.E+06
Sr–92[1]	2.71 h	3.E–06	1.E+05
Sr–93[2]	7.3 min	2.E–06	7.E+04
Y–86[1]	14.74 h	1.E–06	4.E+04
Y–90m[1]	3.19 h	5.E–06[6]	2.E+05[6]
Y–91m[1]	49.71 min	9.E–06	3.E+05
Nb–90[1]	14.60 h	1.E–07	4.E+03
Nb–94m[2]	6.26 min	9.E–04	3.E+07
Nb–97[1]	72.1 min	7.E–06	3.E+05
Nb–97m[1]	60 s	6.E–06	2.E+05
Mo–91[2]	15.9 min	4.E–06	1.E+05
Mo–101[1]	14.61 min	3.E–06	1.E+05
Tc–95[1]	20.0 h	5.E–06	2.E+05
Tc–96m[1]	51.5 min	1.E–04	4.E+06
Tc–99m[1]	6.02 h	3.E–05	1.E+06
Tc–101[1]	14.2 min	1.E–05	4.E+05
Ru–105[1]	4.44 h	5.E–06	2.E+05
Rh–105m[2]	45 s	1.E–04	4.E+06
Rh–106[2]	29.92 s	2.E–05	7.E+05
Ag–108[2]	2.37 min	2.E–04	7.E+06
Ag–109m[2]	39.6 s	1.E–03	4.E+07

*APPENDIX C - DERIVED AIR CONCENTRATION (DAC) FOR WORKERS FROM EXTERNAL EXPOSURE DURING IMMERSION IN A CONTAMINATED ATMOSPHERIC CLOUD (Cont'd)

Subject Matter Expert: 10 CFR 835, *Occupational Radiation Protection*
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Radio-nuclide	Half-Life	Air Immersion DAC	
		(µCi/ml)	(Bq/m³)
Ag–110[2]	24.57 s	9.E–05	3.E+06
Cd–111m[2]	48.7 min	1.E–05	4.E+05
Cd–117[1]	2.49 h	4.E–06	1.E+05
Cd–117m[1]	3.36 h	2.E–06	7.E+04
In–113m[1]	1.658 h	2.E–05	7.E+05
In–114[2]	71.9 s	1.E–04	4.E+06
In–116m[1]	54.15 min	2.E–06	7.E+04
In–117[1]	43.8 min	7.E–06	3.E+05
Sb–117[1]	2.80 h	3.E–05	1.E+06
Sb–126m[1]	19.0 min	3.E–06	1.E+05
Sb–129[1]	4.40 h	3.E–06	1.E+05
Te–133[1]	12.45 min	5.E–06	2.E+05
Te–133m[1]	55.4 min	2.E–06	7.E+04
Te–134[1]	41.8 min	5.E–06	2.E+05
I–122[2]	3.62 min	5.E–06	2.E+05
I–128[1]	24.99 min	5.E–05	2.E+06
I–132[1]	2.30 h	2.E–06	7.E+04
I–134[1]	52.6 min	1.E–06	4.E+04
I–135[1]	6.61 h	7.E–07[6]	3.E+04[6]
I–136[2]	83 s	1.E–06	4.E+04
Xe–122	20.1 h	8.E–05	3.E+06
Xe–123	2.14 h	7.E–06	3.E+05
Xe–125	16.8 h	2.E–05	7.E+05
Xe–127	36.406 d	1.E–05	4.E+05
Xe–129m	8.89 d	2.E–04	7.E+06
Xe–131m	11.84 d	5.E–04	2.E+07
Xe–133	5.245 d	1.E–04	4.E+06
Xe–133m	2.19 d	1.E–04	4.E+06
Xe–135	9.11 h	2.E–05	7.E+05
Xe–135m	15.36 min	1.E–05	4.E+05
Xe–137	3.83 min	2.E–05	7.E+05
Xe–138	14.13 min	4.E–06	1.E+05
Cs–126[2]	1.64 min	4.E–06	1.E+05
Cs–129[1]	32.06 h	1.E–05[6]	4.E+05[6]
Cs–138[1]	32.2 min	2.E–06	7.E+04
Cs–139[2]	9.40 min	1.E–05	4.E+05
Ba–137m[2]	2.552 min	7.E–06	3.E+05
Ba–141[1]	18.27 min	5.E–06	2.E+05
Ba–142[1]	10.70 min	5.E–06	2.E+05
La–142[1]	95.4 min	1.E–06	4.E+04
Pr–144m[2]	7.2 min	9.E–04	3.E+07
Nd–149[1]	1.73 h	1.E–05	4.E+05
Gd–162[2]	9.7 min	1.E–05	4.E+05
Td–162[2]	7.76 min	4.E–06	1.E+05
Dy–157[1]	8.06 h	1.E–05	4.E+05
Re–182m[1]	12.7 h	4.E–06	1.E+05
Os–190m[2]	9.9 min	3.E–06	1.E+05
Ir–190m[1]	3.2 h	8.E–05[6]	3.E+06[6]
Au–195m[2]	30.6 s	2.E–05	7.E+05
Tl–200[1]	26.1 h	3.E–06	1.E+05
Tl–207[2]	4.77 min	4.E–05[3]	1.E+06[3]
Tl–208[2]	3.053 min	1.E–06	4.E+04
Tl–209[2]	2.20 min	2.E–06	7.E+04
Tl–210[2]	1.30 min	1.E–06	4.E+04
Pb–204m[2]	66.9 min	2.E–06	7.E+04
Bi–211[2]	2.13 min	1.E–04	4.E+06
Po–211[2]	0.516 s	5.E–04	2.E+07
Th–233[2]	22.3 min	1.E–04	4.E+06
Pa–234[1]	6.70 h	2.E–06	7.E+04
Pa–234m[2]	1.17 min	4.E–05[3]	1.E+06[3]
U–239[1]	23.40 min	8.E–05[6]	3.E+06[6]
Np–240[1]	65 min	4.E–06	1.E+05
Np–240m[2]	7.4 min	1.E–05	4.E+05
Am–246[1]	25.0 min	4.E–06	1.E+05

[1] Committed effective dose equivalent from inhalation is calculated in ICRP Publication 30, but the DAC value for external exposure to a contaminated atmospheric cloud is more restrictive than the DAC value for inhalation.
[2] Committed effective dose equivalent from inhalation is not calculated in ICRP Publication 30, but DAC value for external exposure to contaminated cloud should be more restrictive than DAC value for inhalation due to relatively short half-life of radionuclide.
[3] DAC value is determined by limit on annual shallow dose equivalent to skin, rather than yearly limit on effective dose equivalent.
[4] DAC value applies to radionuclide in vapor form only; DAC value for inhalation is more restrictive for radionuclide in inorganic form.

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*APPENDIX D - SURFACE CONTAMINATION VALUES

Subject Matter Expert: 10 CFR 835, *Occupational Radiation Protection*
MN471016, Issue C
Revision Date: January 11, 2000, Replaces Document Dated: December 13, 1996

See Attachment 6-1, "Radioactive Contamination Limits."

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*APPENDIX E - VALUES FOR ESTABLISHING SEALED RADIOACTIVE SOURCE ACCOUNTABILITY AND RADIOACTIVE MATERIAL POSTING AND LABELING REQUIREMENTS

Subject Matter Expert: 10 CFR 835, *Occupational Radiation Protection*
MN471016, Issue C
Revision Date: January 11, 2000, Replaces Document Dated: December 13, 1996

Appendix E to Part 835—Values for Establishing Sealed Radioactive Source Accountability and Radioactive Material Posting and Labeling Requirements

The data presented in this appendix E are to be used for identifying accountable sealed radioactive sources as defined at §835.2(a), establishing the need for radioactive material area posting in accordance with §835.603(g), and establishing the need for radioactive material labeling in accordance with §835.605.

Note: The data are listed in alphabetical order by nuclide.

Nuclide	Activity (μCi)	Nuclide	Activity (μCi)	Nuclide	Activity (μCi)
Ac-227	1.5E+00	H-3	1.6E+08	Re-184m	1.5E+02
Ag-105	2.1E+06	Hf-172	3.1E+04	Re-186m	2.8E+05
Ag-108m	1.8E+01	Hf-175	1.8E+06	Rh-101	2.5E+05
Ag-110m	2.2E+01	Hf-178m	4.1E+03	Rh-102	8.3E+04
Al-26	1.6E+01	Hf-181	3.5E+02	Rh-102m	2.1E+05
Am-241	2.3E+01	Hf-182	3.0E+03	Ru-103	4.4E+02
Am-242m	2.4E+01	Hg-194	3.5E+04	Ru-106	2.1E+04
Am-243	2.3E+01	Hg-203	4.9E+02	S-35	4.0E+06
As-73	5.4E+02	Ho-166m	2.2E+01	Sb-124	9.1E+01
Au-195	4.8E+02	I-125	3.5E+02	Sb-125	6.8E+01
Ba-133	5.2E+01	I-129	1.8E+02	Sc-46	6.2E+01
Be-10	2.8E+04	In-114m	7.8E+02	Se-75	6.4E+01
Be-7	3.2E+03	Ir-192	1.4E+02	Se-79	1.0E+06
Bi-207	1.7E+01	Ir-192m	2.6E+04	Si-32	9.9E+03
Bi-208	1.5E+01	Ir-194m	2.7E+01	Sm-145	9.1E+05
Bi-210m	1.3E+03	K-40	2.8E+02	Sm-146	1.2E+02
Bk-247	1.7E+01	La-137	1.1E+05	Sm-151	2.5E+05
Bk-249	7.2E+03	Lu-173	4.4E+05	Sn-113	3.1E+02
C-14	4.8E+06	Lu-174	2.5E+05	Sn-119m	3.3E+02
Ca-41	7.4E+06	Lu-174m	3.9E+05	Sn-121m	8.7E+05
Ca-45	1.5E+06	Lu-177m	5.8E+01	Sn-123	1.3E+04
Cd-109	1.6E+02	Md-258	6.0E+02	Sn-126	1.8E+02
Cd-113m	6.5E+03	Mn-53	2.0E+07	Sr-85	1.2E+02

*APPENDIX E - APPENDIX E - VALUES FOR ESTABLISHING SEALED RADIOACTIVE SOURCE ACCOUNTABILITY AND RADIOACTIVE MATERIAL POSTING AND LABELING REQUIREMENTS (Cont'd)

Subject Matter Expert: 10 CFR 835, *Occupational Radiation Protection*
MN471016, Issue C
Revision Date: January 11, 2000, Replaces Document Dated: December 13, 1996

Nuclide	Activity (μCi)	Nuclide	Activity (μCi)	Nuclide	Activity (μCi)
Cd-115m	1.0E+04	Mn-54	6.5E+01	Sr-89	2.4E+05
Ce-139	2.4E+02	Mo-93	7.7E+01	Sr-90	7.7E+03
Ce-141	2.4E+03	Na-22	1.9E+01	Ta-179	1.5E+06
Ce-144	1.5E+03	Nb-91	7.0E+01	Ta-182	7.3E+01
Cf-248	2.0E+02	Nb-91m	3.6E+02	Tb-157	2.5E+03
Cf-249	1.7E+01	Nb-92	1.8E+01	Tb-158	3.9E+04
Cf-250	3.8E+01	Nb-93m	4.4E+02	Tb-160	1.2E+02
Cf-251	1.7E+01	Nb-94	2.3E+01	Tc-95m	1.3E+02
Cf-252	6.4E+01	Nb-95	3.4E+02	Tc-97	8.1E+01
Cf-254	3.4E+01	Ni-59	7.5E+06	Tc-97m	3.6E+02
Cl-36	4.6E+05	Ni-63	3.2E+06	Tc-98	2.5E+01
Cm-241	6.8E+04	Np-235	1.2E+02	Tc-99	6.8E+06
Cm-242	5.8E+02	Np-236	2.2E+01	Te-121m	1.9E+02
Cm-243	3.3E+01	Np-237	1.9E+01	Te-123m	2.8E+02
Cm-244	4.0E+01	Os-185	1.4E+02	Te-125m	4.4E+02
Cm-245	2.2E+01	Os-194	1.5E+04	Te-127m	8.0E+02
Cm-246	2.2E+01	Pa-231	7.8E+00	Te-129m	2.3E+03
Cm-247	2.4E+01	Pb-202	1.0E+05	Th-228	2.9E+01
Cm-248	6.0E+00	Pb-205	9.1E+01	Th-229	4.7E+00
Cm-250	1.1E+00	Pb-210	9.2E+01	Th-230	3.1E+01
Co-56	4.0E+01	Pd-107	7.8E+05	Th-232	6.1E+00
Co-57	2.3E+02	Pm-143	1.3E+02	Ti-44	1.6E+02
Co-58	1.4E+02	Pm-144	2.9E+01	Tl-204	2.2E+04
Co-60	1.8E+01	Pm-145	2.6E+02	Tm-170	8.4E+03
Cs-134	2.7E+01	Pm-146	4.5E+01	Tm-171	2.8E+04
Cs-135	2.2E+06	Pm-147	2.5E+05	U-232	1.5E+01
Cs-137	6.0E+01	Pm-148m	1.1E+02	U-233	7.4E+01
Dy-159	4.1E+06	Po-209	6.3E+03	U-234	7.5E+01
Es-254	6.3E+01	Po-210	1.1E+03	U-235	6.7E+01
Es-255	4.6E+04	Pt-193	4.4E+07	U-236	8.0E+01
Eu-148	7.0E+05	Pu-236	6.9E+01	U-238	8.4E+01
Eu-149	5.3E+06	Pu-237	3.3E+02	V-49	2.9E+07
Eu-152	3.1E+01	Pu-238	2.5E+01	W-181	1.1E+03
Eu-154	3.1E+01	Pu-239	2.3E+01	W-185	3.9E+06
Eu-155	3.7E+02	Pu-240	2.3E+01	W-188	6.4E+04
Fe-55	3.7E+06	Pu-241	1.2E+03	Y-88	3.4E+01
Fe-59	2.0E+02	Pu-242	2.4E+01	Y-91	5.0E+04
Fe-60	1.3E+04	Pu-244	2.5E+01	Yb-169	5.5E+02
Fm-257	4.3E+02	Ra-226	1.2E+03	Zn-65	1.1E+02
Gd-146	2.6E+05	Ra-228	2.1E+03	Zr-88	1.2E+02
Gd-148	3.0E+01	Rb-83	9.2E+01	Zr-93	3.1E+04
Gd-151	1.1E+06	Rb-84	2.0E+02	Zr-95	2.0E+02
Gd-153	2.1E+02	Re-183	5.4E+02		
Ge-68	5.7E+02	Re-184	2.6E+02		

Any alpha emitting radionuclide not listed above and mixtures of alpha emitters of unknown composition have a value of 10 microcuries.

Any radionuclide other than alpha emitting radionuclides not listed above and mixtures of beta emitters of unknown composition have a value of 100 microcuries.

Note: Where there is involved a combination of radionuclides in known amounts, derive the value for the combination as follows: determine, for each radionuclide in the combination, the ratio between the quantity present in the combination and the value otherwise established for the specific radionuclide when not in combination. If the sum of such ratios for all radionuclides in the combination exceeds unity (1), then the accountability criterion has been exceeded.

[FR Doc. 98–27366 Filed 11–3–98; 8:45 am]

BILLING CODE 6450–01–P

Radiological Protection Procedures Manual

ATTACHMENT 1-7 – TEMPLATE FOR RADIOLOGICAL TWD

Subject Matter Expert: Brian D. Hunt
MN471016, Issue N
Effective Date: March 6, 2007; Replaces Document Dated: November 3, 2006
Review Date: October 11, 2006

The attached template may be used to assist in preparation of TWDs for Radiological Work.

When preparing the TWD, keep in mind the following requirements from Chapter 21 of the *ES&H Manual*.

Managers are responsible for ensuring that for each work activity included in a TWD that has been written for health and safety work activities addresses the following:

- All activity-level hazards and associated controls are documented to communicate to Members of the Workforce the activity-level work hazards and associated work control measures during normal activities or foreseeable emergencies.
- Work control measures are clearly assigned to their associated activity-level hazards identified within the TWD.
- All requirements for TWDs are included in a TWD for work activities when a TWD is required.

Note: Specific TWD requirements and guidance for specific work activities appear throughout the *ES&H Manual*. See "Developing TWDs and Determining Need," for hazards and work activities that have specific TWD requirements.

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Radiological Protection Procedures Manual

ATTACHMENT 8-1 – GUIDANCE FOR ESTABLISHING RADIOLOGICAL SURVEY FREQUENCY

Subject Matter Expert: Martin Brennan
MN471016, Issue G
Effective Date: November 27, 2006; Replaces Document Dated: July 18, 2005
Review Date: November 16, 2006

Area	For Radiation	For Contamination
CONTROLLED AREAS		
Adjacent to radioactive material areas (RMAs)	—	Quarterly
Adjacent to contamination boundaries or postings of areas established for contamination control	—	Quarterly
RADIOLOGICAL BUFFER AREAS		
In office spaces located in radiological buffer areas where the potential exists for personnel exposure to external radiation	Daily	—
In routinely occupied areas adjacent to radiological buffer areas established for exposure to external radiation	Weekly	—
In office spaces located in radiological buffer areas established for contamination control	—	Daily
Lunch rooms/eating areas adjacent to radiological buffer areas established for contamination control	—	Daily

In routinely occupied radiological buffer areas and locker rooms adjacent to radiological buffer areas established for contamination control	—	Weekly
Inside radiological buffer areas established for contamination control	—	Weekly*
RADIATION AREAS		
At temporary boundaries to confirm adequacy of posting	Weekly	—
In routinely occupied areas	Weekly	—
HIGH RADIATION AREAS & HIGH RADIATION AREA BOUNDARIES		
After extended periods of closure, when levels are expected to change	Upon Entry	—
During continuous operations	Weekly	—
CONTAMINATION, HIGH CONTAMINATION, AND AIRBORNE RADIOACTIVITY AREAS		
In routinely occupied contamination areas	—	Weekly*
Lunch rooms/eating areas adjacent to contamination areas	—	Daily
Contamination control points, or radiological change areas, or step-off pads	—	Daily* Once Per Shift in high use situations
RADIOACTIVE MATERIAL AREAS		
In posted RMAs	Monthly*	Monthly*
AIRBORNE RADIOACTIVITY AREAS		
In posted airborne radioactivity areas	Job Specific	Job Specific
OTHER		
Accessible areas where operations are likely to produce hot particles	Daily	Daily
Fixed contamination areas located outside of controlled areas	—	Monthly
Operating HEPA filter ventilation units	Weekly	Upon Entry
Operating temporary HEPA vacuum cleaners or containment devices	Daily	Daily
Respirators (interior, exterior)	—	After Each Use
*Or upon entry, if less frequent.		

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Radiological Protection Procedures Manual

ATTACHMENT 1-4 – STANDARD INSTRUCTIONS FOR DONNING AND REMOVING PROTECTIVE CLOTHING

Subject Matter Expert: Brian D. Hunt
MN471016, Issue N
Effective Date: March 6, 2007; Replaces Document Dated: November 3, 2006
Review Date: October 11, 2006

Instructions for the donning and removal of separate-piece protective clothing and equipment should be posted at the dress-out and step-off-pad areas. Standard instructions, which should be useful for most applications, are provided in this attachment. Specific instructions should be developed on a case-by-case basis to meet operational requirements.

Note: Circumstances requiring Level II protective clothing can vary greatly and should be addressed in project specific documentation and instructions. Level II donning and removal is not covered by this attachment.

The instructions on the following pages may be printed and used for posting in required areas.

INSTRUCTIONS FOR DONNING
LEVEL I PROTECTIVE CLOTHING

1. INSPECT protective clothing prior to use for tears, holes, split seams or other defects that would diminish protection. REPLACE any damaged clothing.

2. DON personal dosimetry as appropriate.

   Note: TLD should be inside coveralls between the waist and neck on the front portion of the body.

3. DON surgeons gloves (and cloth glove liners – optional, for comfort only

4. DON coveralls, taping coveralls over surgeons gloves.

   Note: If using coveralls with attached shoe covers and shoes are too big to fit in coveralls or coveralls are not long enough, the attached shoe covers may be removed and separate shoe covers donned, taping coverall legs to the shoe covers.

5. DON overshoes, if applicable.

6. DON outer gloves, pulling gloves over coverall sleeves.

   Note: Taping gloves to coveralls is dependent on situation but is recommended.

7. DON respirator, if applicable.

8. DON hood, if applicable.

   Note: Taping respirator to hood is dependent on situation but is recommended.

9. DON self-reading dosimetry, if applicable.

   Note: Place self-reading dosimeter inside a bag and tape to outside of coveralls within three inches of, but not over, your personal TLD.

10. Have a partner. CHECK your clothing for proper donning prior to entering the area.

INSTRUCTIONS FOR REMOVING
LEVEL I PROTECTIVE CLOTHING

1. REMOVE overshoes.
2. REMOVE exposed tape that will keep you from continuing to undress.
3. REMOVE outer gloves.
4. REMOVE remaining exposed tape that will keep you from continuing to undress.
5. REMOVE and invert hood, being careful not to contact your hair or face with gloved hands.
6. REMOVE respirator, if applicable.
7. TAKE DOWN barrier closure, if applicable.
8. PLACE self-reading dosimeter on step-off-pad (or other location provided).

   Note: Squeeze dosimeter out of the bag without touching it.

9. REMOVE coveralls.

   Note: Carefully push the coveralls down inside out, touching the inside only and not contacting clothing underneath.

10. REMOVE each foot from the shoe covers, stepping onto the step-off-pad as the covers are removed.
11. REPLACE barrier closure, if applicable.
12. REMOVE inner gloves (and cloth liners, if applicable).
13. PICK UP self-reading dosimetry and proceed to the designated monitoring area.
14. PERFORM required self-monitoring.

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JOB-SPECIFIC RADIOLOGICAL TRAINING MATRIX

Name: _____

SSN: _____

Org.: _____

Supervisor: _____ Date: _____

What follows is a listing of the job-specific radiological training that is appropriate for the above named individual, as determined by the individual's Supervisor. This training should be completed and documented to demonstrate compliance with the requirements of 10 CFR 835.901(c) and RPPM-03.

A. Equipment, instrument, source, and/or device training/orientation:

Name of Equip./Inst./Source/Device, and Unique Identifier (as applicable)	Type of Training or Orientation	Frequency of Training/Retraining

B. Procedures and document training:

Procedure/Document Title and I.D. No.	Type of Training	Frequency of Training/Retraining

 (Attach Continuation Sheets as needed)

JOB-SPECIFIC RADIOLOGICAL TRAINING MATRIX (Cont'd)

Name: _____ SSN: _____

A. Equipment, etc., training/orientation (Continued):

Name of Equip./Inst./Source/Device, and Unique Identifier (as applicable)	Type of Training or Orientation	Frequency of Training/Retraining

B. Procedures and documents training (Continued):

Procedure/Document Title and I.D. No.	Type of Training	Frequency of Training/Retraining

JOB-SPECIFIC RADIOLOGICAL TRAINING MATRIX (Cont'd)

Organization: _____ Supervisor: _____ Date: _____

Name	SSN	Radiological Training *					
		RAD 102	RAD 210	RAD 214	RAD 230	Job-Specific	Other (Specify)

*For each person listed, indicate either, “Yes” (or “Y) or “Not Applicable” (or “N/A”) in each column. If “Yes” (or “Y”) is indicated in the “Job-Specific” column for an individual, a Job-Specific Radiological Training Requirements Matrix should be completed for that individual.

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ATTACHMENT 1-3 – PERSONAL PROTECTIVE EQUIPMENT (PPE) SELECTION

Subject Matter Expert: Brian D. Hunt
MN471016, Issue N
Effective Date: March 6, 2007; Replaces Document Dated: November 3, 2006
Review Date: October 11, 2006

Protective clothing (PC) shall be selected based on the contamination level in the work area, the anticipated work activity, worker health conditions, if applicable, area(s) of the body likely to be exposed to removable contamination, and with regard for nonradiological hazards that may be present. Use Table 1 when determining the appropriate protective clothing.

Table 1. Guidelines for Selecting Protective Clothing (PC)

Work Activities	Removable Contamination Levels		
	Low (<10 times Attachment 6-1 values)	**Moderate (10 to 100 times Attachment 6-1 values)**	**High (>100 times Attachment 6-1 values)**
Routine	[1], [2] Level I PCs	[2] Level I PCs	[3] Level I PCs, double gloves, double shoe covers
Heavy Work	[2] Level I PCs, work gloves	[2] Level II PCs, work gloves	[3] Level II PCs, work gloves
Work with pressurized or large-volume liquids, closed-system breach	[2] Level I non-permeable PCs	[2] Level II PCs (outer set non-permeable), rubber boots	[3]Level II PCs and non-permeable outer clothing, rubber boots

Level I PC generally includes:

- Coveralls
- Cotton glove liners
- Gloves
- Shoe covers
- Rubber overshoes
- Hood

Level II PC generally includes:

- Two pairs of coveralls
- Cotton glove liners
- Two pairs of gloves
- Two pairs of shoe covers
- Rubber overshoes
- Hood

Note: The above recommended levels of PC may not be adequate for radiological work involving tritium. RP personnel should determine, with line management, if specialized PC is required.

[1] Laboratory coats and surgeons gloves may be recommended for low hazard contamination potential situations or whenever work is with liquids or solids to prevent incidental splatter or contact with the material. Laboratory coats should not be used when working with pressurized systems or dispersible material such as powders, gases, vapors, and mists. Gloves may be taped to lab coat sleeves when appropriate.

[2] Shoe covers and inner gloves should be taped or otherwise secured at the coverall

legs and sleeves when necessary to prevent worker contamination.

[3] Shoe covers and inner gloves shall be taped or otherwise secured at the coverall legs and sleeves when removable contamination levels are known or expected to exceed 100 times Attachment 6-1 values or when work activities may result in the spread of contamination to exposed skin.

Upon completion or the review of applicable radiological surveys, and taking into account any other considerations, select PC using Table 1 as a guide.

Document PC and equipment requirements on the appropriate radiological work permit (RWP). If coveralls are required, specify the type to be used (e.g., cotton, Tyvek®, Saranex®, or polyethylene-coated Tyvek®).

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Radiological Protection Procedures Manual

ATTACHMENT 6-1 – RADIOACTIVE CONTAMINATION LIMITS

Subject Matter Expert: Tom Laiche, Bob Miltenberger
MN471016, Issue H
Effective Date: September 22, 2006; Replaces Document Dated: June 21, 2006
Review Date: September 13, 2006
Administrative Changes: June 6, 2007

NUCLIDE	REMOVABLE (dpm/100 cm^2) (*Note 2 and 4*)	TOTAL (FIXED + REMOVABLE) (dpm/100 cm^2) (*Note 2 and 3*)	SOIL (pCi/gram) (*Note 9*)
U-natural, U-235, U-238 and associated decay products	1,000 (*Note 7*)	5,000 (*Note 7*)	1,000
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	20	500 or 100 (*Note 8*)	20
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	200	1,000	200
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above. Includes mixed fission products containing Sr-90. (*Note 5*)	1,000	5,000	1,000
Tritium and tritiated compounds	10,000	N/A (*Note 6*)	10,000

Notes:

1. The values in this *ATTACHMENT, with the exception noted in footnote 6 apply to radioactive contamination deposited on, but not incorporated into the interior or matrix of, the contaminated item. Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for the alpha- and beta-gamma-emitting nuclides apply independently.

2. As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

3. The levels may be averaged over one square meter provided the maximum surface activity in any area of 100 cm^2 is less than three times the value specified. For purposes of averaging, any square meter of surface shall be considered to be above the surface contamination value if (1) from measurements of a representative number of sections it is determined that the average contamination level exceeds the applicable value or (2) it is determined that the sum of the activity of all isolated spots or particles in any 100 cm^2 area exceeds three times the applicable value.

4. The amount of removable radioactive material per 100 cm^2 of surface area should be determined by swiping the area with dry filter or soft absorbent paper, applying moderate pressure, and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. (Note that the use of dry material may not be appropriate for tritium.) When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area shall be based on the actual area and the entire surface shall be wiped. It is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.

5. This category of radionuclides includes mixed fission products with Sr-90 present in them. It does not apply to Sr-90 that has been separated from the other fission products or mixtures where the Sr-90 has been enriched.

6. Tritium contamination may diffuse into the volume or matrix of materials. Evaluation of surface contamination shall consider the extent to which such contamination may migrate to the surface in order to ensure the surface contamination value provided in this *ATTACHMENT is not exceeded. Once this contamination migrates to the surface, it may be removable, not fixed; therefore, a "Total" value does not apply.

7. Alpha

8. SNL added note: Per *Response to Questions and Clarification of Requirements and Processes: DOE Order 5400.5, Section II.5 and Chapter IV Implementation (Requirements Relating to Residual Radioactive Material*) and DOE 5400.5, *Radiation Protection of the Public and the Environment*, the value for unrestricted release of material is 100 dpm/100 cm^2; otherwise, the 500 dpm/100 cm^2 applies.

9. SNL added note: Soil contamination existing as fine-grained soil-like material requiring "Contamination Area" level of controls and training. Radioactivity concentrations in this column do not apply to free release of soils.

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Radiological Protection Procedures Manual

ATTACHMENT 6-3 – CONDITIONALLY CONTROLLED MATERIAL LIST

Subject Matter Expert: Tom Laiche, Bob Miltenberger
MN471016, Issue H
Effective Date: September 22, 2006; Replaces Document Dated: June 21, 2006
Review Date: September 13, 2006
Administrative Changes: June 6, 2007

Description of Item	TWD	Posting	Labeling	Rad Training	Dosimetry	Monitoring	Source Control Program	Additional Requirements/ Restrictions
Inline Ionizers containing up to 10 mCi of Po-210.	No	No - See RPPM Chapter 2	Yes - Label must be legible, visible and attached to the device. If label from the manufacturer is clearly visible, no additional labeling is required	GERT	No	Yes - Receipt inspection required; Leak test in accordance with manufacturers requirements	No	• Maintain records of receipt inspection and inventory at location of use. • Device must be disposed of in accordance with manufacturer's requirements or in accordance with Chapter 19 of the ES&H Manual. • Do not transfer to another location, person

								or company. • If device is stolen, lost or damaged contact Radiation Protection.
ADAM Mine Parts containing 0.096g DU in an epoxy matrix weighing 417g.	Yes	No	No	GERT	No	Yes - Specified in TWD	No	TWD required for any chemical, physical, or metallurgical processing.
Radiation detector housing on Radiation and Physical Inventory Pallet (RPIP) containing ≤ 0.05 m Ci Cs-137 and ≤ 0.01 m Ci Am-241.	No	No	No	GERT	No	Required when removing sources or if damage is suspected.	No	Contact Radiation Protection prior to accessing the sources.
Tritium gas in commercial exit markers (these devices are generally licensed by the NRC and may contain up to 25 Ci of tritium) (NCRP 95, Section 3.1.1.1).	No Follow manufacturer guidelines for use and handling.	No - See RPPM Chapter 2	Yes - if label from the manufacturer is clearly visible, no additional labeling is required.	No	No	No	No	• Notify Radiation Protection of the existence and location of these items. • Contact Radiation Protection prior to removal of these items (additional requirements may apply).

								• Disposal in accordance with Chapter 19 of the *ES&H Manual* .
Lightning detectors containing tritium	No Follow manufacturer guidelines for use and handling.	No - See RPPM Chapter 2	Yes - If label from the manufacturer is clearly visible, no additional labeling is required.	No	No	No	No	• Notify Radiation Protection of the existence and location of these items. • Contact Radiation Protection prior to removal of these items (additional requirements may apply). • Disposal in accordance with Chapter 19 of the *ES&H Manual* .

Ni-63 sources in gas chromatographs	No Follow manufacturer guidelines for use and handling.	No - See RPPM Chapter 2	Yes - If label from the manufacturer is clearly visible, no additional labeling is required.	GERT	No	• Upon receipt. • If damage is suspected. • When sources are changed out.	No	• Notify Radiation Protection when source change out is to occur. • Maintain local inventory of these items. • Disposal in accordance with Chapter 19 of the *ES&H Manual* .
Field test fire sets used to initiate explosive detonators containing <100 microcuries of Kr-85 or Ni-63.	No	No - See RPPM Chapter 2	No - See RPPM Chapter 2	GERT	No	Monitoring for storage and use areas if the area is posted as a Radioactive Materials area.	No	• Notify Radiation Protection if damaged. • Disposal in accordance with Chapter 19 of the *ES&H Manual* . • Survey prior to on-site movement.

Devices designed for uses as static eliminators which contain, as a sealed source or sources, by-product material consisting of a total of not more than 500 microcuries of Po-210 per device.	No Follow manufacturer guidelines for use and handling.	No - See RPPM Chapter 2	Yes - If label from the manufacturer is clearly visible, no additional labeling is required.	GERT	No	• Upon receipt. • If damage is suspected.	No	• Maintain local inventory of these items. • Disposal in accordance with Chapter 19 of the *ES&H Manual* .
Complete unaltered functional weapon component neutron generator subassemblies and fully encapsulated or potted tube transformer assemblies Listed are the controls for Routine Handling. Testing or alteration that could lead to release of tritium through rupture of the encapsulant or neutron tube are not considered	No	No - See RPPM Chapter 2	In accordance with RPPM Chapter. 2	GERT	No	• Upon receipt from offsite. • If damage is suspected.	No	• Disposal in accordance with Chapter 19 of the *ES&H Manual.* • Transport in accordance with Chapter 12 of the *ES&H Manual*.

routine handling.								
Individual manufactured radioactive sources with an activity less than or equal to the lesser of • 1/10 of the RPPM Appendix E values • 10 CFR 30.71 (Schedule B) values See Notes	No	No - See RPPM Chapter 2 if 10 or more sources are owned.	No - See RPPM Chapter 2 if 10 or more sources are owned.	GERT	No	• Should be monitored upon receipt. • If damage to the package or source is suspected.	Not required; registration at the discretion of the owner/ custodian.	• Maintain local inventory of these items. • Disposal in accordance with Chapter 19 of the *ES&H Manual* TBD.
Self-luminous products containing tritium (e.g., EXIT markers and floor lights) used in accordance with the manufacturers guidelines. These devices must be licensed by the NRC and may contain up to 25 Ci of tritium per item. **[NCRP 95, Section 3.1.1.1 & 10 CFR 30.19]**	Not required. Follow manufacturers guidelines for intended use and handling.	In accordance with Chapter 2 of the RPPM.	Required if label from the manufacturer is not clearly visible. If label not visible see Chapter 2 of the RPPM.	No	No	No	No	• Notify Radiation Protection (RP) of the existence and location of these items. • Contact RP prior to removal of any of these items (additional requirements may apply) • Contact RP if there is any damage (actual or suspected) to these items. • Transport in accordance with

								the requirements of Chapter 12 of the *ES&H Manual* • Dispose in accordance with Chapter 19 of the *ES&H Manual.*
Items, sources and materials that have been activated or volume contaminated with surface contamination levels ≤Attachment 6-1, "Total (Fixed + Removable)" and a dose rate ≤50 microrem/hr (on contact).	Not required unless physical, chemical, or metallurgical processing is planned. See bullet #3 in "Additional Requirements/ Restrictions" column of this table.	In accordance with Chapter 2 of the RPPM.	In accordance with Chapter 2 of the RPPM.	GERT	Not required	Not required, unless chemical, physical, or metallurgical processing is planned. See bullet #3 in the Additional Requirements/ Restrictions column of this table.	Not required	• A/VCs shall meet the criteria for free release from SNL in accordance with ES&H Manual, Chapter 19D, Radioactive Material Management Areas (RMMAs) • A/VCs shall be disposed in accordance with ES&H Manual, Chapter 19, Waste Management. • Contact your ES&H Customer Support Team prior to any chemical, physical, or metallurgical processing. A

								TWD may be required.
Optical Glass Containing ≤5% by Wt. of Uranium	No	In accordance with Chapter 2 of the RPPM.	In accordance with Chapter 2 of the RPPM.	GERT	No	No	No	• No physical, chemical or metallurgical processing of the glass. • Dispose of in accordance with chapter 19 of the *ES&H Manual*.

Notes:

1. Any area within a controlled area, accessible to individuals, in which items or containers of radioactive material exist and the total activity of radioactive material exceeds the applicable values provided in Appendix E, must be posted as a Radioactive Material Area. Note that the sum of the fractions rule applies in making this determination.
2. Where a combination of radionuclides in known amounts is involved, derive the value for the combination as follows: determine for each radionuclide in the combination, the ratio between the quantity present in the combination and the lesser of the Appendix E values. If the sum of such ratios for all radionuclides in the combination exceeds one-tenth (1/10), the source is controlled - not conditionally controlled.

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ATTACHMENT 10-2 – INSTALLATION-SPECIFIC OPERATIONS

Subject Matter Expert: Kevin Rolfe
MN471016, Issue J (I not used)
Effective Date: June 15, 2007; Replaces Document Dated: September 29, 2005
Review Date: September 26, 2006

Table 10-1. Operating Requirements for Exempt Shielded RGDs

REQUIREMENT	INHERENTLY SAFE	CERTIFIED CABINETS	DIFFRACTION/ FLUORESCENCE	OTHER
Minimum Radiological Training	RAD102	RAD102 (RAD214 recommended)	RAD214, RAD210, or RAD230, as appropriate	
Device-Specific Training	Yes			
TWD Prior to Start-Up	No N/A	Yes No		
Radiation Surveys:				
• Initial	Yes[1]	Yes[1]		
• Movement/ Modification	Yes[1]	Yes[1]		

• Routine periodic	No	Biennial (plus 30-day grace period to accommodate scheduling needs)	
Operational Checks of Safety Devices	N/A	Semiannual (plus 30-day grace period to accommodate scheduling needs)	
Operations/ Maintenance Records	No	Yes	
Access Controls	No	No[2]	Per Radiation Protection
Radiological Posting	None		
Dosimetry	Not required	Whole-body TLD not required Extremity dosimeter may be required	

[1]Commercially obtained RGDs that are expected to meet the criteria for classification as "exempt shielded" (see Attachment 10-1) may be operated within design specifications with all safety features (e.g., interlocks) engaged and all shielding in place to ensure the device is operational before contacting radiation protection personnel for a radiation survey.

[2]Access controls and other safety features are prescribed by the standard that the device must meet to be classified as this type (i.e., 21 CFR 1020.40 for certified cabinet devices and ANSI N43.2 for Diffraction and Fluorescence devices). If the device meets the applicable standard, there are no further requirements for access controls. Any questions concerning whether a device meets the applicable standard should be directed to radiation protection personnel.

Table 10-2. Operating Requirements for Shielded RGDs

REQUIREMENT	SHIELDED INSTALLATIONS
Minimum Radiological Training	RAD214, RAD210, or RAD230, as appropriate (see Section 4.8.1)
Device-Specific Training	Yes

TWD Prior to start-up	Yes Yes
Radiation Surveys:	
• Initial	Yes
• Movement/Modification	Yes
• Routine periodic	Annual (plus 30-day grace period to accommodate scheduling needs)
Operational Checks of Safety Devices	Semiannual (plus 30-day grace period to accommodate scheduling needs)
Operations/Maintenance Records	Yes
Access Controls	Per Chapter 5, "Access Control"
Radiological Posting	Per Chapter 2
Dosimetry	Whole-body TLD required unless exempted by TWD

Table 10-3. Operating Requirements for Open RGDs

REQUIREMENT	OPEN INSTALLATIONS
Minimum Radiological Training	RAD214, RAD210, or RAD230, as appropriate (see Section 4.1)
Device-Specific Training	Yes
TWD Prior to start-up	Yes Yes
Radiation Surveys:	

• Initial	Yes
• Movement/Modification	Yes
• Routine periodic	At least annual[1] (plus 30-day grace period to accommodate scheduling needs)
Operational Checks of Safety Devices	Semiannual (plus 30-day grace period to accommodate scheduling needs)
Operations/Maintenance Records	Yes
Access Controls	Per Chapter 5
Radiological Posting	Per Chapter 2
Dosimetry	Whole-body TLD required unless exempted by TWD
[1]For cases where the device is operated continuously in the same location for a year or longer.	

Table 10-4. Operating Requirements for Unattended RGDs

REQUIREMENT	UNATTENDED
Minimum Radiological Training	RAD102
Device-Specific Training	Yes
TWD Prior to start-up	Yes Yes
Radiation Surveys:	
• Initial	Yes

• Movement/Modification	Yes
• Routine periodic	Annual (plus 30-day grace period to accommodate scheduling needs)
Operational Checks of Safety Devices	Semiannual (plus 30-day grace period to accommodate scheduling needs)
Operations/Maintenance Records	Yes
Access Controls	Per Radiation Protection
Radiological Posting	Per Radiation Protection
Dosimetry	Not required

Table 10-5. Operating Requirements for Neutron Generating Devices

REQUIREMENT	NEUTRON GENERATING DEVICES
Minimum Radiological Training	RAD210 or RAD230, as appropriate (see Section 4.1)
Device-Specific Training	Yes
TWD Prior to Start-Up	Yes Yes (See Note 1 below)
Radiation Surveys	(See Note 2 below)
Operational Checks of Safety Devices	N/A
Operations/Maintenance Records	Yes (See Note 3 below)
Access Controls	(See Note 4 below)
Radiological Posting	(See Note 5 below)
Dosimetry	Whole-body TLD required unless exempted by TWD

[1]**TWD.** The TWD for neutron generator operations can be written for a single device or a facility containing multiple devices. See Attachment 10-3 for guidance on the content of TWDs for neutron generator operations.

Users shall document in the TWD an estimate of the anticipated neutron output for each device or tester, including both the quantity and energy of the maximum number of neutrons produced per hour and the total number of neutrons produced in a calendar quarter. The number of neutrons produced is calculated by multiplying the number of times the device is pulsed by the number of neutrons produced per pulse. Radiation dose in mrem can then be calculated at any distance using neutron flux rate and a known conversion factor.

[2]**Radiation Surveys.** Neutron generator operations do **not** require initial or routine periodic surveys, because the dose from these operations is determined from calculations based on neutron output; however, radiation surveys or area monitoring may be performed to validate the effectiveness of the controls on the operations.

[3]**Operations and Maintenance Records.** Maintain a log for each registered tester or device describing:

- The approximate number of neutron generating pulses or shots.
- Estimated number of neutrons per pulse or shot.
- Modifications to equipment that negatively impact the designed safe operating envelope of the equipment.

[4]**Access Control.** An exclusion area shall be established to ensure that exposure from neutron generating operations is maintained ALARA. The device operator shall ensure that the exclusion area is not occupied during neutron producing activities. A minimum exclusion area shall be established 1 meter from the point of neutron generation. The exclusion area shall be expanded to include accessible areas where total dose is expected to exceed 10 mrem per quarter due to neutron generating activities. Access to the exclusion area shall be controlled in accordance with Chapter 5, "Entry Control".

Exceptions to the exclusion radius requirement may be made when not practicable due to facility characteristics such as size and equipment location, programmatic requirements, and ALARA considerations, with approval from radiation protection personnel.

[5]**Radiological Posting.** All neutron generator operations shall be performed within a controlled area. If the dose in mrem due to operations at the maximum hourly neutron output exceeds the criteria in Chapter 2, "Posting and Labeling for Radiological Control," for establishment of a radiation area, high radiation area, or very high radiation area, then each access to the area shall be posted and controlled in accordance with Chapter 2, "Posting and Labeling for Radiological Control."

[6]**RMMA Designation.** Consult mixed waste management personnel to determine if operations require establishment of a radioactive material management area (RMMA). An RMMA may be established based on the probability of tritium contamination due to a tube rupture or leakage or neutron activation of surrounding materials.

Emergency Actions due to Neutron Tube Rupture. All users of neutron generating devices shall be aware of the actions taken in response to a neutron tube rupture that could lead to the spread of tritium contamination. These actions are:

- Stand-down work and secure the operation.
- Isolate the affected area.
- Warn others in the immediate area.
- Contact radiation protection personnel.

Table 10-6. Operating Requirements for Medical RGDs

REQUIREMENT	MEDICAL INSTALLATIONS
Minimum Radiological Training	RAD214, RAD210, or RAD230, as appropriate (see Section 4.1)
Device-Specific Training	Yes
TWD	Yes
Prior to start-up	Yes

Radiation Surveys:	
• Initial	Yes
• Movement/Modification	Yes
• Routine periodic	At least annual (plus 30-day grace period to accommodate scheduling needs)
Operational Checks of Safety Devices	Semiannual (plus 30-day grace period to accommodate scheduling needs)
Operations/Maintenance Records	Yes
Access Controls	Per Chapter 5
Radiological Posting	Per RP
Dosimetry	Whole-body TLD required for the operator unless exempted by TWD

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ATTACHMENT 1-1 – 10 CFR 835 EXPOSURE LIMITS

Subject Matter Expert: Brian D. Hunt
MN471016, Issue N
Effective Date: March 6, 2007; Replaces Document Dated: November 3, 2006
Review Date: October 11, 2006

Type of Exposure	Annual Limit
Radiological Worker - Total Effective Dose Equivalent (TEDE)	5 rem
Radiological Worker - Lens of Eye Dose Equivalent	15 rem
Radiological Worker - Extremity (hands and arms below the elbow; feet and legs below the knees) Skin - Shallow Dose Equivalent	50 rem
Radiological Worker - Any organ or tissue (other than lens of eye) Sum of External Deep Dose Equivalent and Committed Dose Equivalent	50 rem
Declared Pregnant Worker - Embryo/Fetus Dose Equivalent	0.5 rem per gestation period
Minors (under age 18) - Total Effective Dose Equivalent	0.1 rem
Visitors and Public* - Total Effective Dose Equivalent	0.1 rem
*People who fall into this category are individuals who will not be performing any radiological work.	

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ATTACHMENT 1-2 – DOE 5400.5 PUBLIC DOSE LIMITS

Subject Matter Expert: Brian D. Hunt
MN471016, Issue N
Effective Date: March 6, 2007; Replaces Document Dated: November 3, 2006
Review Date: October 11, 2006

Basic public dose limits stated in DOE 5400.5 are:

- The exposure of members of the public to radiation sources as a consequence of all routine DOE activities **SHALL NOT** cause, in a year, an effective dose equivalent greater than 100 mrem (1 mSv). Dose evaluations should reflect realistic exposure conditions. **[DOE Order 5400.5, II.1.a.]**

- The limit of 100 mrem (1 mSv) EDE in a year is the sum of the EDE from exposures to radiation sources external to the body during the year (or Deep Dose Equivalent, if dosimeter data is used), plus the committed effective dose equivalent (CEDE) from radionuclides taken into the body during the year. **[DOE Order 5400.5, II.1.a(1)]**

Sources and pathways to include in public dose estimates are:

- The public dose limits apply to dose from exposures to radiation sources from routine activities, including remedial actions and naturally occurring radionuclides released by DOE processes and operations (e.g., uranium processing operations). The dose limits also apply to the doses to individuals who are exposed to radiation or contamination by radionuclides at properties subsequent to remedial action and release of the property. Limits for radon and its decay products in air are provided in terms of Working Levels and concentrations in air are addressed independently. In addition, DOE operators are required to report DOE-related effective dose

equivalent contributions of 10 mrem (0.1 mSv) or more in a year. **[DOE Order 5400.5, II.1.a(3)]**

- For the purposes of estimating doses to offsite members of the public due to SNL operations, the following sources and pathways shall be considered:
- Airborne and waterborne radioactive materials, released from SNL facilities
- External radiation from SNL radioactive sources, radiation generating devices, or surface contamination
- Conduct of remedial actions
- Naturally occurring radionuclides released by SNL due to the processing of such materials (currently no such operations are conducted by SNL)
- Exposure to radiation or contamination by radionuclides at properties subsequent to remedial action and release of the property from SNL control.

Sources and pathways to exclude from public dose estimates:

- The public dose limits do not apply to doses from medical exposures, consumer products, and generally do not apply to doses from naturally occurring radiation sources or from exposures due to accident conditions, where controls of exposures cannot be maintained. **[DOE Order 5400.5, II.1.a.(3)(b)]**
- For the purposes of estimating doses to off-site members of the public due to SNL operations, the following sources and pathways are excluded:
    - Medical exposures.
    - Consumer products.
    - Naturally occurring radioactive materials, except as noted in 4.1.3.
    - Exposures due to accident conditions. Doses resulting from accident conditions are minimized by the use of Protective Action Recommendations (PARs). The PARs are based on Emergency Action Levels (EAL's) established for SNL facilities as required by DOE O 151.1b, *Comprehensive Emergency Management System*.

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ATTACHMENT 1-5 – GUIDELINES FOR PERSONNEL MONITORING WITH PORTABLE FRISKING INSTRUMENTS

Subject Matter Expert: Brian D. Hunt
MN471016, Issue N
Effective Date: March 6, 2007; Replaces Document Dated: November 3, 2006
Review Date: October 11, 2006

Personnel monitoring with portable frisking instruments should do the following:

1. Visually inspect frisking instrument to verify that the:
    - Instrument is on.
    - Instrument is on lowest scale.
    - Audio output can be heard.
2. Prior to picking up probe, frisk one hand by moving hand across the active area of probe. Hold the surfaces being frisked within 1/2 inch of the probe for beta contamination and within 1/4 inch of the probe for alpha contamination. Move the probe across surface being frisked at a rate not to exceed 1 to 2 inches per second.
3. If the instrument's audible output increases, hold the probe over the area for 10-15 seconds to provide adequate time for instrument response. Special monitoring requirements may be necessary to assure adequate instrument sensitivity relative to the nuclide of concern, background issues or other factors affecting the adequacy of the frisk. Should special monitoring requirements be needed, the requirements will be documented and issued on a case by case basis by the

responsible RP Personnel.

4. After frisking the first hand, frisk the other hand.

5. If the frisk of the second hand does not indicate the presence of contamination. Complete a whole-body frisk in the order below:

   a. Head and face. Pause at mouth and nose.

   b. Neck and shoulders.

   c. Arms.

   d. Chest and abdomen.

   e. Back, hips, and seat of pants.

   f. Legs.

   g. Shoe tops and sides.

   h. Bottoms of shoes.

   i. Personal equipment.

6. Return probe to holder and leave the area. Be sure to position the probe so that the next person can frisk one hand without touching the probe.

7. If contamination is indicated, notify RP personnel and remain at the frisking station.

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ATTACHMENT 1-6 – REQUIREMENTS FOR PLANNED SPECIAL EXPOSURES (PSEs)

Subject Matter Expert: Brian D. Hunt
MN471016, Issue N
Effective Date: March 6, 2007; Replaces Document Dated: November 3, 2006
Review Date: October 11, 2006

SCOPE

This attachment contains requirements for preparing, reviewing, and implementing PSEs at SNL/NM. PSEs at SNL/CA are conducted in accordance with OP471361, *Administrative Procedure for Planned Special Exposures to Radiation or Radioactive Materials*.

A PSE may be authorized so that a radiological worker may receive radiation doses in addition to, and accounted for separately from, the doses received under the limits in Attachment 1-1. A PSE is considered only in an exceptional situation that is deemed to be vital to SNL's mission and for which alternatives that might prevent a radiological worker from exceeding the dose limits in Attachment 1-1 are unavailable or impracticable.

Note:

- The requirements in this attachment do not apply to exposures received in emergency situations.
- Declared pregnant workers will not be considered for participation in a PSE.

RESPONSIBILITIES

SNL Personnel

SNL personnel are responsible for:

- Identifying and evaluating operations to determine whether PSEs may be required.
- Preparing justifications for PSEs.
- Obtaining consent from personnel who will participate in PSEs.
- Preparing radiological work permits (RWPs) to control PSEs.
- Preparing ALARA reviews for PSEs.
- Obtaining approval for PSEs from SNL management and DOE.
- Submitting final reports to DOE regarding the conduct of PSEs.

RP Personnel

RP personnel are responsible for:

- Assisting organizations with identifying and evaluating operations that may require a PSE.
- Assisting organizations in preparing and conducting ALARA reviews.
- Reviewing RWPs for adequacy of radiological controls.
- Assessing and tracking doses received by individuals who participate in PSEs.

PROCEDURE

Planning PSEs

Requirements

Managers shall be responsible for:

- Identifying upcoming nonemergency situations that require an individual to exceed his/her annual occupational dose limits and for which alternative solutions that would avoid high doses are unavailable or impracticable.

  Note: This responsibility may, in some instances, be assumed by a Radiation Protection Line Support Project Leader.

- Reviewing the following in consultation with radiation protection personnel:
  - Proposed activities
  - Alternatives to proposed activities
  - Possible need for PSEs associated with proposed activities
- Consulting with RP personnel to prepare radiological work permits (RWPs) for activities that warrant PSEs.

  Note: RP personnel will review RWPs and provide assistance in preparing formal ALARA reviews for affected activities.

- Evaluating and approving RWPs and ALARA reviews.
- Submitting RWPs and ALARA reviews to the Radiation Protection Safety Committee (RPSC) for evaluation and approval.
- Considering skills needed for the task and past exposure histories when selecting personnel to participate in PSE activities.
- Submitting the names of selected individuals to the Radiation Protection Sample Diagnosis Department (RPSDD) for:
  - Evaluation of each individual's occupational dose history.
  - Calculation of each individual's permitted PSE limit, which shall be the lower

of the following:

5 rem total effective dose equivalent (TEDE)
-V rem TEDE received in prior PSEs during current year
-W rem TEDE received in excess of occupational dose limits during current year
= Permitted PSE limit

OR

25 rem TEDE
-X rem TEDE received during all previous PSEs over the person's lifetime
-Y rem TEDE received in excess of occupational dose limits over the person's lifetime
= Permitted PSE limit

- Considering prior dose histories, job dose evaluations, and permitted PSE limits when selecting individuals who will perform PSEs.
- Preparing administrative justifications to exceed SNL administrative control levels (ACLs) and DOE limits for occupational dose.
- Obtaining necessary approvals for exceeding SNL ACLs.

  Note: Depending on expected doses, approvals to exceed SNL ACLs may be required from the department manager and others, up to and including the SNL President (or designee).

- Submitting justifications describing proposed activities, procedures, and evaluations to the RPSC for review and approval.
- Following approval by the RPSC, submitting justifications for review and approval to the Vice President of the division responsible for the work.
- Following approval by the appropriate Vice President, submitting justifications to DOE for approval by the Program Secretarial Office and the Assistant Secretary for Environment Safety and Health (EH-1).
- Ensuring that justifications have been jointly approved, in writing, by the Program Secretarial Official and the Assistant Secretary for Environment, Safety and Health

(EH-1) before proceeding.

Vice Presidents of responsible divisions shall review and approve PSE justifications.

Conducting PSEs

Requirements

Supervisors of individuals who have been selected to participate in PSE activities shall inform the individuals of:

- The purpose of the PSE activity.
- The procedures to be used.
- Estimated doses and associated risks.
- Specific radiological conditions and other hazards involved.
- ALARA dose reduction measures.

Managers shall be responsible for:

- Obtaining written consent from individuals who have been selected for PSE activities.
- Ensuring that work is conducted in accordance with the approved RWPs and ALARA controls.

Note: To ensure that doses recorded for each individual during the activity does not exceed his/her permitted PSE limit, RP personnel will consider using special dosimeters and non-routine, frequent bioassays to track individual doses during PSE activities.

Evaluating PSEs

Requirements

Managers shall be responsible for:

- Developing reports, with the assistance of radiation protection personnel, that describe PSE activities and the results of those activities.

- Submitting PSE reports within 30 days to DOE's Program Secretarial Office and the Assistant Secretary for Environment, Safety and Health (EH-l).

- Recommending appropriate ACLs for annual occupational exposure for each person with a lifetime occupational dose exceeding N rem, where N is the age of the person in years. The recommended ACL shall **not** exceed 1 rem and should allow the person's lifetime occupational dose to approach N rem as additional occupational exposure is received.

  Note: Individuals who have received PSEs may require lower individualized ACLs.

- Ensuring that participating individuals' occupational dose records reflect PSE results and any special ACLs. PSE doses shall be accounted for separately from routine occupational doses.

RECORDS

Managers shall be responsible for maintaining the following PSE-related records:

- Radiological work permits (RWPs) and ALARA reviews for PSEs.

- Administrative justification and approval to exceed ACLs, authorization for the PSE, and documentation of recommended ACLs.

- Written consent from individuals who have been selected to participate in PSE activities, with copies entered into affected individuals' Health Hazard Case Files.

- Final reports of PSEs.

- Reports of doses received during PSEs.

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ATTACHMENT 6-2 – EXEMPTED ITEMS LIST

Subject Matter Expert: Tom Laiche, Bob Miltenberger
MN471016, Issue H
Effective Date: September 22, 2006; Replaces Document Dated: June 21, 2006
Review Date: September 13, 2006
Administrative Changes: June 6, 2007

The items on this list are exempt from the requirements of the SNL Radiological Protection Procedures Manual (RPPM) subject to the following provisions:

- The dose to an individual from the item is unlikely to result in 100 mrem total effective doe equivalent (TEDE) in a year.
- The item has not been modified or altered in a way prohibited or otherwise not intended by the manufacturer of the item.
- The radioactive material in the item is not known to have been modified, technologically enhanced, concentrated, or isotopically altered.

Any questions concerning this list should be directed to your Division ES&H Team

Electronic Products

- Television receivers (NCRP 95, Section 2.1.1; 21 CFR 1020.10).
- Video display terminals (VDTs) (NCRP 95, Section 2.1.2, 21 CFR Subchapter J.v

Radioluminous Products

- Tritium gas tube light sources used to backlight liquid crystal displays (LCDs) (NCRP 95, Section 3.1.1; 10 CFR 30.19).

- Tritium paint and tritium gas in watches and clocks (NCRP 95, Section 3.1.1; 10 CFR 30.19).
- Pm-147 paint used in watches and clocks (NCRP 95, Section 3.1.1; 10 CFR 30.19).
- Radium dial watches (NCRP 95, Section 3.1.1).
- Tritiated gun sights (10 CFR 30.19).

Spark Gap Irradiators

Spark gap irradiators containing up to 1 m Ci of Co-60 in plated or alloy form. Spark gap irradiators are used as an electric igniter in an industrial fuel oil burner to enhance the reliability of ignition and safety during the ignition sequence (NCRP 95, Section 3.1.3.1; 10 CFR 30.15).

Electron Tubes

Electron tubes (including spark gap tubes, power tubes, gas tubes including glow lamps, receiving tubes, microwave tubes, indicator tubes, pickup tubes, radiation detection tubes, and any other completely sealed tube that is designed to conduct or control electrical currents) provided that each tube does not contain more than one of the following specified quantities of byproduct material:

- 150 millicuries of tritium per microwave receiver protector tube or10 millicuries of tritium per any other electron tube.
- 1 microcurie of cobalt-60.
- 10 microcuries of nickel-63.
- 30 microcuries of krypton-85.
- 5 microcuries of cesium-137.v
- 30 microcuries of promethium-147.
- 40 microcuries of carbon-14.

Electron tubes are used for voltage regulation, current surge protection, and as indicator lights. Spark gap tubes or glow lamps are used as starters for fluorescent lamps and in electric blanket thermostats and other specialty devices (NCRP 95, Section 3.1.3.2; 10 CRF 30.15).

Krytrons

Krytrons containing up to 10 microcuries of Ni-63. Krytrons are used as pulsed-power switching devices (10 CFR 30.71 [Schedule B quantity]).

Gas and Aerosol Detectors

Gas and aerosol detectors designed to protect life or property from fires and airborne hazards (NCRP 95, Section 3.1.4; 10 CFR 30.20).

Glass and Ceramics

The following items containing natural uranium/thorium isotopes:

- Glazed ceramic tableware (NCRP 95, Section 3.2.7.2; 10 CFR 40.13).
- Piezoelectric ceramic (used in many consumer products that require an electromechanical coupling device) (10 CFR 40.13).
- Glassware containing not more than 10% by weight uranium or thorium (NCRP 95, Section 3.2.7.1; 10 CFR 40.13).
- Commercially manufactured glass brick, pane glass, ceramic tile, or other glass or ceramic used in construction containing not more than 0.05% by weight uranium or thorium (NCRP 95, Section 3.2.7.1, 10 CFR 40.13).
- Ceramic Grinding Wheels/Polishing Compounds.
- Ceramic electric insulators.
- Ceramic heating elements.
- Commercially available ceramic materials used for mold making and molten metal processing.

- Ceramic and porcelain tile, toilet bowls, tanks, urinals, and sinks.

Products Containing Thorium

- Any quantities of thorium contained in:
    - Incandescent gas mantles (mantles in gas-lanterns and gas yard lights consist almost entirely of the oxides of thorium (95%), magnesium, aluminum, cerium, beryllium, and silicon) (NCRP 95, Section 3.2.8.2; 10 CFR 40.13).
    - Vacuum tubes (10 CFR 40.13).
    - Welding rods (thoriated tungsten welding rods contain an average of 2% of radioactive thorium by weight). (NCRP 95, Section 3.2.8.4; 10 CFR 40.13).
- Electric lamps for illuminating purposes provided that each lamp does not contain more than 50 milligrams of thorium (10 CFR 40.13).
- Germicidal lamps, sunlamps, and lamps for outdoor or industrial lighting provided that each lamp does not contain more than 2 grams of thorium (10 CFR 40.13).
- Rare earth metals and compounds, mixtures, and products containing not more than 0.25 percent by weight thorium, uranium, or any combination of these (10 CFR 40.13).
- Personnel neutron dosimeters provided that each dosimeter does not contain more than 50 milligrams of thorium (10 CFR 40.13).
- Contact lenses, spectacles, or in eyepieces in binoculars or other optical instruments containing up to 0.05% by weight of uranium or thorium or any combination of these materials (10 CFR 40.13).
- Optical lenses (including camera and microscope lenses), provided that each lens does not contain more than 30 percent by weight of thorium, and provided that shaping, grinding or polishing of such lens or manufacturing processes other than the assembly of such lens into optical systems and devices without any alteration of the lens is prohibited (10 CFR 40.13).

- Fluorescent lamp starters (average starter contains 5 pCi of thorium) (NCRP 95, Section 3.2.8.5).

- Any finished product or part fabricated of, or containing tungsten or magnesium-thorium alloys, provided that the thorium content of the alloy does not exceed 4 percent by weight, and provided that chemical, physical or metallurgical treatment or processing of any such product or part is prohibited (10 CFR 40.13).

ES&H Samples

ES&H samples are exempted from the requirements of the RPPM if it is reasonably expected that the:

- Exterior of the sample container exhibits contamination levels less than those listed in Attachment 6-1, “Radioactive Contamination Limits.”

- Dose rate on contact with the container is less than 0.5 mrem per hour.

Miscellaneous

- Unrefined and unprocessed uranium or thorium ore samples (10 CFR 40.13).

- Photographic film, negatives, and prints containing uranium or thorium (10 CFR 40.13).

- Fertilizer products (principal radionuclides include U/Th decay series and K-40) (NCRP 95, Section 3.2.5.1).

- Building materials such as granite, sandstone, cement, limestone concrete, sandstone concrete, brick, dry wallboard, manufactured anhydride (by-product gypsum) (major radionuclides of importance are isotopes of uranium, thorium, and potassium) (NCRP 95, Section 3.2.2 and 3.2.4).

- Combustible fuels (coal, oil, and natural gas) (NCRP 95, Section 3.2.6).

- Mineral wool (a fibrous, wool-like material used for nonflammable, thermal insulation that may have elevated levels of Ra-226 from the manufacturing process).

- High temperature insulation containing uranium/thorium isotopes.

- Tape dispenser ballast (zircon sands of depleted uranium (DU) have been used in the manufacture of tape dispenser ballast and may contain U-238 and/or uranium daughters).
- Any product, reagent chemical, etc., which contains natural potassium such as salt substitutes containing potassium chloride (the activity of K-40 in natural potassium is approximately 1800 dpm/g-K).
- Oil (new motor oil has trace amounts of U/Th).
- Prefused Flux (may contain uranium/thorium and daughters and K-40).
- Grinding disks, pads, and stones.
- Sandpaper.
- Static eliminators containing tritium.
- Petroleum compounds containing NORM used to weatherproof electrical devices.
- Spark plugs containing Po-210.

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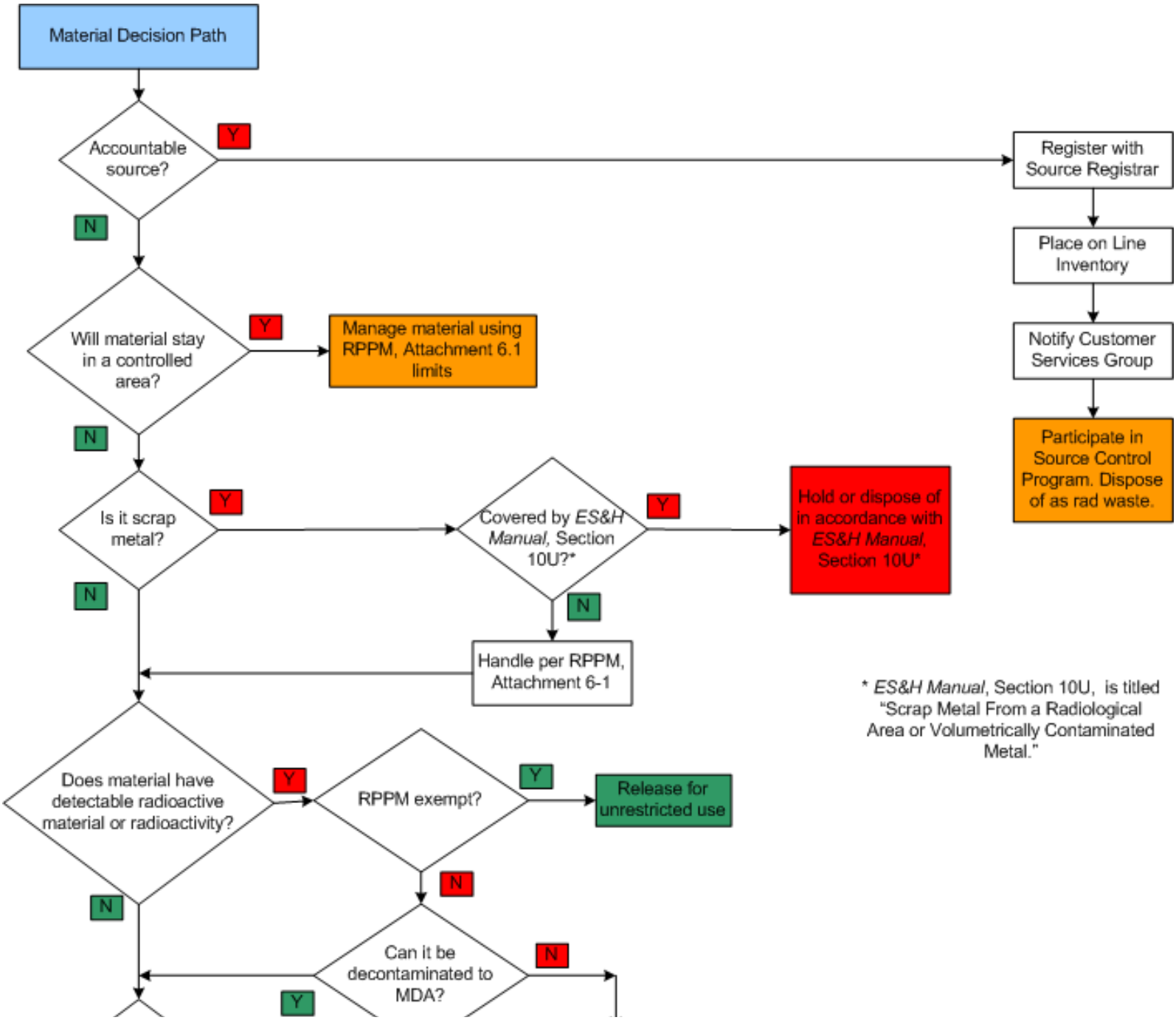
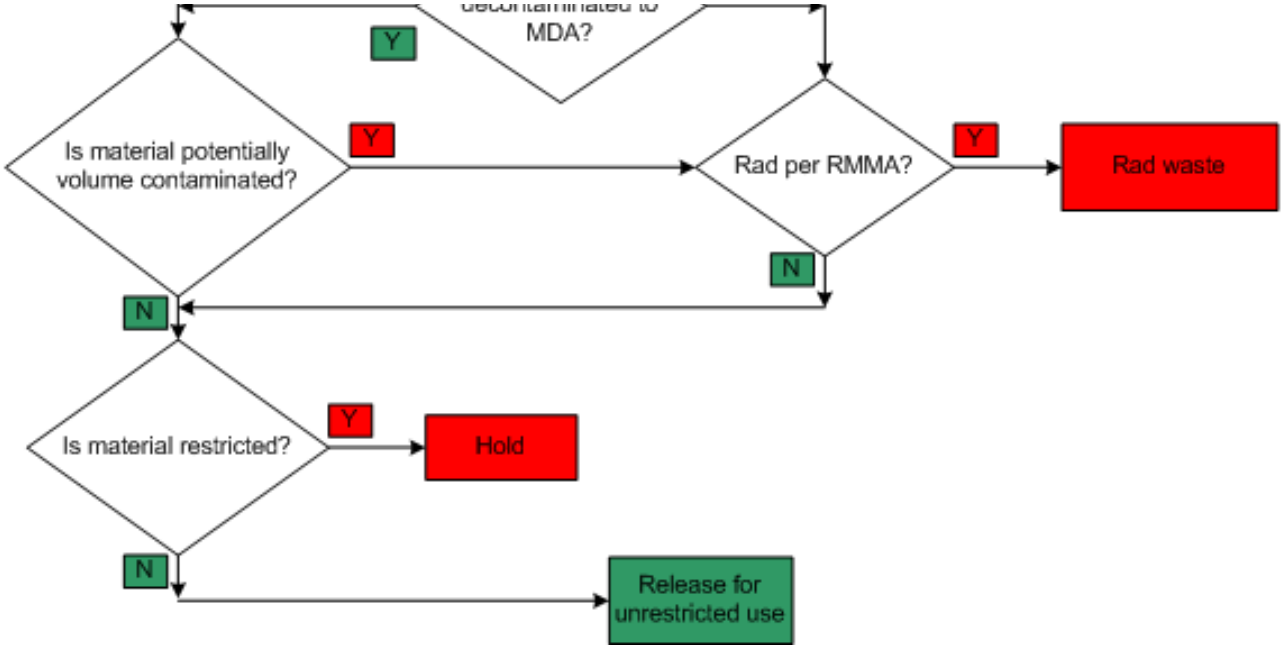
ATTACHMENT 6-4 – RELEASE/DISPOSAL DECISION FLOWCHART

Subject Matter Experts: Tom Laiche, Bob Miltenberger

MN471016, Issue H
Effective Date: September 22, 2006; Replaces Document Dated: June 21, 2006
Review Date: September 13, 2006
Administrative Changes: June 6, 2007





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ATTACHMENT 7-1 – ENVIRONMENTAL ALARA SCREENING

Subject Matter Experts: Ted Simmons, Mark Miller
MN471016, Issue D
Effective Date: March 31, 2006;, Replaces Document Dated: January 11, 2000

The environmental ALARA screening process is intended to help the user identify operations that may require an Environmental ALARA evaluation, and includes the following steps:

1. Determine if there is a pathway for dose to the public or release to the environment by asking whether the operation will result in:
    - Radioactive air emissions?
    - Releases of radioactive liquid effluents to the environment or sanitary sewer?
    - Offsite external radiation fields?
    - Creation of an offsite Radiological Area and/or Controlled Area?
2. Determine if there is a potential offsite public receptor by asking whether the operation will affect:
    - A routinely occupied area, such as offices or residences?
    - An intermittently occupied area (e.g., a public-access road)?
    - Any temporary activities in progress (e.g., construction, well drilling, etc.)?
3. If the screening process:

- Fails to identify either a potential source or receptor, then additional qualitative and quantitative ALARA evaluations are not normally required.

- Indicates that both a potential source and receptor exist, or if in doubt, then consult the Environmental ALARA Coordinator for assistance with further evaluation.

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Radiological Protection Procedures Manual

ATTACHMENT 9-1– SUMMARY OF REGISTRATION, TRAINING, TECHNICAL WORK DOCUMENT (TWD), LEAK TESTING, AND INVENTORY REQUIREMENTS

Subject Matter Expert: Kevin Rolfe
MN471016, Issue G
Effective Date: May 24, 2007; Replaces Document Dated: November 14, 2002
Review Date: September 26, 2006

Source Type	Registration	[1,2,3]Training	TWD / RWP	Leak Testing
Active accessible Accountable Sealed Radioactive Sources (ARSs)	Required	RAD210, RAD230, or RCT	TWD – Required RWP – See Chapter 1	Required **[10 CFR 835.1202(b)]**
Active accessible gaseous ARSs Active accessible ARSs containing only tritium	Required	RAD210, RAD230, or RCT	TWD – Required RWP – See Chapter 1	Not Required **[10 CFR 835.1202(b)]**

Active inaccessible ARSs	Required	Custodian: RAD210, RAD230, or RCT Users: RAD102	TWD – Required RWP – Chapter 1	Required (unless located in an area that is unsafe for human entry) **[10 CFR 835.1202(d)]**
Neutron sources used for reactor startup	Required	RAD210, RAD230, or RCT	Not Required (must be covered by other safety documentation such as a SAR)	Not Required while an integral part of the reactor assembly
High Strength Sources	Required	RAD230, or RCT	TWD – Required RWP – Required	Required if accessible
ARSs in Storage (regardless of form)	Required	RAD210, RAD230, or RCT	Not Required	Not Required
Sources available for reapplication (may be accountable or non-accountable)	Required	Accountable: RAD210, RAD230, or RCT Non-Accountable: See Chapter 3	Not Required for ARS[5] See Chapter 1 for Non-accountable source	Not Required
Non-Accountable Sources (regardless of form)	Optional	See Chapter 3	See Chapter 1	Not Required

Materials in process, activated shielding materials, materials not used as sources of radiation (see Section 2.0) Sources with a half life <30 days	Optional	See Chapter 3	See Chapter 1	N/A

[1] Both primary and alternate source custodians must take RAD218 in addition to the other applicable training requirements.

[2] RAD218 = Radioactive Source Control for Source Custodians
RAD210 = Radiological Worker I Training (RWI)
RAD230 = Radiological Worker II Training (RWII)
RAD102 = General Employee Radiological Training (GERT)
RCT = Qualified Radiological Control Technician

[3] Managers require RAD250, Management of Radiological Operations.

[4] Additional survey requirements and operational checks of safety devices apply (see Section 4.5).

[5] Must have a TWD/RWP prior to use.

[6] Leak Test ARS prior to use.

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ATTACHMENT 9-2– CHANGES THAT COULD INCREASE RADIATION EXPOSURE FROM A HIGH STRENGTH RADIOACTIVE SOURCE

Subject Matter Expert: Kevin Rolfe
MN471016, Issue G
Effective Date: May 24, 2007; Replaces Document Dated: November 14, 2002
Review Date: September 26, 2006

The following are examples of changes that could increase radiation exposure however, the exact changes that could cause such increases are specific to each high strength radioactive source and should be addressed in associated technical work documents (TWDs) (see CPR400.1.1, MN471001, *ES&H Manual*, Chapter 21, "Technical Work Documents [TWDs]").

Changes to operations that could increase radiation exposure include:

- Changing the location of the high strength radioactive source.
- Repositioning a high strength radioactive source (i.e., positioning a source closer to a shield wall.)
- Moving a high strength radioactive source via disassembly of the source housing and reassembly in a new location.

  Note: A radiation survey is not required if the movement is part of the routine use of the source, and the movement is covered in the TWD for the source.
- Changing the occupancy of adjacent areas (i.e., converting a source storage area to office space)

- Changing the configuration or operational characteristics of the source housing as the result of maintenance or repair.

- Changing source shielding (examples of changes that can alter the effectiveness of shielding include):

    - Removing and replacing sourceshielding (includes the removal and replacement of the same shielding or identical shielding).

    - Using different shielding material, especially a material with a lower atomic number (Z).

    - Changing the form of the shielding material, such as using thinner shielding or using the same material in a different form (particularly a lower density form).

    - Changing the size of the shielding, such as making a shielding component smaller so that it no longer covers the same area.

    - Moving shielding from one location to another.

Note: Components of a high strength radioactive source housing may function as radiation shielding, in addition to the primary function for which the components were designed (e.g., cameras mounted at viewports). Thus, extreme care should be exercised when removing or moving any component of a high strength radioactive source housing to ensure that the radiation shielding of the source is not compromised.

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ATTACHMENT 9-3 – RADIATION SURVEY CONDITIONS THAT REQUIRE OPERATING RESTRICTIONS IN ASSOCIATED TECHNICAL WORK DOCUMENTS (TWDs) FOR HIGH STRENGTH RADIOACTIVE SOURCES

Subject Matter Expert: Kevin Rolfe
MN471016, Issue G
Effective Date: May 24, 2007; Replaces Document Dated: November 14, 2002
Review Date: September 26, 2006

If a high strength source is not surveyed under worst-case conditions, appropriate operating restrictions shall be reflected in the associated TWD. The following table presents relevant examples.

Worst-Case Condition (Example)	**Operating Restrictions Noted in TWD** (If the High Strength Radioactive Source is Not Surveyed Under Worst-Case Condition)
If the high strength source housing utilizes any device that restricts or modifies the high strength radioactive source beam (i.e., collimators or filters), then the high strength radioactive source should be surveyed for each potential configuration that is expected to be used.	If the high strength radioactive source is not surveyed for each potential configuration, then the high strength radioactive source shall only be used in the configurations in which it has been surveyed, and this restriction shall be reflected in the TWD for the high strength source.

The high strength radioactive source should be surveyed in all geometries in which the useful beam can be directed, with the beam positioned and oriented so that the highest exposure rate will be encountered in the area under evaluation.	If the high strength radioactive source is not surveyed in all geometries in which the useful beam can be directed, the high strength source shall only be used in the geometries in which it has been surveyed, and this restriction shall be reflected in the TWD for the high strength source.
If the high strength radioactive source housing has any components that can be removed, such as removable shielding or equipment (i.e., cameras mounted at viewports), then the high strength radioactive source should be surveyed with those components in place and with those components removed to determine if their removal presents a hazard.	If the high strength radioactive source is not surveyed under these conditions, the high strength source shall only be used with those components in place, and this restriction shall be reflected in the TWD for the high strength radioactive source.

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ATTACHMENT 10-1 – CLASSIFICATION OF RADIATION-GENERATING DEVICES (RGDs)

Subject Matter Expert: Kevin Rolfe
MN471016, Issue J (I not used)
Effective Date: June 15, 2007; Replaces Document Dated: September 29, 2005
Review Date: September 26, 2006

INTRODUCTION

An RGD installation is defined as the radiation source, its associated equipment, and the space in which it is located. The installation classes differ in their relative dependence on inherent shielding, operating restrictions, and engineered and administrative controls to achieve the required degree of radiation safety.

1.0 EXEMPT SHIELDED INSTALLATION

The term exempt shielded does not mean that a device is exempt from the RGD Program. An exempt shielded installation is a shielded installation (see Section 2.0 of this *ATTACHMENT) in which the dose equivalent at any accessible region 2 inches (5 cm) from the outside surface of the enclosure does not exceed in any 1 hour 0.5 mrem deep dose to the whole body. This dose rate limit shall be met for any radiation source intended for use in the enclosure. A radiation survey is required to classify an RGD as an exempt shielded installation. See Section 4.10 of Chapter 10 for more information on RGD surveys.

In addition, exempt shielded devices generally utilize a cabinet or enclosure that is not

designed for entry by the whole body (as opposed to the room-within-a-room concept generally utilized by shielded installations).

This class provides the highest degree of engineered safety and does not require restrictions in occupancy outside the enclosure since shielding is sufficient to meet the maximum permissible dose equivalent requirements for non-controlled areas.

Exempt shielded RGDs include the types of devices discussed below.

1.1 Inherently Safe

To be inherently safe, there shall be no means (e.g., defeating interlocks, removing shielding, etc.) by which any part of a person's body could be exposed to ionizing radiation. Inherently safe RGDs shall **not** depend on compliance with any administrative controls or operating limitations for radiation protection.

This type is primarily limited to devices that accelerate electrons or ions in vacuum and in which there is no means to access the radiation source without breaking the vacuum required for operation. Examples of devices that are considered inherent safety include the following:

- Scanning electron microscopes.
- Transmission electron microscopes.
- Electron beam deposition systems.
- Electron beam welders.
- Electron beam furnaces.
- Electron diffraction devices.
- Scanning ion microprobes.
- Auger analysis devices.

1.2 Certified Cabinets

Certified cabinets consist of equipment meeting the requirements of 21 CFR 1020.40. To be considered a certified cabinet, the device shall be certified by the manufacturer (either by a label affixed to the device or in the operating manual for the device) as meeting the requirements of 21 CFR 1020.40 and shall **not** have been subsequently modified.

Examples of devices that may be certified cabinets are:

- Faxitrons.
- Baggage (security) x-ray machines.

1.3 X-Ray Diffraction and Fluorescence Analysis Equipment

This type consists of x-ray diffraction and fluorescence analysis equipment meeting the standards of ANSI N43.2. Not all x-ray diffraction and fluorescence analysis equipment meets these standards. To determine if a device meets ANSI N43.2 standards, first determine whether the device is an enclosed beam or open beam system according to the criteria set forth below, then see either SF 2001-EDF (Word file/Acrobat file) or SF 2001-ODF (Word file/Acrobat file) for the ANSI standard requirements that apply to that type of system. For equipment not meeting ANSI N43.2 standards, consult RP personnel for assistance in determining the proper installation class/type.

An enclosed beam x-ray system is one in which all possible x-ray paths are fully enclosed according to all the following requirements:

- The radiation source, sample, detector, and analyzing crystal (if used) shall be enclosed in a chamber or coupled chambers that cannot be entered by any part of the body during normal operation.
- The inherent shielding of the chamber walls shall be sufficient to limit the dose rate in all regions 5 cm from its outer surface to 0.25 mrem/h during normal operation.
- The sample chamber closure shall be interlocked with the x-ray tube high voltage supply or a shutter in the primary beam so that no x-ray beam can enter the sample chamber while it is open unless the interlock has been consciously and deliberately defeated.
- The interlock required above shall be of fail-safe design.

- If there is more that one port in the radiation source housing or more than one radiation source, all requirements shall be satisfied for each port in every source housing associated with the system.

An x-ray system that does not comply with all of the above requirements for an enclosed beam x-ray system shall be classified as an open beam x-ray system.

1.4 Other Exempt Shielded Devices

This type includes all devices meeting the definition of an exempt shielded installation that do not meet the requirements for an inherently safe device, a certified cabinet device, or an x-ray diffraction or fluorescence analysis device. This classification requires concurrence from radiation protection personnel.

2.0 SHIELDED INSTALLATION

This class generally utilizes the room-within-a-room concept with engineered shielding structures and safety devices. Administrative controls may also be instituted to maintain potential dose rates ALARA. In a shielded installation, the source of radiation and all objects exposed thereto are within a fixed structure that attenuates the radiation to an acceptable level and within which no person is permitted to remain during irradiation.

Shielded RGDs include the types of devices discussed below.

2.1 High-Energy Particle Accelerators

This type of device employs electrostatic or electromagnetic fields to impart kinetic energy to molecular, atomic, or sub-atomic particles; is capable of creating a radiological area; and is capable of activating materials or causing contamination of equipment.

2.2 X-Ray Generators and Low-Energy Particle Accelerators

This type of device employs electrostatic or electromagnetic fields to impart kinetic energy to molecular, atomic, or sub-atomic particles and is capable of creating a radiological area, but is **not** capable of causing activation or contamination of materials.

These devices are used in applications such as radiography, mine detection, or the production of incidental photons or particles.

2.3 Other Shielded Installations

This type includes all other devices meeting the definition of a shielded installation. This classification requires concurrence from radiation protection personnel.

3.0 OPEN INSTALLATION

An open installation is an installation that, due to operational requirements or temporary needs, cannot be provided with the inherent degree of protection specified for either the shielded or unattended installations. The protection of personnel and the public depends almost entirely on administrative controls. Open installations include operations conducted in fixed facilities with equipment such as portable x-ray systems that **cannot** be connected to warning and interlock systems. This class shall only be selected if operational requirements prevent the use of one of the other classes. Examples include mobile LINAC and well-logging devices.

Open installations include the types of devices discussed below.

3.1 Portable or Mobile Radiography

This type includes any portable or mobile x-ray machine or LINAC.

3.2 Fixed Devices With Partial Shielding

This type includes any fixed device **without** fully-enclosed shielding or engineered access controls, such as flash x-ray units operated on open firing pads.

3.3 Portable Analytical Devices With Open-Beam Configurations

This type includes analytical devices that use a shutter to control the presence of a radiation beam, such as soil moisture or density gauges.

3.4 Other Open Installations

This type includes all other devices meeting the definition of an open installation. This classification requires concurrence from radiation protection personnel.

4.0 UNATTENDED INSTALLATION

An unattended installation is designed for a specific purpose and is designed to run unattended at all times (not just for occasional periods). No person shall receive a total effective dose equivalent (TEDE) of more than 100 mrem in a year from operation of an unattended RGD. This class of device has very limited application at SNL, and classification as an unattended installation requires concurrence from radiation protection personnel.

5.0 NEUTRON GENERATOR OPERATIONS

Neutron generator operations include the testing and operation (resulting in the production of neutrons) of weapon component neutron generators and neutron tubes, field test neutron generators, and stand-alone neutron generating devices such as controlatrons and zetatrons.

Generally, an individual neutron-generating device is not capable of producing neutrons unless it is connected to an external energy source. If the device is connected to an external energy source, one or both shall be registered and shall comply with the operating requirements for Neutron Generator Operations (see Chapter 10, Section 2.0).

6.0 MEDICAL INSTALLATION

Medical installations include devices used for patient diagnoses and treatment.

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ATTACHMENT 10-3 – TECHNICAL WORK DOCUMENTS (TWDs) FOR RADIATION-GENERATING DEVICES (RGDs)

Subject Matter Expert: Kevin Rolfe
MN471016, Issue J (I not used)
Effective Date: June 15, 2007; Replaces Document Dated: September 29, 2005
Review Date: September 26, 2006

INTRODUCTION

Technical work documents (TWDs) associated with the operation of RGDs should cover the following elements to the extent they apply. Any elements that are covered in other documents may be incorporated by reference to those documents; however, those documents should be available for review, if necessary. A TWD may cover multiple RGDs; however, the following elements (to the extent they apply) should be covered for each RGD. See CPR400.1.1, MN471001, *ES&H Manual*, Chapter 21, "Technical Work Documents (TWDs)."

1.0 GENERAL INFORMATION

- A detailed description of the radiation-generating device (RGD), including:
  - Type of device
  - Manufacturer
  - Model number

- Serial number(s)
- Operating parameters (voltage, current, activity, etc.)
- Type and energy of radiation produced
- Mechanism by which radiation is produced (for incidental devices)
- Location or locations (for portable devices)
- RGD registration number

- Names of RGD custodian and authorized operators/users (to facilitate management oversight of training and control of equipment)
- Training requirements:
  - Specify the required radiological training (RAD102, RAD214, RAD210, RAD230)
  - Specify how device-specific training is accomplished and documented
- Personnel dosimetry requirements (e.g., thermoluminescent dosimeters [TLDs], extremity dosimeters, self-reading dosimeters, electronic alarming dosimeters)

2.0 HAZARD INFORMATION

- Radiological hazards associated with operation of the RGD:
  - Dose rates associated with operation
  - Avenues through which radiation exposure could occur (e.g., failure to evacuate an exposure room, by-passing of an interlock, improper replacement of removable shielding).
- Physical and administrative controls in place to minimize radiation exposure (give

instructions for using radiation protection safety devices where applicable):

- Shielding (especially removable shielding).
- Warning labels/signs.
- Interlocks.
- Warning lights.
- Audible alarms.
- Emergency off switches.
- Stationary and portable radiation survey instruments.
- Personal protective equipment.
- Radiation survey frequencies.
- Changes that could increase radiation exposure and, therefore, require a radiation survey.
- Controls to prevent unauthorized use of the RGD:
  - If the system governing production of radiation is equipped with a lock and key, the number of keys in existence and how the keys are controlled.
  - Methods and occasions for locking and securing radiation sources.

- Radiological areas created during operation of the RGD and methods for controlling access to those areas in compliance with Chapter 5, "Entry Control."
- Methods to ensure that no individual may bypass a safety device or interlock without proper authorization.
- Methods of monitoring and controlling any radiological hazards that may exist following operation of an accelerator (e.g., activation products or changes in contamination).

3.0 OPERATING INFORMATION

- Frequency of and methods for performing and documenting operational checks of safety devices (e.g., shutters, lights, audible alarms, interlocks, and emergency off switches).
- Instructions for calibration or alignment of the useful beam.
- Administrative requirements for placing the RGD into and taking it out of a maintenance mode:
    - Changes in posting requirements during maintenance operations.
    - Who is authorized to remove and replace shielding.
    - Post-maintenance radiation survey requirements.
- Any restrictions on operation of the RGD, such as:
    - Magnitude of voltage and/or current.
    - Presence of mechanical or electrical devices that restrict beam orientation and magnitude (such as collimators or filters).
    - Allowable beam orientations.
    - Requirement for presence of removable equipment and/or shielding.
- Instructions for handling and transporting the RGD (for portable RGDs).
- Post-movement radiation survey requirements.

4.0 EMERGENCY INFORMATION

- Types of reasonably credible emergencies that may be encountered:
  - For RGDs that need to be energized to produce radiation:
    - Failure of the RGD to turn off.
    - Fire involving the installation.
    - Radiation levels outside the installation in excess of prescribed limits.
    - Failure to evacuate personnel from an exposure room prior to producing radiation.
  - For particle accelerators that use targets in which radioactivity can be induced, or neutron tube/generator test devices:
    - Loss of radioactive material containment.
    - Fire involving the installation.
    - Radiation levels outside the installation in excess of prescribed limits.
    - Failure to evacuate personnel from an exposure room prior to producing radiation.
- Response actions for any audible or visible alarm signal.
- Response actions according to Chapter 11, "Radiological Incidents."
- Names of individuals and organizations to be notified in the event of an emergency.

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ATTACHMENT 10-4 – CHANGES THAT COULD INCREASE RADIATION EXPOSURE FROM RADIATION-GENERATING DEVICES (RGDs)

Subject Matter Expert: Kevin Rolfe
MN471016, Issue J (I not used)
Effective Date: June 15, 2007; Replaces Document Dated: September 29, 2005
Review Date: September 26, 2006

The following are examples of changes that could increase radiation exposure; however, the exact changes that could cause such increases are specific to each RGD and should be addressed in associated TWDs: (See CPR400.1.1, MN471001, *ES&H Manual*, Chapter 21, "Technical Work Documents [TWDs]").

- Changes to shielding (examples of changes that can change the effectiveness of shielding include):
    - Removal and replacement of shielding (even removal and replacement of the same shielding or identical shielding).
    - Using different shielding material, especially a material with a lower atomic number (Z).
    - Changing the form of the shielding material, such as using thinner shielding or using the same material in a different form (particularly a lower density form).
    - Changing the size of the shielding, such as making a shielding component smaller so that it no longer covers the same area.

- Moving shielding from one location to another.

  Note: components of a device may function as radiation shielding, in addition to the primary function for which the components were designed (e. g., cameras mounted at viewports). Thus, extreme care should be exercised when removing or moving any component of an RGD to ensure that the radiation shielding of the device is not compromised.

- Changes to operation. Changes to operations that could increase radiation exposure include:

  - Presence of a higher radiation source strength, such as using a target material with a higher atomic number (Z) (for electron beam devices).

  - Changing the location of the radiation source, such as positioning an x-ray tube closer to a shield wall.

- Changes to equipment, such as using a higher energy x-ray tube inside an enclosure.

- After movement (because movement generally requires disassembly of the device and reassembly in a new location).

  Note: A radiation survey is not required if the movement is part of the routine use of the device, and the movement is covered in the TWD for the device.

- Changes to occupancy of adjacent areas, such as when a storage area is converted to office space.

- After maintenance or repair operations that change the configuration or operational characteristics of the device.

- Reactivation of an out-of-service RGD.

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ATTACHMENT 10-5 – RADIATION SURVEY CONDITIONS THAT REQUIRE OPERATING RESTRICTIONS IN ASSOCIATED TECHNICAL WORK DOCUMENTS (TWDs)

Subject Matter Expert: Kevin Rolfe
MN471016, Issue J (I not used)
Effective Date: June 15, 2007; Replaces Document Dated: September 29, 2005
Review Date: September 26, 2006

If a radiation-generating device (RGD) is not surveyed under worst-case conditions, appropriate operating restrictions shall be reflected in the associated TWD. The following table presents relevant examples.

Worst-Case Condition (Example)	Operating Restrictions Noted in TWD (If RGD is Not Surveyed Under Worst-Case Condition)
RGDs should be surveyed at the maximum rated voltage and current.	If the RGD is not surveyed at the maximum rated voltage and/or current, the RGD shall **not** be operated above the voltage and current at which it has been surveyed, and this restriction shall be reflected in the TWD for the RGD.

No mechanical or electrical devices that restrict beam orientation and magnitude (such as collimators or filters) should be used during the survey unless the device (s) are permanently attached and the RGD cannot be operated without them.	If the RGD is surveyed with any such devices in place, the RGD shall **not** be operated without the device(s) in place, and this restriction shall be reflected in the TWD for the RGD.
The RGD should be surveyed in all geometries in which the useful beam can be directed, with the beam positioned and oriented so that the highest exposure rate will be encountered in the area under evaluation.	If the RGD is not surveyed in all geometries in which the useful beam can be directed, the RGD shall only be operated in the geometries in which it has been surveyed, and this restriction shall be reflected in the TWD for the RGD.
If the RGD has any parts that can be removed and still allow the device to operate, such as removable shielding or equipment (such as cameras mounted at viewports), the RGD should be surveyed both with those items in place and with those items removed to determine if their removal presents a hazard.	If the RGD is not surveyed under these conditions, the RGD shall only be operated with those parts in place, and this restriction shall be reflected in the TWD for the RGD.

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ATTACHMENT 12-1 – PERFORMING OPERATIONAL PERFORMANCE TESTS ON RADIATION-MONITORING INSTRUMENTS

Subject Matter Expert: David Sinton
Contributor: Walen Mickey, Robert Miltenberger
MN471016, Issue E
Effective Date: November 27, 2006; Replaces Document Dated: February 22, 2005
Review Date: October 19, 2006

Use the following process or a similar procedure that affords the same level of test accuracy to perform operational performance tests on radiation monitoring instruments:

1. Obtain the radiation check source(s) specified to use on the instrument for the test. Always perform an operational performance test using the same check source (s) that was used to establish the reference reading(s) for the instrument that you are using.

2. Verify instrument calibration. Be sure that the instrument you choose has a calibration notice on it and that the calibration expiration date has not passed. If the instrument calibration has expired, remove it from service.

3. Perform a physical inspection of the instrument. Inspect the exterior of the instrument, the detector probe, and any associated cabling for damage that might affect the instrument's operability. If any damage is apparent, remove the instrument from service.

4. Turn instrument on and check the instrument-specific functions (e.g., battery, high voltage, audible indication, and alarm/control circuit actuation). If any instrument-specific function does not operate or indicate properly, remove the instrument from

service.

5. Take a background reading in an area away from radiation sources. Compare the background reading to the reference background reading. If the background reading obtained is greater than ten times the reference background reading, remove the instrument from service.

6. Take a reading of the check source(s). Repeat the following steps for each check source:

   A. Expose the instrument detector's sensitive area, such as the beta window, to the check source in a way that provides a reproducible geometry and note the instrument reading.

   B. Compare the reading to the operational performance test reference reading of the instrument. If the reading is not within ±20% of the reference reading, remove the instrument from service.

7. Check facility-specific devices that are controlled by the radiation monitoring instrument (e.g., external interlocks and/or alarms). If a facility-specific device does not perform properly with the instrument, follow the guidance in the applicable facility technical work documents (TWDs). If the instrument is defective, remove it from service.

8. Record the operational performance test results (including the instrument readings and functional status) in a log book or on a log sheet. Sign and date the log entry. Provide a method (such as a tag or label) to indicate that the instrument is "OK-to-use."

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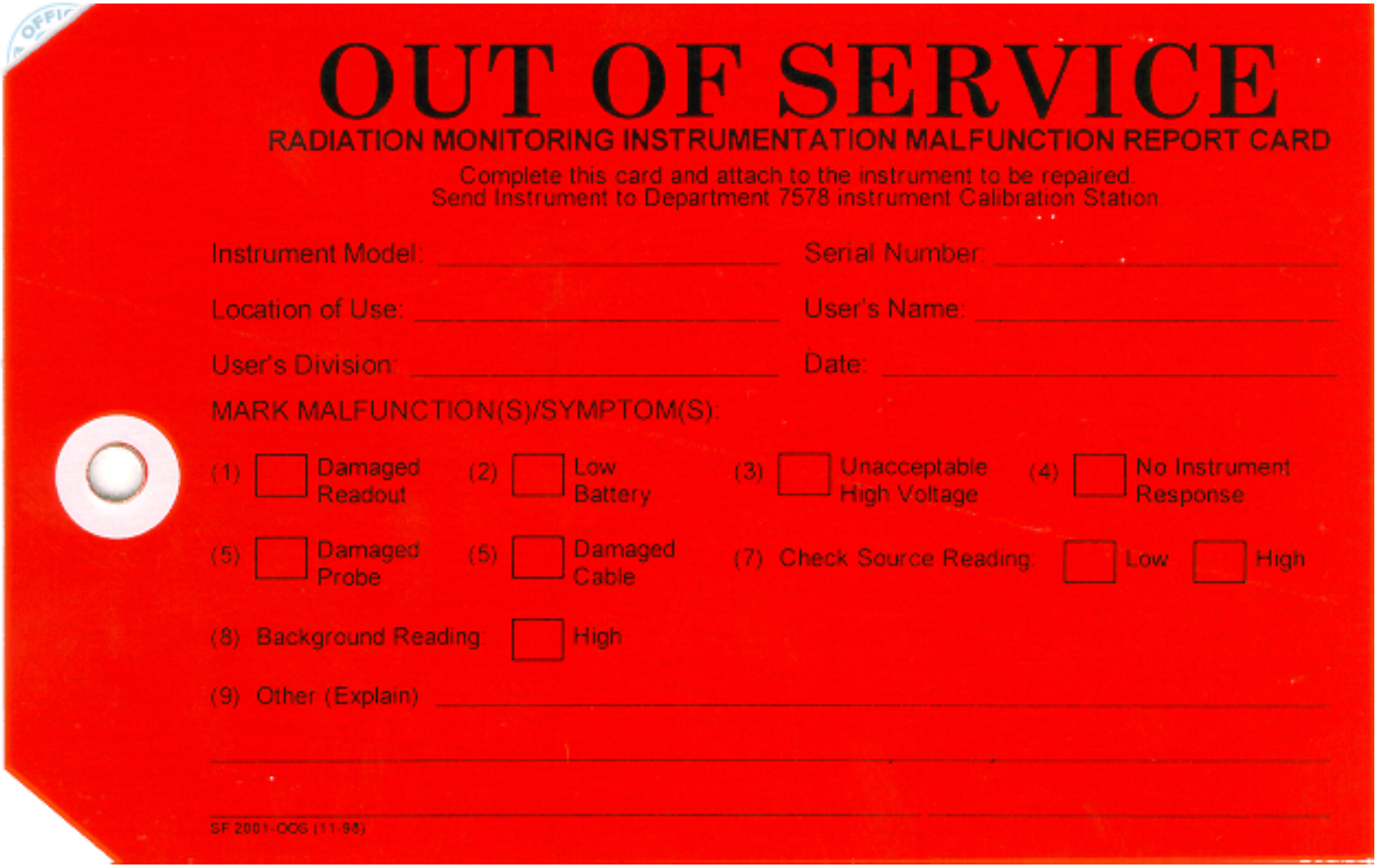
Radiological Protection Procedures Manual

ATTACHMENT 12-2 – SAMPLE OUT-OF-SERVICE TAG

Subject Matter Expert: David Sinton
Contributors: Walen Mickey, Robert Miltenberger
MN471016, Issue E
Effective Date: November 27, 2006; Replaces Document Dated: February 22, 2005
Review Date: October 19, 2006



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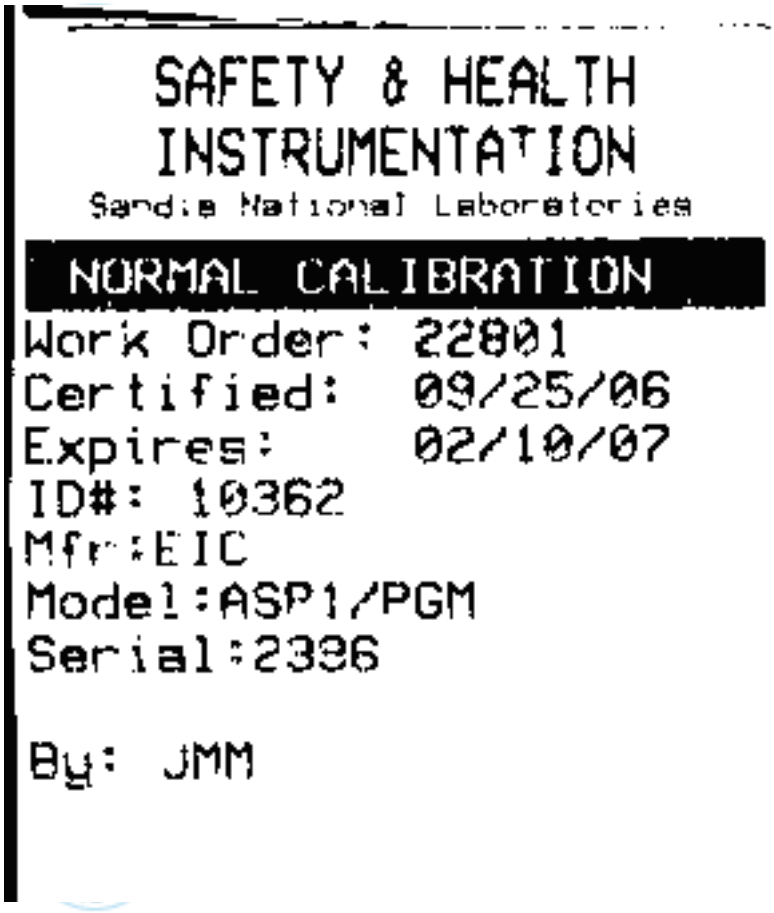
Radiological Protection Procedures Manual

ATTACHMENT 12-3 – SAMPLE CALIBRATION LABEL

Subject Matter Expert: David Sinton
Contributor: Walen Mickey, Robert Miltenberger
MN471016, Issue E
Effective Date: November 27, 2006; Replaces Document Dated: February 22, 2005
Review Date: October 19, 2006



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Radiological Protection Procedures Manual

ATTACHMENT 12-4 – SAMPLE CALIBRATION RECALL NOTICE

Subject Matter Expert: David Sinton
Contributor: Walen Mickey, Robert Miltenberger
MN471016, Issue E
Effective Date: November 27, 2006; Replaces Document Dated: February 22, 2005
Review Date: October 19, 2006

Sandia Standards Laboratory
RECALL NOTICE

Sandia National Laboratories

To: DE LA ROSA,DIANA M.
DEPT: 07523 , MS-1102
BLDG: 919 , RM. 15

SubFacility: CWLF Location: 919/15 Phone No: (505) 844-9570

Item: PORTABLE Mfr.: EIC Model: ASP1/PGM

Serial: 2398 Instrument ID: 10364 Cal Due Date: 10-Nov-1999

INSTRUCTIONS: **Call David Sinton at (505) 844-8703 if you have any questions.**

Attach to the instrument described above with the MOVE ORDER TO CALIBRATION LAB section showing, then call transportation at 844-8048 for pick up. Write any comments or special instructions on the bottom or back of this form.

Sandia Standards Laboratory
MOVE ORDER TO CALIBRATION LAB

Sandia National Laboratories

Move To: Bldg. 869/31
RPI

Attn: D.J. Sinton
Phone (505) 844-8703

Item: PORTABLE Mfr.: EIC Model: ASP1/PGM

Serial: 2398 Instrument ID: 10364 Cal Due Date: 10-Nov-1999

Sandia Standards Laboratory
MOVE ORDER TO OWNER

Sandia National Laboratories

To: DE LA ROSA,DIANA M.
DEPT: 07523 , MS-1102
BLDG: 919 , RM. 15

SubFacility: CWLF Location: 919/15 Phone No: (505) 844-9570

Item: PORTABLE Mfr.: EIC Model: ASP1/PGM

Serial: 2398 Instrument ID: 10364 Cal Due Date: 10-Nov-1999

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Radiological Protection Procedures Manual

ATTACHMENT 14-1 – ACTIONS TAKEN FOLLOWING A DECLARATION OF PREGNANCY

Subject Matter Expert: Susan K. Vosburg
MN471016, Issue D
Effective Date: April 16, 2004, Replaces Document Dated: January 11, 2000

An official declaration of pregnancy initiates the following actions:

- Radiation Protection (RP) personnel perform a radiological hazard evaluation of the worker's work area.
- Dosimetry personnel estimate the dose to the embryo/fetus prior to the time of the declaration (i.e., from the estimated date of conception to the date of declaration).
- Dosimetry personnel provide personnel dosimetry to monitor the radiation exposure to the embryo/fetus as requested by the responsible manager.

If necessary, either (1) a mutually agreeable work assignment will be provided by the manager, if available, or (2) radiological work restrictions will be negotiated among the worker, the responsible manager, the worker's contracting company (if applicable), the SNL medical organization, and RP personnel, so that:

- The embryo/fetus:
  - Does not exceed the total allowed dose equivalent limit of 0.5 rem (0.005 sievert).
  - Is not exposed to a substantial variation above the uniform exposure rate that would satisfy the allowable dose equivalent for the remaining gestation period (e.g., 12 mrem/week for 40 weeks).

- The worker is not allowed to participate in planned special exposure activities.
- If the total allowed dose equivalent limit to the embryo/fetus has already been reached or exceeded by the time the worker declares her pregnancy, she is not allowed to access areas that would result in additional occupational exposure during the remainder of the gestation period.

Note: Examples of appropriate work restrictions may include:

- Reducing the time allowed in radiological areas.
- Restricting or prohibiting access to radiological areas.
- Restricting the time spent in certain areas within a radiological area.
- Restricting performance of certain tasks.
- Requiring use of supplemental controls, such as shielding, ventilation, and personal protective equipment (PPE).
- Imposing a restriction against entering areas where the worker may receive an intake of radioactive material.

Note: Any radiological work restrictions imposed on a declared pregnant worker shall remain in place until the worker is no longer pregnant, the declaration of pregnancy has been withdrawn, or it is determined that such restrictions are no longer necessary.

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