

Program Requirements Document

Radiological Control Manual



RADIOLOGICAL CONTROL MANUAL	Identifier: PRD-183
	Revision: 7
	Page: i of iv

Companywide	Program Requirements Document	For Additional Info: http://EDMS	Effective Date: 02/04/04
-------------	-------------------------------	---	---------------------------------

Manual: 15A – INEEL Radiological Control

Change Number: 106226

CONTENTS

ACRONYMS.....	iii
CHAPTER 1, EXCELLENCE IN RADIOLOGICAL CONTROL	1-1
CHAPTER 2, RADIOLOGICAL STANDARDS	2-1
CHAPTER 3, CONDUCT OF RADIOLOGICAL WORK.....	3-1
CHAPTER 4, RADIOACTIVE MATERIALS	4-1
CHAPTER 5, RADIOLOGICAL HEALTH SUPPORT OPERATIONS	5-1
CHAPTER 6, TRAINING AND QUALIFICATION	6-1
CHAPTER 7, RADIOLOGICAL RECORDS	7-1
CHAPTER 8, REFERENCES	8-1
GLOSSARY	G-1

RADIOLOGICAL CONTROL MANUAL

Identifier: **PRD-183**

Revision: **7**

Page: **ii of iv**

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183

Revision: 7

Page: iii of iv

ACRONYMS

ALARA	as low as reasonably achievable
ALI	annual limit on intake
CEDE	cumulative effective dose equivalent
CFR	Code of Federal Regulations
DAC	derived air concentration
DCG	derived concentration guide
DOE	Department of Energy
DOELAP	DOE Laboratory Accreditation Program for Personnel Dosimetry System
DRD	direct-reading dosimeter
ED	electronic dosimeter
GERT	General Employee Radiological Training
HEPA	high-efficiency particulate air
ICARE	issue communication and resolution environment
ISMS	Integrated Safety Management System
LHRA	locked high radiation area
NCRP	National Council on Radiation Protection
NRC	Nuclear Regulatory Commission
PAO	poly alpha olefin
PEQ	personnel exposure questionnaire
RBA	radiological buffer area
RCT	radiological control technician
RWP	radiological work permit
SNL	Sandia National Laboratories

RADIOLOGICAL CONTROL MANUAL

Identifier: **PRD-183**

Revision: **7**

Page: **iv of iv**

TEDE total effective dose equivalent

TLD thermoluminescent dosimeter

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 1-1 of 1-19

CHAPTER 1 CONTENTS

RADIOLOGICAL HEALTH AND SAFETY POLICY	1-3
CHAPTER 1, EXCELLENCE IN RADIOLOGICAL CONTROL	1-6
Part 1, Radiological Control Manual	1-6
Article 111, Radiological Health and Safety Policy	1-6
Article 112, Applicability and Control of Department of Energy Radiological Control Standard Documents	1-6
Article 113, Reserved	1-6
Article 114, Site-Specific Radiological Control Manual	1-6
Article 115, Application of Provisions	1-7
Article 116, Reserved	1-8
Article 117, As Low As Reasonably Achievable Process	1-8
Article 118, Integrated Safety Management System	1-8
Part 2, Leadership in Radiological Control	1-9
Article 121, Senior Management Commitment	1-9
Article 122, Worker Attitude	1-10
Article 123, Worker Responsibilities	1-11
Article 124, Radiation and Risk Communications	1-12
Article 125, Conduct of Radiological Operations	1-13
Article 126, Improving Worker Awareness of Radiological Conditions	1-13
Article 127, Critiques	1-14
Article 128, Facility Modifications and Radiological Design Considerations	1-14
Part 3, Improving Radiological Control Performance	1-14
Article 131, Radiological Performance Goals	1-14
Article 132, Management of Radiological Control Goals and Performance Indicators	1-14
Article 133, Radiological Control Performance Reports	1-15
Article 134, Assessments	1-15
Article 135, Workplace Awareness	1-16
Article 136, Reserved	1-16
Article 137, Reserved	1-16
Article 138, ALARA Committees	1-16
Part 4, Site Radiological Control Organization	1-17
Article 141, Radiological Control Organization	1-17
Article 142, Radiological Control Director Qualifications	1-17
Article 143, Radiological Control Organization Functions and Staffing	1-18
Article 144, Relationship Between Radiological Control Technicians and Workers	1-18
Article 145, Marginal Radiological Control Performance	1-19

RADIOLOGICAL CONTROL MANUAL	Identifier: PRD-183
	Revision: 7
	Page: 1-2 of 1-19

Part 5, DOE Management 1-19

 Article 151, Reserved 1-19

 Article 152, Reserved 1-19

 Article 153, Reserved 1-19

 Article 154, Reserved 1-19

 Article 155, Reserved 1-19

 Article 156, DOE Employees in the Site Workplace 1-19

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 1-3 of 1-19

Note on the Format: The Radiological Control Manual has been formatted in accordance with guidance in Department of Energy (DOE) Standard DOE-STD-1098-99, “Radiological Control.” The chapter, part, article headings, and text in this manual are from corresponding sections of the standard, with changes made to reflect Site-specific functions and requirements. For ease of communications, portions of this document should be referred to by the specific article followed by the item number, if applicable, such as Article 114.12. Portions of this manual noted as “reserved” indicate DOE-STD-1098-99 provisions have not been incorporated into the Site Radiological Control Manual.

The use of the word “shall” in this manual identifies elements and requirements that are mandatory because of their derivation from 10 CFR 835, “Occupational Radiation Protection,” or other regulations or DOE orders in the management and operating contract for the Site. These requirements are indicated by a bracketed reference (e.g., [see 10 CFR 835.XXX]) that follows the Radiological Control Manual provision.

The use of the word “should” in this manual indicates that a provision is a proven practice or remedy that supports compliance with the basic requirements found in applicable regulations or DOE orders or their underlying basis documents for occupational radiation protection. The use of “should” recognizes that (1) there may be Site- or facility-specific attributes that warrant special treatment, (2) the safety benefit derived from implementation of the provision may not in all cases be commensurate with the associated detriments (e.g., financial cost, worker discomfort, or schedule impacts), and (3) literal compliance with the provision may not achieve the desired level of radiological control performance.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 1-4 of 1-19

RADIOLOGICAL HEALTH AND SAFETY POLICY

The Site contractor shall conduct radiological operations in a manner that ensures the health and safety of all general employees, contractors, and the general public. To achieve this objective, the Site contractor shall ensure that radiation exposures to its workers and the public and releases of radioactivity to the environment are maintained below regulatory limits and deliberate efforts are taken to further reduce exposures and releases as low as reasonably achievable. The Site contractor shall implement a radiological control program of the highest quality that consistently reflects this policy.

To meet this policy, the Site contractor shall:

- 1. Ensure that personnel responsible for performing radiological work activities are appropriately trained.**
- 2. Ensure the technical competence of personnel responsible for implementing and overseeing the radiation protection program.**

An appropriate level of technical competence gained through education, experience, and job-related technical and professional training is a critical component for achieving the goals of this radiological health and safety policy. Qualification requirements commensurate with this objective shall be established for technical and professional radiation protection program positions and shall, at a minimum, be consistent with applicable industry standards and promote professional development and excellence in radiological performance as a goal.

- 3. Establish and maintain, at all levels, line management involvement and accountability for radiological performance.**

The responsibility for compliance with the radiological protection requirements and for minimizing personnel radiation exposure starts at the worker level and broadens as it progresses upward through the line organization. Line managers are fully responsible for radiological performance within their programs and field activities, and facilities assigned to them. Line managers shall take the necessary actions to ensure that requirements are implemented and performance is monitored and corrected as necessary.

- 4. Ensure that radiological measurements, analyses, worker monitoring results, and estimates of public exposures are accurate and appropriately made.**

The capability to accurately measure and analyze radioactive materials and workplace conditions, and determine personnel radiation exposure, is fundamental to the safe conduct of radiological operations. Policy, guidance, and quality control programs shall be directed toward ensuring that such measurements are appropriate, accurate, and based on sound technical practices.

- 5. Conduct radiological operations in a manner that controls the spread of radioactive materials and reduces exposure to the work force and the general public and that uses a process that seeks exposure levels as low as reasonably achievable.**

Radiological operations and activities shall be preplanned to allow for the effective implementation of dose and contamination reduction and control measures. Operations

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 1-5 of 1-19

and activities shall be performed in accordance with conduct of operations requirements and shall include reasonable controls directed toward reducing exposure, preventing the spread of radioactive contamination, and minimizing the generation of contaminated waste and the release of effluents.

6. Incorporate dose reduction, contamination reduction, and waste minimization features into the design of new facilities and significant modifications to existing facilities in the earliest planning stages.

Wherever possible, facility design features shall be directed toward controlling contamination at the source, eliminating airborne radioactivity, maintaining personnel exposure and effluent releases below regulatory limits, and using a process that seeks exposure levels and releases as low as reasonably achievable. Radiological design criteria shall reflect appropriate consensus recommendations of national and international standards setting groups.

7. Conduct contractor self-assessments to ensure that requirements are being complied with and appropriate radiological work practices are being implemented.

The requirements of this manual apply to all individuals that access radiologically controlled areas, both general employees and members of the public as defined in the glossary.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 1-6 of 1-19

CHAPTER 1, EXCELLENCE IN RADIOLOGICAL CONTROL**Part 1, Radiological Control Manual****Article 111, Radiological Health and Safety Policy**

A key element of the 1987 Radiation Protection Guidance to the Federal Agencies for Occupational Exposure, and a fundamental principle underlying this Radiological Control Manual, is “There should not be any occupational exposure of workers to ionizing radiation without the expectation of an overall benefit from the activity causing the exposure” (52 FR 2822).

The Site is firmly committed to having a radiation protection program of the highest quality. This commitment is reflected in the Radiological Health and Safety Policy immediately preceding this chapter.

Article 112, Applicability and Control of Department of Energy Radiological Control Documents

The Department of Energy (DOE) established basic standards for occupational radiation protection in Title 10, Code of Federal Regulations (CFR), Part 835, “Occupational Radiation Protection.” Section 835.101 of 10 CFR 835 requires affected DOE activities to be conducted in compliance with a documented radiation protection program that addresses each requirement of that regulation. Guidance for developing and implementing a radiation protection program sufficient to ensure compliance with 10 CFR 835 is provided in the DOE 441.1 series of guides. The DOE 441.1 series of guides are primarily directed toward radiological control organization professionals who are responsible for developing programs that will ensure regulatory compliance. The guides, therefore, tend to provide flexibility to allow the use of professional judgment and are more technical and general in nature than DOE Standard DOE-STD-1098-99, “Radiological Control.” Primarily directed toward line management, DOE-STD-1098-99, therefore, addresses specific, detailed measures that should be implemented by line managers as they discharge their radiological control responsibilities. However, because both the DOE 441.1 series of guides and DOE-STD-1098-99 address development and implementation of appropriate radiological controls, many overlaps are necessary.

Article 113, Reserved**Article 114, Site-Specific Radiological Control Manual**

To ensure implementation of a comprehensive and coherent radiation protection program, the Site contractor implemented the provisions of DOE-STD-1098-99 to the extent appropriate to facility hazards and operations, consistent with the DOE Integrated Safety Management System (ISMS). Should any conflicts arise between this manual and PLN-260, “INEEL Radiation Protection Program,” the requirements of PLN-260 take precedence. The Site contractor will resolve any such conflicts expeditiously.

This manual is not a substitute for regulations, but is intended to be consistent with all relevant statutory and regulatory requirements and will be revised whenever necessary to ensure such consistency.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 1-7 of 1-19

The provisions of this manual and 10 CFR 835 requirements [see 10 CFR 835.1(b)(1)] are not applicable to activities at the Site that are regulated through a license by the Nuclear Regulatory Commission (NRC) or the State of Idaho under an agreement with the NRC, including activities certified by the NRC under Section 1701 of the Atomic Energy Act.

1. Contractor management shall issue and endorse a Site-specific Radiological Control Manual. The development of the Site-specific Radiological Control Manual invokes the applicable provisions of DOE-STD-1098-99 modified by Site-specific additions, supplements, and clarifications included in the appropriate chapters and directly referenced to the corresponding article. Additions and supplements to address unique situations or to provide more detailed or prescriptive direction may be included.
2. Management policies, requirements, expectations, and objectives for the Site radiation protection program are stated clearly and unambiguously.
3. The Site-specific Radiological Control Manual will be kept current and entered into the contractor document control system.
4. Radiological Control is a Site-wide organization and this manual applies to all facilities and projects at the Site.
5. The Radiological Control director is responsible for setting radiological control policy and for writing and maintaining the resulting implementing procedures. In addition, the director has the responsibility for planning, administering, and maintaining PLN-260 with support from line management at all levels. The Radiological Control director will ensure that the functional elements of PLN-260 are appropriately implemented and maintained through periodic review of radiological policies, procedures, and documents.
6. Subcontractors will comply with this manual.
7. The requirements of this manual will be invoked in documents such as subcontracts or work orders for subcontract work performed at the Site. In cases where the Site contractor is performing work at another DOE site or possesses an NRC or agreement state license, radiological responsibilities will be specified in memorandums of understanding, or in specific radiological control agreements.
8. The provisions of this manual do not apply to radioactive material contained in NRC general licensed consumer products, provided that they are used for their intended purpose and the use does not alter the form or release the radioactive materials. Any other use that could result in the release of the radioactive material from its licensed form requires appropriate radiological controls under the provisions of this manual. Consumer product radioactive materials often have special handling and disposal procedures, which must be followed.

Article 115, Application of Provisions

Existing organizational structures and committee charters used in this manual reflect applicable provisions and current areas of emphasis and will be revised as necessary. Similarly, titles such as “Radiological Control director” and “radiological control technician” are used in this manual unless operational requirements necessitate the use of other titles. Corresponding position

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 1-8 of 1-19

descriptions and organizational charts will be revised to accurately reflect required radiological control titles and responsibilities.

Article 116, Reserved**Article 117, As Low As Reasonably Achievable Process**

10 CFR 835 requires the Site to develop and implement plans and measures to maintain occupational radiation exposures as low as reasonably achievable (ALARA) [see 10 CFR 835.101(c) and 835.1001]. As applied to occupational radiation exposure, the Site ALARA process does not require that exposures to radiological hazards be minimized without further consideration, but that such exposures be optimized, taking into account the benefits arising out of the activity, the detriments arising from the resultant radiation exposures, and the controls to be implemented.

An effective ALARA process includes consideration, planning, and implementation of both physical design features (including engineering controls) and administrative controls to balance the risks of occupational radiation exposure against the benefits arising out of the authorized activity. Lessons learned are documented, institutionalized, and considered in planning and executing subsequent activities to further the goals of the ALARA process and to provide optimal employee protection.

While most or all of the provisions of this manual support the ALARA process, the provisions of Chapter 3 are specifically directed toward the planning and execution of work, physical design features, administrative controls, and efforts to implement work controls commensurate with the radiological hazards.

Article 118, Integrated Safety Management System

The ISMS has been implemented to integrate safety (including radiological safety) with management and work practices at all levels (see DOE P 450.4, "Safety Management System Policy," and its associated guidance documents). This manual implements ISMS by providing a system of radiological controls that can be implemented on a Site-wide basis and tailored to meet facility- and hazard-specific needs. This manual also provides guidance for increasing worker involvement in the identification and implementation of appropriate controls. Like the ALARA process, an effective ISMS emphasizes the development and implementation of controls that are commensurate with the hazards associated with any specified activity.

1. Under ISMS, line managers are charged with the responsibility for integrating safety measures into all facets of work planning and execution. Line managers should use this manual as a guide for integrating radiological control measures into work planning and execution.
2. This manual supports the ISMS guiding principles as follows:
 - a. **Line management responsibility:** This manual clearly identifies that line management is responsible for ensuring adequate implementation of the radiological control radiation protection program.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 1-9 of 1-19

- b. **Clear roles and responsibilities:** This manual establishes clear roles and responsibilities for line management and for the Radiological Control organization.
 - c. **Competence commensurate with responsibilities:** This manual provides guidance for classroom and on-the-job training so that individuals may gain and maintain appropriate competence.
 - d. **Identification of safety standards and requirements:** This manual provides cross-references to other DOE, federal agency, scientific, and consensus standards important to developing and implementing an effective and comprehensive radiation protection program.
 - e. **Hazard controls tailored to work being performed:** This manual provides guidance for implementing a program that establishes radiological controls commensurate with the hazards. This manual allows flexibility for consideration of other industrial hazards such as industrial safety, industrial hygiene, or environmental hazards by other safety professionals.
3. The concepts of balanced priorities and operations authorization are outside the scope of this manual.
 4. In addition to establishing basic radiological safety standards that must be observed, 10 CFR 835 requirements provide significant flexibility so that individual activities may implement compliance measures in a manner commensurate with specific hazards and work activities. This manual provides Site-specific guidance for implementing radiological controls that have been evaluated and found to comply with the requirements of 10 CFR 835.

Part 2, Leadership in Radiological Control

Superior, consistent performance is achieved when qualified individuals use approved procedures and management actively monitors the workplace and assesses ongoing activities. Such ongoing activities include, but are not limited to, operations, remediation, laboratory work, research and development, and cleanup. Constant review and informed interest by senior management are required to achieve a superior radiation protection program. Management at all levels should emphasize the need for high standards for radiological control through direct communication, instruction, and inspection of the work space. Contractor management should have a basic knowledge of radiation, its effects, and radiological control requirements. Management also should be familiar with the current radiological control performance record. Key principles common in a successful, well-managed radiation protection program are provided in Article 121.

Article 121, Senior Management Commitment

1. Senior managers will establish high standards for radiological control performance and frequently communicate these standards and management expectations to the work force.
2. Senior managers will state in writing their firm commitment to a radiation protection program of the highest quality. Management commitment and support will be

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 1-10 of 1-19

- demonstrated, in part, by allocating sufficient resources, including personnel, and providing for training to ensure that workers are qualified for their assigned duties.
3. Managers will ensure that orientation and training reinforce rules and guidelines for each worker to control radiation exposure and radiological conditions.
 4. Managers will hold workers and their supervisors accountable for radiological control performance. Relevant knowledge and performance will be assessed as a specific part of each individual's performance evaluation. This assessment will not be limited to those who perform radiological work, because many other workers have an impact on the radiation protection program.
 5. Senior managers will solicit feedback from their radiological control professionals, line management, and workers on radiological control performance.
 6. Senior managers will adopt and promote a positive attitude toward radiological control that encourages initiatives to identify concerns at an early stage, to prevent conditions from deteriorating, and to promote doing the right job correctly the first time.
 7. Prevention of the spread of radioactive material is usually less costly than remediation. Management will be willing to accept change that will improve radioactive material control and will foster this mindset throughout the organization.
 8. The authority and responsibility to establish a comprehensive and effective radiological control training program will be assigned to line managers and their subordinates. Training, in most cases, will be provided by a dedicated training organization, but the responsibility for quality and effectiveness rests with line management.
 9. Senior managers will be alert for opportunities to minimize the generation of radioactive waste and discharges to the environment, controlling contamination at its source, and reducing radiation exposure to workers and the public.
 10. Reporting a problem to a Site contractor superior or DOE superior does not absolve the responsible manager from promptly fixing or mitigating a situation.

Article 122, Worker Attitude

The control of worker radiation exposure can be achieved only if all individuals involved in radiological activities have an understanding of and the proper respect for radiological hazards:

1. Each worker should understand that proper radiological control is an integral part of his/her daily duties.
2. The Radiological Control training program will support efforts to improve the attitude of the work force. Training instructors will be knowledgeable about the work environment and those aspects of radiological control that are important to developing a good worker attitude and perspective.
3. The attitude that constant improvement is required in radiological work will be developed at all levels of management and in the work force. Cooperation between the work force and the Radiological Control organization should be developed and fostered. The workers should not look at radiological controls as hurdles or restrictions to be bypassed.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 1-11 of 1-19

4. Radiological Control personnel should be helpful in showing workers how to follow radiological control rules. This spirit of cooperation should be developed without subverting the control functions of the radiological control technicians (RCTs). A situation in which radiological controls are left solely to the Radiological Control organization is unacceptable.

Article 123, Worker Responsibilities

Trained individuals should recognize that their actions directly affect contamination control, personnel radiation exposure, and the overall radiological environment associated with their work. The Radiological Control rules listed below are applicable to each individual in the workplace. A poster that displays basic worker responsibilities, including those listed below, has been produced and copies are displayed at appropriate access points and work areas.

TO CONTROL YOUR EXPOSURE TO RADIATION AND RADIOACTIVE MATERIAL, OBSERVE THE FOLLOWING RULES:**OBEY**

- Posted, written, and oral Radiological Control instructions and procedures including instructions on radiological work permits.
- Evacuate and stop work orders from Radiological Control personnel promptly.

DO NOT

- Loiter in radiation areas.
- Smoke, eat, drink, or chew in radiological buffer areas, contamination areas, high contamination areas, and airborne radioactivity areas.

BE SURE TO

- Wear personnel monitoring devices where required by radiological work permits, signs, procedures, or by Radiological Control personnel. Report immediately the loss, damage, or unexpected exposure of personnel monitoring devices or off-scale readings of self-reading dosimeters to the Radiological Control organization.
- Keep track of your radiation exposure status and avoid exceeding administrative control levels.
- Wear personal protective equipment and clothing properly whenever required by radiological work permits or postings.
- Minimize the spread of potential radioactive spills and promptly notify the appropriate personnel of all spills.
- Avoid contacting skin, clothing, and equipment with contaminated surfaces.
- When not in use, place contaminated tools, equipment, and solid waste items on disposable surfaces such as plastic sheets.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 1-12 of 1-19

- Notify Radiological Control personnel of alarming or faulty radiological control equipment.
- Notify Radiological Control personnel of off-Site occupational radiation exposures so that worker dosimetry records can be updated.

PRIOR TO ENTERING AN AREA

- Ensure that you are mentally alert and in physically sound condition.
- Limit the amount of material taken into contaminated areas to minimize radioactive waste and future decontamination.
- Have necessary materials and equipment on hand to complete your task, thereby minimizing time and exposure.
- Notify Radiological Control personnel of the presence of open wounds, sores, or rashes before entering an area in which contamination exists, and exit immediately if a wound occurs while in such an area.

UPON LEAVING AN AREA

- Properly remove personal protective equipment and clothing to minimize the spread of contamination.
- Frisk or be frisked for contamination when entering an uncontaminated area after exiting contamination, high-contamination, or airborne radioactivity areas and associated radiological buffer areas and notify Radiological Control personnel when contamination is found.

Article 124, Radiation and Risk Communications

Resulting from continuing concerns of many individuals related to low radiation exposure and health impacts, managers should be trained to deal with personnel perceptions about radiation risks. Managers and first-line supervisors should be sensitive to the fact that workers have to understand the fundamentals of radiation, its risks, and their role in controlling exposure. Relying solely on regulatory limits is not sufficient for establishing or defining acceptable work practices and work environments.

1. Appropriate training in accordance with Article 651 is helpful in dealing with workers who have anxiety about radiation.
2. Some workers, such as those who have had internal depositions of radionuclides, may be concerned about future doses. Such instances warrant special attention on the part of managers. Counseling with such workers is the preferred way to consider relevant factors. In some cases, special control levels as described in Article 216 will be applied.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 1-13 of 1-19

Article 125, Conduct of Radiological Operations

1. This manual is consistent with the provisions of DOE O 5480.19, "Conduct of Operations Requirements for DOE Facilities." The concepts of all chapters of DOE O 5480.19 apply to the conduct of radiological control activities.
2. Managers at all levels should be involved in the planning, scheduling, and conduct of radiological work. Adequate radiological safety will not be compromised to achieve production, remediation, or research objectives.
3. Supervisors should be technically knowledgeable and inquisitive and should ask questions of the work force concerning radiological work details to verify worker comprehension.
4. Line managers will periodically monitor work areas to observe personnel at work and to identify good radiological work practices and radiological deficiencies and concerns. Frequent inspections and walk-throughs, including off-hours and weekends (where appropriate), are essential to reinforce management expectations to the work force.
5. Managers, supervisors, and workers will be involved in the development of accurate, clear, written procedures for performing radiological work. If during the use of procedures a written requirement cannot be responsibly followed, the work will be stopped and guidance obtained.
6. Supervisors and managers should encourage the work force to identify radiological control deficiencies and concerns. Prompt action will be taken to address and eliminate identified issues and prevent recurrence. Training, indoctrination, and procedure review are useful in addressing these issues.
7. Managers and supervisors will establish working conditions that encourage improved radiological control. The conditions include temperature, humidity, and lighting as well as the more difficult considerations of accessibility. Work conditions will be considered in planning work.
8. Cleanliness and good housekeeping are essential. A good radiation protection program cannot exist in a dirty, cluttered workplace. Cleaning up after operations should be required for all workers. To expect radiological control to be separated from the work environment is not reasonable—they go together.
9. Subcontractors and subcontracted employees will be treated the same as facility staff in the area of radiological control matters, shall have comparable radiation safety training [see 10 CFR 835.901], and will meet the same requirements and expectations.
10. Conditions that could cause or promote the spread of contamination, such as a leaking roof or piping, will be identified and corrected on a priority basis.

Article 126, Improving Worker Awareness of Radiological Conditions

In performing assigned duties within radiological areas, workers will be familiar with the area radiological conditions and be aware of the possibility that unforeseen changes may occur. Although the conduct of radiological surveys is viewed as a traditional role of RCTs, experience

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 1-14 of 1-19

has shown that properly trained and qualified workers are capable of performing supplemental radiological surveys in the course of work. This process results in exposure savings and improved contamination control.

Specific examples of surveys that may be effectively performed by workers and result in exposure reductions include self-monitoring of dose rates during high radiation area entries and monitoring of tools and equipment for contamination as a qualitative check during work in contamination areas. The performance of legal record surveys, such as release surveys, remain the responsibility of the Radiological Control organization.

Article 127, Critiques

Based on concern for the safety and well-being of workers and the general public, radiological work practices should be continually scrutinized and questioned so that opportunities for improvement can be identified, assessed, and applied.

A formal critique process will be established to obtain pertinent facts following an unusual radiological situation or at the satisfactory conclusion of a new or unusual operation involving radiological controls. This process complements the occurrence reporting and processing system outlined in DOE O 231.1A, "Environment, Safety, and Health Reporting." The process, as described in Article 351, is used to establish facts quickly in chronological order so that the underlying reasons or causes for the success or failure are well understood.

Article 128, Facility Modifications and Radiological Design Considerations

Radiological Control performance is affected by human performance and engineered design features. This manual primarily addresses the way individuals operate and use existing facilities and sites. General design criteria for new facilities and major modifications to existing facilities are provided in 10 CFR 835 and DOE O 420.1A, "Facility Safety." Additional design criteria are provided in Chapter 3.

Part 3, Improving Radiological Control Performance**Article 131, Radiological Performance Goals**

DOE O 231.1A and DOE M 231.1-1, "Environment, Safety, and Health Reporting Manual," are used to establish requirements for applying goals and performance indicators. Goals are intended as a measure of and a motivation for improvement, not an end in themselves. Goals are not to be viewed narrowly as numerical values, but as tools to assist management in focusing their priorities and attention. The primary radiological performance goal for the Site is collective dose in person-rem.

Article 132, Management of Radiological Control Goals and Performance Indicators

1. Radiological Control management establishes, approves, and maintains a Site-level radiological control goals and performance indicator program.
2. Radiological Control goals are measurable, achievable, auditable, challenging, and meaningful in promoting improvement.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 1-15 of 1-19

3. Goals are developed by those responsible for performing the work at each facility/project. Several ALARA committees have been formed that approve these goals.
4. Radiological Control ALARA goals will be reviewed at least annually and revised as appropriate. The goals will be set annually to reflect the work scope as well as improved radiological control performance at each facility/project. Because of the varying work scope and fluctuating budgets at many of the facilities and projects, the goals may require periodic updates and may vary considerably from year to year.

Article 133, Radiological Control Performance Reports

1. The Radiological Control director or designee will develop a quarterly performance summary report for management. This report will include indicators of progress toward achieving the radiological control goals established in accordance with Articles 131 and 132.1. Performance indicators that provide for appropriate analysis of performance normally are established annually. The quarterly report will provide the current status of these performance indicators for the quarter, and may include tracking and trending for previous quarters.
2. The Radiological Control director will provide appropriate performance indicator information to supervisors and managers on a frequent enough basis to permit management of radiological control performance. The frequency will be consistent with the nature of the workload and the potential for exceeding the established goals.

Note: Quarterly radiological control performance reports may be integrated with other contractor reports when appropriate.

Article 134, Assessments

Assessment, as used in this manual, refers to the process of providing independent feedback to senior line managers to indicate the adequacy of the radiation protection program, identify problems, and promote continuous improvement.

1. Inspections, audits, reviews, investigations, and self-assessments are part of the numerous checks and balances needed in a good radiation protection program. Assessments of the radiation protection program shall be conducted so that over a 36-month period, all functional elements are assessed [see 10 CFR 835.102]. The assessments will address program performance, applicability, content, and implementation. These assessments will be performed in accordance with company procedures by the Radiological Control organization and supported by oversight and line management organizations.
2. The functional elements considered in the assessment program are documented in company procedures.
3. Results of assessments will be incorporated into the ongoing process of improving radiological control performance.
4. A prioritization system to implement actions for resolving the deficiencies will be implemented.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 1-16 of 1-19

5. In developing corrective action plans for assessment activities, managers will address root causes for the identified deficiencies or concerns, not just the specific symptoms identified by the reviewer.
6. The Issues Communication and Resolution Environment (ICARE) or successor system will be used to provide feedback to management on findings from assessments, root-cause analyses, status of corrective actions, and adherence to action plans.

Article 135, Workplace Awareness

1. Management initiatives are encouraged to facilitate the expression of concerns on the part of the work force, to address such concerns, and to solve them to ensure the proper respect for and understanding of radiation.
2. Management should establish and support a radiological awareness reporting system. To enhance work force awareness, the program should encourage continuous evaluation and improvements, track resolution of concerns, provide feedback to employees, and post results and trends. This system may be integrated with similar reporting systems for nonradiological concerns.

Article 136, Reserved**Article 137, Reserved****Article 138, ALARA Committees**

The process of managing radiation exposures ALARA is a fundamental requirement of every radiation protection program. Site, project, and program ALARA committees have been established that assist line management in providing a focus and direction for improvement and effective implementation of radiological control. Facility and discrete project ALARA committees provide the forum for reviewing radiological control plans and performance, verifying benefits of exposure and focusing management resources on radiological control issues.

1. Site or major project (e.g., the Idaho Completion Project) ALARA committees and facility-specific or discrete project ALARA committees have been established as required to facilitate an effective ALARA program. The committee membership should include managers and workers from the line, the technical support organizations, and the Radiological Control organization. A line manager, such as the director of Operations, Research, or Maintenance, normally will serve as the committee chair.
2. The facility/project ALARA committee will make recommendations to management to improve progress toward controlling radiation exposure. The facility/project committee will evaluate items such as construction and design of facilities and systems, planned major modifications or work activities, and experimental test plans for exposure, waste, and release controls.
3. The Site, facility, or project ALARA committees are accountable to the senior Site contractor executive and include the respective subordinate facility or discrete project committee chairpersons as members. The committee is used as one conduit for driving improvements, sharing lessons learned, and informing senior management. The Site,

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 1-17 of 1-19

facility, or project committees may review program audits or complex Site-wide radiological control issues and assist with promoting radiation protection program awareness.

4. The Radiological Control organization or its representatives will facilitate the ALARA program administration and implementation.

Part 4, Site Radiological Control Organization

Article 141, Radiological Control Organization

1. A radiological control organization has been established to provide relevant support to line managers and workers. To function effectively, the Radiological Control organization is independent of the line organizational element responsible for production, operation, or research activities and has an equivalent reporting level. A single, dedicated radiological control organization for the Site contractor is required to implement the requirements of both this manual and PLN-260, which is required by 10 CFR 835. The Site uses an approach that provides Site-wide consistency and individual facility/project Radiological Control support. The senior line manager responsible for operations at a facility has matrixed Radiological Control personnel dedicated to the facility/project. Consistency of radiological control is critical to the successful implementation of a radiation protection program.
2. Radiological Control personnel will monitor adherence to this manual and be available to the facility line manager for radiological support to the work force. To function effectively in this capacity, they receive their day-to-day priorities from facility managers. To ensure independence in making correct radiological control decisions, the Radiological Control organization is directly accountable to the Radiological Control director.
3. The Radiological Control director heads the Radiological Control organization and is responsible for and establishes a high quality radiation protection program.
4. The Radiological Control director has access to the senior Site executive for radiological control matters.

Article 142, Radiological Control Director Qualifications

1. The Radiological Control director is an experienced radiological control professional and is familiar with the design features and operations of the facility that affect radiological hazards.
2. The Radiological Control director has the technical competence and experience to establish radiation protection programs and the supervisory capability to direct the implementation and maintenance of the radiation protection programs.
3. The Radiological Control director should have a minimum of a bachelor's degree or the equivalent in science or engineering, including some formal training in radiological control. Certification by the American Board of Health Physics provides equivalency to the above. The Radiological Control director should have at least 3 years of professional

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 1-18 of 1-19

experience in applied radiological control work. Advanced academic degrees can count as 1 year of experience where course work related to radiological control is involved. Radiological Control director qualifications will be consistent with the guidelines provided in DOE-STD-1107-97, "Knowledge, Skills, and Abilities for Key Radiation Protection Positions at DOE Facilities."

4. If the most effective person for this position does not satisfy the above qualifications, special arrangements will be made. In these situations, the assignment of a deputy with the requisite expertise and qualifications can satisfy the requirement. The education, training, and skills requirements of 10 CFR 835.103 would apply to both individuals to the extent that their responsibilities address programs to ensure compliance with 10 CFR 835.
5. Persons assigned to or being considered for the Radiological Control director position are encouraged to pursue certification by the American Board of Health Physics.

Article 143, Radiological Control Organization Functions and Staffing

1. The senior staff of the Radiological Control organization will include health physicists and other professionals with 4-year degrees in science or engineering. A continuing training program will be established. Pursuit of certification by the American Board of Health Physics is encouraged for senior and professional staff members. Training and education provisions for these individuals are established in Article 654.
2. Radiological support personnel provide health physics and radiological engineering, dosimetry, bioassay, independent oversight, instrumentation, and calibration functions. Training and education provisions for these individuals are established in Article 654.
3. Appropriate standards for the education and training of Radiological Control senior staff and support personnel are provided in DOE-STD-1107-97.

Article 144, Relationship Between Radiological Control Technicians and Workers

Radiological control technicians and their supervisors perform the functions of assisting workers by characterizing the radiological environment, providing oversight and monitoring of radiological control work practices, and guiding workers in the radiological aspects of the job.

1. Radiological workers will be sufficiently trained to recognize questionable or deteriorating radiological conditions and seek advice from radiological control technicians and their supervisors.
2. Radiological control technicians and their supervisors have the responsibility and authority to stop work or mitigate the effect of an activity in accordance with Article 345.
3. The actions or presence of Radiological Control personnel providing oversight and monitoring does not absolve the workers of their responsibility for properly conducting the radiological control aspects of the job.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 1-19 of 1-19

Article 145, Marginal Radiological Control Performance

1. When Radiological Control performance is less than adequate, consideration will be given to strengthening line management and the Radiological Control organization to provide adequate radiological control.
2. If the work force does not have the required level of sensitivity for radiological work practices, additional management attention is needed to ensure the proper outcome. Line management will be held accountable for implementation of the radiation protection program. Corrective actions that will be considered include:
 - a. More direct line supervision in the work space.
 - b. Curtailment of work schedules.
 - c. Deferral of work.
 - d. Additional Radiological Control personnel.
 - e. Additional training.
3. When the workers and supervisors achieve the proper level of radiological control performance, the ongoing need for the corrective actions instituted in accordance with Article 145.2 will be reevaluated.

Part 5, DOE Management**Article 151, Reserved****Article 152, Reserved****Article 153, Reserved****Article 154, Reserved****Article 155, Reserved****Article 156, DOE Employees in the Site Workplace**

The DOE employees at Site facilities and projects are subject to the provisions of this manual.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 2-1 of 2-17

CHAPTER 2 CONTENTS

CHAPTER 2, RADIOLOGICAL STANDARDS	2-2
Part 1, Administrative Control Levels and Dose Limits	2-2
Article 211, Administrative Control Level	2-2
Article 212, Lifetime Control Level	2-2
Article 213, Occupational Dose Limits	2-3
Article 214, Member of the Public Dose Limit	2-4
Article 215, Embryo/Fetus Dose Controls	2-4
Article 216, Special Control Levels	2-5
Part 2, Contamination Control and Control Levels	2-5
Article 221, Personnel Contamination Control	2-6
Article 222, Contamination Control Levels	2-6
Article 223, Airborne Radioactivity Control Levels	2-6
Article 224, Areas of Fixed Contamination	2-8
Part 3, Posting	2-9
Article 231, General Posting Provisions	2-9
Article 232, Posting Controlled Areas	2-11
Article 233, Posting Radiological Buffer Areas	2-12
Article 234, Posting Radiation Areas	2-12
Article 235, Posting Contamination, High Contamination, and Airborne Radioactivity Areas	2-14
Article 236, Posting Radioactive Material Areas	2-15
Article 237, Posting Underground Radioactive Material Areas	2-15
Article 238, Posting Soil Contamination Areas	2-16
Appendix 2A—Nonuniform Exposure of the Skin	2-17

FIGURE

2-1. Types of posting for and training to access radiologically controlled areas	2-10
--	------

TABLES

2-1. Summary of occupational dose limits	2-3
2-2. Summary of surface contamination values	2-7
2-3. Criteria for posting radiation areas	2-13
2-4. Criteria for posting contamination, high contamination, and airborne radioactivity areas	2-14
2-5. Criteria for posting fixed, soil contamination, and radiological buffer areas	2-15

RADIOLOGICAL CONTROL MANUAL

Identifier:	PRD-183
Revision:	7
Page:	2-2 of 2-17

CHAPTER 2, RADIOLOGICAL STANDARDS**Part 1, Administrative Control Levels and Dose Limits**

To accomplish the DOE objective of maintaining individual doses well below regulatory limits and to administratively control and help reduce individual and collective radiation doses, rigorous numerical administrative control levels will be established at the Site that are below the regulatory limits. These control levels will be multitiered with increasing levels of authority required to approve higher administrative control levels. Unless otherwise indicated, administrative, lifetime, and special control levels and dose limits are stated in terms of the total effective dose equivalent (TEDE), which is the sum of the doses received from internal and external sources.

Article 211, Administrative Control Level

1. The occupational dose received by the employee shall not exceed a TEDE of 5 rem in a year [see 10 CFR 835.202(a)(1)].
2. Site contractor management will establish an annual administrative control level based on an evaluation of historical and projected radiation exposures, workload, and mission. The administrative control level will be evaluated annually by the Radiological Control director and any changes will be approved by the Site contractor senior executive.
3. No individual will be allowed to exceed the administrative control level without the prior written approval of the Radiological Control organization, cognizant facility management, and the Radiological Control director.

Article 212, Lifetime Control Level

1. Each individual's lifetime occupational dose will be controlled below a lifetime control level of N rem where N is the age of the individual in years. Article 216 will be used to specify special control levels for radiological workers who have doses exceeding N rem based on the dosimetry information available.
2. To ensure compliance with the lifetime control level, an effort will be made to determine the lifetime occupational dose of individuals expected to receive more than 1 rem in 1 year. The lifetime occupational dose is determined by summing all occupational internal and external doses received during the individual's lifetime.
3. The internal contribution to a lifetime occupational dose from intakes prior to January 1, 1989, may be calculated in terms of either cumulative annual effective dose equivalent or committed effective dose equivalent (CEDE). The CEDE should be used to the extent that adequate data are available to calculate doses in these terms.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 2-3 of 2-17

Article 213, Occupational Dose Limits

- Occupational dose limits for general employees provided in Table 2-1 shall not be exceeded [see 10 CFR 835.202(a)(1)-(4)]. All occupational doses received during the current year, except the doses resulting from planned special exposures and emergency exposures, shall be included when demonstrating compliance with Table 2-1 limits [see 10 CFR 835.202(b) and 702(d)]. If formal records of an individual's prior occupational dose during the year cannot be obtained, a written estimate signed by the individual may be accepted [see 10 CFR 835.702(d)]. Written estimates will not be used as a basis for authorizing planned special exposures or emergency exposures.

Table 2-1 Summary of occupational dose limits.

Type of Exposure	Limit
General employee: whole body (internal + external) TEDE [see 10 CFR 835.202(a)(1)]	5 rem/year
General employee: lens of the eye (external) [see 10 CFR 835.202(a)(3)]	15 rem/year
General employee: skin and extremities (external shallow dose) [see 10 CFR 835.202(a)(4)]	50 rem/year
General employee: any organ or tissue (other than lens of eye) (internal + external)[see 10 CFR 835.202(a)(2)]	50 rem/year
Declared pregnant worker: embryo/fetus (internal + external) [see 10 CFR 835.206(a)]	0.5 rem/ gestation period
Minors: whole body (internal + external) TEDE [see 10 CFR 835.207]	0.1 rem/year
Minors: lens of the eye, skin, and extremities [see 10 CFR 835.207]	10% of general employee limits
CFR = Code of Federal Regulations TEDE = total effective dose equivalent Notes: <ul style="list-style-type: none"> The weighting factors in 10 CFR 835 shall be used in converting organ dose equivalent to TEDE for the whole body dose [see 10 CFR 835.203(b)]. The annual limit of dose to "any organ or tissue" is based on the committed dose equivalent to that organ or tissue resulting from internally deposited radionuclides over a 50-year period after intake plus any deep dose equivalent to that organ from external exposures during the year [see 10 CFR 835.202(a)(2)]. Exposures caused by (1) background radiation, (2) as a patient undergoing therapeutic and diagnostic medical procedures, or (3) participation as a subject in medical research programs shall not be included in either personnel radiation dose records or assessment of dose against the limits in the table [see 10 CFR 835.202(c)]. See Appendix 2A for guidance on nonuniform exposure of the skin. Whole body dose TEDE is the effective dose equivalent from external exposures plus committed effective dose equivalent from internal exposures [see 10 CFR 835.203(a)]. Lens of the eye dose equivalent is the dose equivalent from external exposure determined at a tissue depth of 0.3 cm [see 10 CFR 835.2(a)]. Shallow dose equivalent is the dose equivalent from external exposure determined at a tissue depth of 0.007 cm [see 10 CFR 835.2(a)]. 	

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 2-4 of 2-17

2. In an exceptional situation, a radiological worker may be authorized to receive a dose that exceeds the limits specified in Table 2-1.
 - a. Planned special exposures may be authorized for an individual to receive doses in addition to and accounted for separately from doses received under the Table 2-1 limits [see 10 CFR 835.204].
 - b. Under emergency conditions, individuals may be authorized to receive doses that exceed the limits established in Table 2-1. The provisions of this manual are not intended to limit actions necessary to protect health and safety under these conditions [see 10 CFR 835.3(d)].

A planned special exposure or emergency exposure will constitute a best management practice in few, if any, situations. Proper implementation of the provisions of this manual will obviate the need for conducting either of the operations described under Items a or b. Therefore, specific guidance for conduct of these operations is not provided in this manual. Requirements for conducting, recording, and reporting these operations are provided in 10 CFR 835 and, for authorizing emergency exposures, in DOE emergency management orders.

3. The occupational dose limits provided in Table 2-1 apply to all general employees. However, general employees who have not completed appropriate training and examinations are not permitted unescorted access to any radiological area [see 10 CFR 835.901(b)].

Article 214, Member of the Public Dose Limit

Members of the public permitted access to a controlled area at a facility/project shall be limited to an annual radiation dose of 100 mrem from the sum of doses received from internal and external radiation sources [see 10 CFR 835.208].

Article 215, Embryo/Fetus Dose Controls

After a female worker at a facility/project voluntarily notifies her supervisor in writing that she is pregnant, for the purposes of embryo/fetal protection, she is considered a declared pregnant worker. The declared pregnant worker may revoke the declaration in writing at any time [see 10 CFR 835.2(a), declared pregnant worker].

1. The option of a mutually agreeable assignment of work tasks, without loss of pay or promotional opportunity, so that further occupational radiation exposure during the remainder of the gestational period is unlikely.
2. For a declared pregnant worker who chooses to continue work involving occupational exposure:
 - a. The dose limit for the embryo/fetus from conception to birth (entire gestational period) as a result of the occupational exposure of the declared pregnant worker is 500 mrem [see 10 CFR 835.206(a)]. The dose to the embryo/fetus is equal to the sum of doses received from external doses, sources inside the mother, and sources inside the embryo/fetus.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 2-5 of 2-17

- b. Measures shall be taken to avoid substantial variation above the uniform exposure rate necessary to meet the 500-mrem limit for the gestational period [see 10 CFR 835.206(b)]. Efforts will be made to avoid exceeding 50 mrem per month to the declared pregnant worker.
3. If the dose to the embryo/fetus is determined to have already exceeded 500 mrem when a worker notifies her employer of her pregnancy, the worker shall not be assigned to tasks where additional occupational radiation exposure is likely during the remainder of the gestational period [see 10 CFR 835.206(c)].

Article 216, Special Control Levels

Certain situations may require lower individual exposure control levels. In addition to considering recommendations from senior Radiological Control and medical officials, the Radiological Control director will obtain advice from professionals in other disciplines, such as Human Resources and Legal, in establishing special control levels. The Radiological Control director may wish to establish these special control levels using a radiological health advisory group.

1. A special control level for annual occupational exposure should be established for each radiological worker with a lifetime occupational dose exceeding N rem, where N is the age of the individual in years. The special control level should allow the individual's lifetime occupational dose to approach and, if practicable, fall below N rem during ensuing years as additional occupational dose is received.
2. Personnel undergoing radiation therapy or treatment involving internal intakes of medical isotopes are encouraged to inform their supervisor or the Radiological Control organization in advance of the treatment, or upon return to work. The Radiological Control organization will determine which special controls may be appropriate. Consideration will be made in the selection of special controls for internal intakes of medical isotopes that include ensuring (a) thermoluminescent dosimeters (TLDs) are not exposed to medical sources of radiation and (b) monitoring for personnel contamination is also not affected by the medical isotope.
3. Special controls on an individual dose will not be implemented in a manner that interferes with an individual's right to work. If reasonable efforts to implement a special control level below the annual administrative control level threaten to restrict the individual's right to work or are otherwise unsuccessful, the Site contractor senior executive will evaluate and consider, when appropriate, any doses in excess of the applied special control level, but not to exceed the regulatory dose limits.

Part 2, Contamination Control and Control Levels

Control of radioactive contamination at the facility/project will be, where practicable, achieved by using engineering controls and worker performance to contain contamination at the source, reducing existing areas of contamination, and promptly decontaminating areas that become contaminated.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 2-6 of 2-17

Article 221, Personnel Contamination Control

1. See Article 338 for personnel contamination monitoring requirements and guidance. This guidance is not relevant to individuals exiting areas containing only radionuclides such as tritium that cannot be detected using hand-held or automatic frisking equipment.
2. Monitoring for contamination will be performed using frisking equipment, or other applicable monitoring equipment, that can detect total contamination at or below the values specified in Table 2-2. The facility/project will use automatic monitoring units that meet the above requirements, if practicable.
3. Individuals found with detectable contamination on their skin or personal clothing, other than noble gases or natural background radioactivity, will be decontaminated promptly as described in Article 541.

Article 222, Contamination Control Levels

1. A surface is considered contaminated if either the removable or the total surface contamination exceeds the values listed in Table 2-2. Controls shall be implemented for these surfaces commensurate with the nature of the contaminant and level of contamination [see 10 CFR 835.1102(b)]. Appropriate postings and controls are established in Part 3 of this chapter and Chapters 3 and 4.
2. Surfaces exceeding the values of Table 2-2 for total contamination may be covered with a fixative coating to prevent the spread of contamination. However, reasonable efforts will be made to decontaminate an area before a coating is applied. A fixative coating should not be applied without the approval of the Radiological Control director or designee.
3. Appropriate controls for areas of fixed contamination are provided in Article 224.
4. For areas with contaminated soil that is not releasable in accordance with DOE environmental protection standards, a soil contamination area should be established that:
 - a. Is posted as specified in Article 238.
 - b. Meets the requirements of Article 231.1 through 231.8.
5. Soil contamination areas may be located outside a radiological buffer area.

Article 223, Airborne Radioactivity Control Levels

1. Use of engineering and administrative controls to reduce the potential for internal exposure will be evaluated before allowing individuals, with or without respiratory protection, to enter areas with airborne radioactivity.
2. Posting requirements for areas with airborne radioactivity are specified in Article 235. The values of derived air concentrations (DACs) that are provided in 10 CFR 835 Appendixes A and C shall be used in the control of occupational exposures to airborne radioactive material [see 10 CFR 835.209(a)].

RADIOLOGICAL CONTROL MANUAL	Identifier: PRD-183 Revision: 7 Page: 2-7 of 2-17
------------------------------------	---

Table 2-2. Summary of surface contamination values.^a

Radionuclide	Removable (dpm/100 cm ²) ^{b, d}	Total (Fixed + Removable) (dpm/100 cm ²) ^{b, c}
U-natural, U-235, U-238, and associated decay products	1,000 alpha	5,000 alpha
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, and I-129	0 ^e	0 ^e
Th-natural, Th-232, Sr-90, ^f Ra-223, Ra-224, U-232, I-126, I-131, and I-133	200	1,000
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above; and mixed fission products containing Sr-90 ^f	1,000 beta-gamma	5,000 beta-gamma
Tritium and tritiated compounds ^g	10,000	NA

CFR = Code of Federal Regulations

NA = not applicable

a. Except as indicated in footnote g below, the values in this table apply to radioactive contamination deposited on, but not incorporated into the interior of, the contaminated item. Where contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for the alpha- and beta-gamma-emitting nuclides apply independently [see 10 CFR 835, Appendix D].

b. As used in this table, dpm 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.

c. The levels may be averaged over 1 m² provided the maximum activity in any area of 100 cm² is less than three times the values in Table 2-2. For the 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, the average contamination level is determined to exceed the applicable value or (2) the sum of the activity of all isolated spots or particles in any 100-cm² area is determined to exceed three times the applicable value in Table 2-2 [see 10 CFR 835, Appendix D].

d. The amount of removable radioactive material per 100 cm² of surface area will be determined by swiping the area with dry filter or soft absorbent paper while applying moderate pressure and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. (However, the use of dry material may not be appropriate for tritium.) For objects with a surface area less than 100 cm², the entire surface will be swiped, and the activity per unit area will be based on the actual surface area. The use of swiping techniques is not necessary to measure removable contamination levels if direct scan surveys indicate that the total residual contamination levels are below the values for removable contamination [see 10 CFR 835, Appendix D].

e. Items to be released exceeding the values specified require an evaluation to be performed and documented:

- If the removable contamination is less than 20 dpm/100 cm², the item may be released.
- If the total beta-gamma contamination is less than 100 dpm/100 cm², the item may be released.
- Any items with total TRU alpha contamination will not be released.

f. These values will be applied to total Sr-90/Y-90 activity resulting from processes involving the separation or purification of Sr-90. For mixed fission products containing Sr-90:

- If the Sr-90 fraction is 50% or less of the total activity, the mixed fission product surface activity values apply.
- If the Sr-90 fraction is between 50% and 90% of the total activity, the surface radioactivity values should be 3000 dpm/100 cm² total and 600 dpm/100 cm² removable.
- If the Sr-90 fraction exceeds 90% of the total activity, the Sr-90 surface activity values apply (RCTP 96-02).

g. 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 to ensure that the surface radioactivity value provided in this table is not exceeded. Once this contamination migrates to the surface, it may be removable, not fixed; therefore, a "Total" value does not apply [see 10 CFR 835, Appendix D].

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 2-8 of 2-17

Article 224, Areas of Fixed Contamination

Areas having only fixed contamination usually do not warrant the full range of entry controls established for areas having removable contamination levels exceeding the Table 2-2 values. Areas located outside of radiological areas having measured total contamination exceeding the total surface contamination values specified in Table 2-2 (with removable contamination levels below Table 2-2 values) are subject to the following controls:

1. Periodic surveys shall be conducted to ensure that the surface contamination remains fixed to the surface and removable surface contamination levels remain below Table 2-2 values [see 10 CFR 835.1102(c)(1)].
2. Markings indicating the status of the area shall be applied [see 10 CFR 835.1102(c)(2)]. These markings will be applied directly to the surface or at the access points to provide appropriate warning. Unidentified areas of fixed contamination at facilities or projects will be controlled as they are identified by radiological surveys. This level of control is consistent with the intent of the requirement and is not considered to be an off-normal event. Locations of areas with multiple fixed contamination may be posted at access points. These markings also may provide appropriate instructions to individuals entering the area or coming in contact with the surface (e.g., “fixed contamination” or “fixed contamination, notify radiological control personnel prior to removing paint”). Signs, stencils, or other appropriate markings may be used. See Table 2-5 for posting requirements of fixed contamination areas.
3. Records of areas with fixed contamination will be maintained.
4. Markings and postings will be maintained in a legible condition.
5. Appropriate written procedures will be implemented to prevent unplanned or uncontrolled removal of the contamination. These procedures will address issues such as access controls and fixative coatings, if needed, survey techniques and frequency, area tracking and maintenance, and required markings.
6. If surveys indicate that contamination is likely to be transferred from the area, fixative coatings should be applied. When paint is used as a fixative coating, it should consist of two layers having contrasting colors, to provide indication of erosion of the top layer. The bottom layer should be magenta and the top layer contrasting such as white. Other fixative coatings, such as strippable coatings and applied plastics and foams, will be periodically evaluated for evidence of degradation. Removable contamination will be reduced to the minimum practicable level before application of fixative coatings using an approved work document.
7. Areas meeting these requirements are exempt from the posting requirements of Articles 232 through 238 and the entry and exit requirements of Chapter 3.

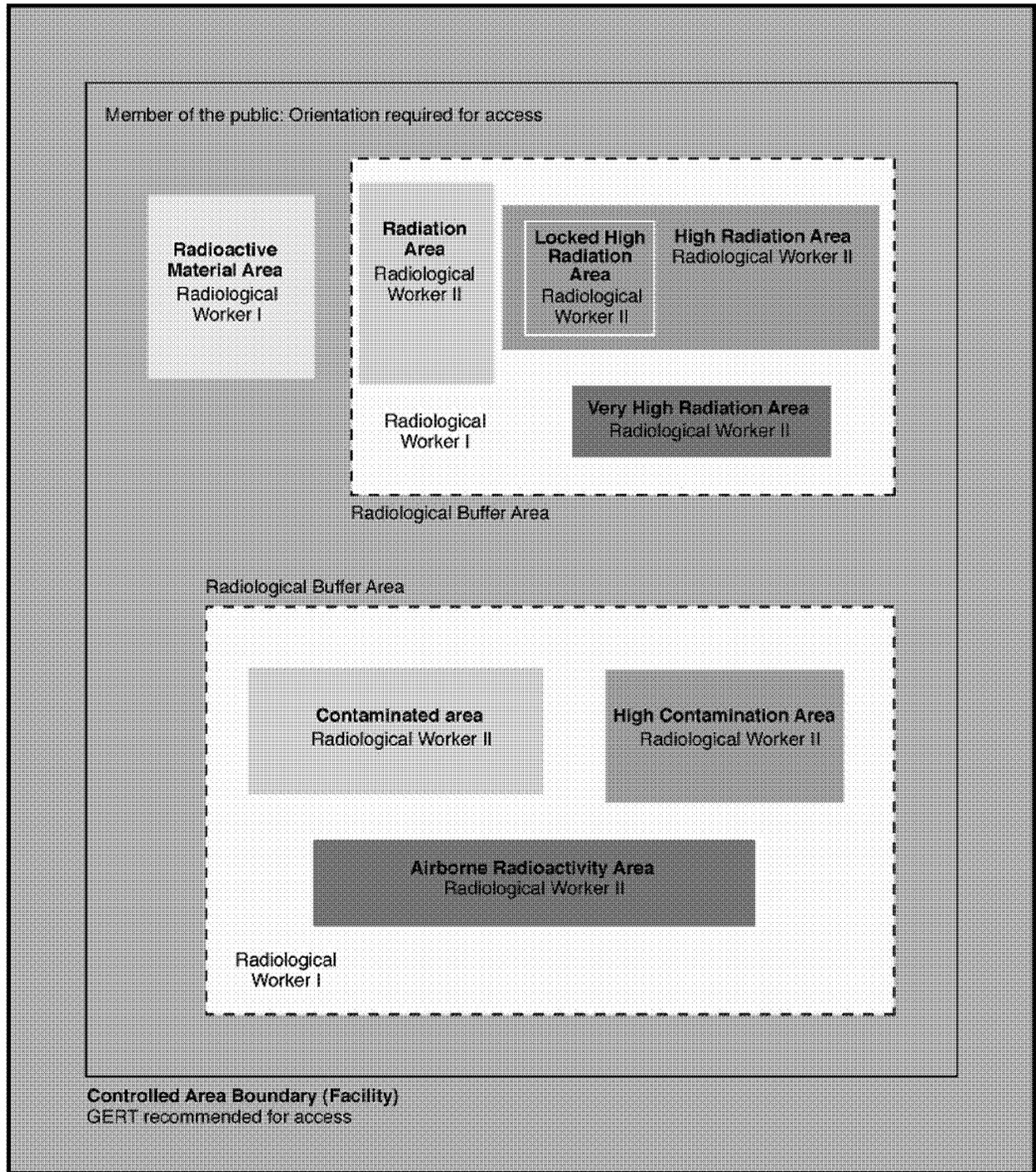
RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 2-9 of 2-17

Part 3, Posting**Article 231, General Posting Provisions**

1. Radiological postings are intended to alert individuals to the presence of radiation and radioactive materials and to aid them in controlling exposures and preventing the spread of contamination. The types of boundaries used for radiological control purposes are depicted in Figure 2-1.
2. Signs shall contain the standard radiation symbol (radiation warning trefoil) colored black or magenta on a yellow background [see 10 CFR 835.601(a)]. Lettering should be black or magenta. Standardized signs, as described in DOE core training and 10 CFR 835 guides, will be used where practicable.
3. The Radiological Control director may modify posting requirements to reflect the special considerations of DOE activities conducted at private residences or businesses. Such modifications shall provide the same level of protection to individuals as the existing provisions in 10 CFR 835 [see 10 CFR 835.601(c)].
4. Signs shall be clearly and conspicuously posted at each access point, clearly worded, and, where appropriate, may include radiological control instructions [see 10 CFR 835.601(b)]. Radiological postings will be displayed only to signify actual or potential radiological conditions. Signs used for training will be clearly marked such as “For Training Purposes Only.”
5. Areas that are not normal access points to high radiation areas, and require earth-moving or rigging gear (e.g., large deck plugs or roof hatches) to access, require no posting or weekly checks. Such access points should be controlled by a work document that directs installation of postings when opened. An evaluation of each such area will be performed and documented using an engineering design file (or other listing method such as incorporating the evaluation in the appropriate facility high radiation area control notebook) to determine whether it is a normal access point.
6. Posted areas will be as small as practicable for efficiency.
7. Postings will be maintained in a legible condition and updated based on the results of the most recent surveys.
8. If more than one radiological condition (such as contamination and high radiation) exists in the same area, each condition should be identified.
9. In areas of ongoing work activities, the dose rate and contamination level or range of each will be included on or in conjunction with each posting, as applicable.
10. Postings at entrance points to areas of ongoing work activities controlled for radiological purposes will state basic entry requirements such as dosimetry, radiological work permits (RWPs), or other written authorization, and respiratory protection requirements.

RADIOLOGICAL CONTROL MANUAL	Identifier: PRD-183
	Revision: 7
	Page: 2-10 of 2-17



Site Boundary

03-50219-25

Figure 2-1. Types of posting for and training to access radiologically controlled areas.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 2-11 of 2-17

11. Rope, tape, chains, and similar barriers used to designate the boundaries of posted areas should be yellow and magenta in color.
12. Physical barriers will be placed so that they are clearly visible from all directions and at various elevations. They are not to be easily walked over or under, except at identified access points. These barriers shall be set up so that they do not impede the intended use of emergency exits or evacuation routes [see 10 CFR 835.501(e), 502(d)].
13. Areas shall be clearly and conspicuously posted [see 10 CFR 835.601(b)]. Doors will be posted so that the posting remains visible when doors are open or closed.
14. A radiological posting that signifies the presence of an intermittent radiological condition should include a statement specifying when the radiation is present, such as “CAUTION: RADIATION AREA WHEN RED LIGHT IS ON.”
15. Accessible areas may be exempted from radiological area posting requirements:
 - a. During transient radiological conditions less than 8 continuous hours in duration when posting is not practical, such as during radioactive material transfers. Under these conditions, the area shall be placed under the continuous observation and control of individuals who are knowledgeable of and empowered to implement required access and exposure control measures [see 10 CFR 835.604(a)]. These individuals will be stationed to provide line of sight surveillance and verbal warnings.
 - b. When an area contains only packages received from radioactive material shipments that are labeled and in nondegraded condition while awaiting survey in accordance with Article 423 [see 10 CFR 835.604(c)].

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

Article 232, Posting Controlled Areas

Controlled areas are established and posted to warn individuals when they are entering areas controlled for radiation protection purposes. All radiological areas and radioactive material areas lie within the boundaries of controlled areas. Individuals who enter only the controlled area without entering radiological areas or radioactive material areas are not expected to receive a TEDE exceeding 100 mrem in a year.

1. Each access point to a controlled area shall be posted whenever radiological areas or radioactive material areas may be present in the area [see 10 CFR 835.602(a)].
2. A sign will be used to avoid conflict with the Site security requirements [see 10 CFR 835.602(b)]. The Radiological Control director will approve any sign change.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 2-12 of 2-17

Article 233, Posting Radiological Buffer Areas

Radiological buffer areas are intended to provide secondary boundaries within a controlled area to minimize the spread of contamination and to limit doses to general employees who have not been trained as radiological workers.

1. A radiological buffer area should be established for contamination control adjacent to any entrance to or exit from a contamination, high contamination, or airborne radioactivity area. The size of the radiological buffer area will be commensurate with the potential for the spread of contamination.
2. Radiological buffer areas should be established for exposure control adjacent to radiation, high radiation, and very high radiation areas. The boundary for the radiological buffer area will be established to limit radiation doses to general employees to less than 100 mrem per year.
3. A radiological buffer area is not required for:
 - a. High contamination or airborne radioactivity areas that are completely within contamination areas.
 - b. Inactive contamination, high contamination, or airborne radioactivity areas (i.e., areas to which entry has been prohibited by posting or barricades).
 - c. Exposure control if other posted boundaries or controls provide equivalent employee protection.
 - d. Exposure control if general employees who are not trained as radiological workers are restricted from unescorted entry to controlled areas.
4. The need for radiological buffer areas around radioactive material areas, soil contamination areas, and underground radioactive material areas will be evaluated based on the potential for exposure of unmonitored individuals and the spread of contamination.
5. Posting of radiological buffer areas will be in accordance with Article 231 and contain the wording "CAUTION, RADIOLOGICAL BUFFER AREA." See Table 2-5 for posting requirements for radiological buffer areas.

Article 234, Posting Radiation Areas

1. Radiation areas shall be posted to alert individuals to the presence of external radiation in accordance with Table 2-3 [see 10 CFR 835.601, 603]. In addition, hot spots will be labeled as described below to provide warning of discrete radiation sources.
2. Radiation areas and high radiation areas shall be identified based on the dose rates at a distance of 30 cm either from the source or from any surface penetrated by the radiation [see 10 CFR 835.2(a), radiation area and high radiation area]. Very high radiation areas shall be identified based on the dose rate at a distance of 100 cm either from the source or from any surface penetrated by the radiation [see 10 CFR 835.2(a), very high radiation area].

RADIOLOGICAL CONTROL MANUAL	Identifier: PRD-183 Revision: 7 Page: 2-13 of 2-17
------------------------------------	--

Table 2-3. Criteria for posting radiation areas.

Area	Criteria Required	Posting	Supplemental Posting
Radiation area	Radiation levels could result in an individual receiving > 0.005 rem in 1 hour at 30 cm	“CAUTION, RADIATION AREA” [see 10 CFR 835.603(a)]	“RWP AND PERSONNEL DOSIMETER REQUIRED FOR ENTRY”
High radiation area	Radiation levels could result in an individual receiving > 0.1 rem in 1 hour at 30 cm	“CAUTION,” or “DANGER,” “HIGH RADIATION AREA” [see 10 CFR 835.603(b)]	“PERSONNEL DOSIMETER, SUPPLEMENTAL DOSIMETER, AND RWP REQUIRED FOR ENTRY”
Very high radiation area	Radiation levels could result in an individual receiving > 500 rad in 1 hour at 100 cm	“GRAVE DANGER, VERY HIGH RADIATION AREA” [see 10 CFR 835.603(c)]	“SPECIAL CONTROLS REQUIRED FOR ENTRY” ^a
RWP = radiological work permit a. Access requirements may be deleted or modified if personnel access is specifically prohibited.			

3. Contact readings will be used to determine the need for labeling hot spots. Measures taken to identify sources of elevated general area radiation levels while conducting routine radiation surveys are sufficient to identify hot spot locations. Special surveys for the sole purpose of identifying hot spots are not required.
4. A label reading “Caution, Hot Spot” and marking the location of the hot spot will be placed on or as near the spot as practicable. The provisions of Articles 231.7 through 231.11 do not apply to the hot spot labeling. Labeling of hot spots is not required in areas with general area dose rates greater than 1 rem/hour. However, the locations of such hot spots will be noted on area surveys and discussed in pre-job briefings.
5. Dose received in an hour may be used as the criterion for posting (see the Criteria Required column of Table 2-3). For very high doses received at high dose rates (such as doses received in a very high radiation area), dose rates will be measured and recorded in units of rad rather than rem in 1 hour.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 2-14 of 2-17

Article 235, Posting Contamination, High Contamination, and Airborne Radioactivity Areas

1. Areas shall be posted to alert individuals to the presence (or likely presence) of surface contamination and airborne radioactivity in accordance with Table 2-4 [see 10 CFR 835.603].
2. Derived air concentration values found in 10 CFR 835, Appendixes A and C, shall be used in posting airborne radioactivity areas in accordance with Table 2-4 [see 10 CFR 835.209(a)].

Table 2-4. Criteria for posting contamination, high contamination, and airborne radioactivity areas.

Area	Criteria	Required Posting	Supplemental Posting
Contamination area	Removable contamination levels (dpm/100 cm ²) > Table 2-2 values ^a but ≤ 100 × Table 2-2 values	“CAUTION, CONTAMINATION AREA” [see 10 CFR 835.603(e)]	“RWP AND PROTECTIVE CLOTHING REQUIRED FOR ENTRY”
High contamination area	Removable contamination levels (dpm/100 cm ²) > 100 × Table 2-2 values ^a	“CAUTION,” or “DANGER,” “HIGH CONTAMINATION AREA” [see 10 CFR 835.603(f)]	“RWP AND PROTECTIVE CLOTHING REQUIRED FOR ENTRY”
Airborne radioactivity area	Airborne concentrations (μCi/mL) above background: (1) are > the applicable DAC values ^a ; or (2) could result in an individual (without respirator) receiving an intake > 12 derived air concentration -hours in a week	“CAUTION,” or “DANGER, AIRBORNE RADIOACTIVITY AREA” [see 10 CFR 835.603(d)]	“RWP AND PROTECTIVE CLOTHING REQUIRED FOR ENTRY”
DAC = derived air concentration value RWP = radiological work permit a. Levels exceed or are likely to exceed the listed values.			

RADIOLOGICAL CONTROL MANUAL	Identifier: PRD-183 Revision: 7 Page: 2-15 of 2-17
------------------------------------	--

Table 2-5. Criteria for posting fixed, soil contamination, and radiological buffer areas.

Area	Criteria	Required Posting
Fixed contamination	Removable contamination levels < Table 2-2 removable values and total contamination levels > Table 2-2 total values	“CAUTION, FIXED CONTAMINATION”
Soil contamination	Contaminated soil not releasable in accordance with DOE O 5400.5, “Radiation Protection of the Public and the Environment”	“CAUTION, SOIL CONTAMINATION AREA”
Radiological buffer area	See Article 233 for criteria	“CAUTION, RADIOLOGICAL BUFFER AREA”

Article 236, Posting Radioactive Material Areas

1. Accessible areas where items or containers of radioactive material in quantities exceeding the values provided in 10 CFR 835, Appendix E, are used, handled, or stored shall be posted “CAUTION, RADIOACTIVE MATERIAL” [see 10 CFR 835.603(g)].
2. Radioactive material areas shall be located within controlled areas [see 10 CFR 835.2(a)].
3. Radioactive material areas may be exempted from the posting requirements when:
 - a. The area is posted as a radiological area in accordance with Articles 234 or 235 [see 10 CFR 835.604(b)(1)].
 - b. Each item or container of radioactive material in the area is clearly labeled to warn individuals of the hazards [see 10 CFR 835.604(b)(2)].
 - c. The radioactive material of concern consists solely of structures or installed components that have been activated (such as by exposure to neutron radiation or particles produced in an accelerator) [see 10 CFR 835.604(b)(3)].
 - d. The area contains only packages received from radioactive material shipments that are labeled, in nondegraded condition, and awaiting monitoring in accordance with Article 423.2 [see 10 CFR 835.604(c)].
 - e. For periods of 8 continuous hours or less, the area is under the continuous observation and control of an individual knowledgeable of, and empowered to implement, required access and exposure control measures [see 10 CFR 835.604(a)].
4. Provisions for labeling radioactive material are specified in Chapter 4.

Article 237, Posting Underground Radioactive Material Areas

1. Underground radioactive material areas should be established to indicate the presence of underground items that contain radioactive materials such as pipelines, radioactive cribs, covered ponds, covered ditches, catch tanks, inactive burial grounds, and sites of known,

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 2-16 of 2-17

- covered, and unplanned releases (spills). Underground radioactive material areas need not be posted if physical or administrative controls are implemented to ensure appropriate radiological controls are established prior to excavating, penetrating, or otherwise disturbing underground radioactive materials.
2. Underground radioactive material areas should be posted “UNDERGROUND RADIOACTIVE MATERIAL.” Posting will include instructions or special warnings to workers such as “Consult With Radiological Control Organization Before Digging” or “Subsurface Contamination Exists.” The posting should meet the applicable requirements of Article 231.
 3. Two methods will be used at the facility/project to post underground radioactive material areas. Gated facilities will have postings meeting the requirements listed in Items 1 and 2 above at the entrance gates to these facilities. All other facilities will have postings to identify the underground radioactive material area. For items such as contaminated sewer pipes, signs will be posted at the openings, or as close as practicable. If the opening is in a roadway or high traffic area, then the posting may be stenciled on or near the opening or on a sign placed as close as practicable.
 4. Underground radioactive material areas may be located outside controlled areas unless access is likely to result in individual doses (TEDE) greater than 100 mrem in 1 year from underground radioactive material.
 5. Underground radioactive material areas are exempt from the entry and exit requirements of Chapter 3 when access is not likely to result in individual doses greater than 100 mrem in 1 year. Article 333.1 provides entry provisions for instances in which access is likely to result in an individual dose greater than 100 mrem in 1 year.

Article 238, Posting Soil Contamination Areas

1. For areas with contaminated soil that is not releasable in accordance with DOE environmental protection standards, a soil contamination area will be established that is posted in accordance with the requirements in Articles 231.1 through 231.8. Posting will include the words “Caution, Soil Contamination Area” and instructions or special warnings to workers, such as “Consult With Radiological Control Organization Before Digging” or “Subsurface Contamination Exists” (see Table 2-5).
2. Soil contamination areas may be located outside controlled areas if exposure to the material in the area is not likely to cause any individual to receive a TEDE in excess of 100 mrem in a year.
3. If the contamination levels in the area exceed the values provided in Table 2-2 (as evidenced by the likelihood of tracking contamination out of the area at levels exceeding these values), then the area is a contamination area or high contamination area and shall be posted in accordance with Article 235 [see 10 CFR 835.2(a), and 10 CFR 835.603(e) and (f)].

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
 Revision: 7
 Page: 2-17 of 2-17

Appendix 2A**Nonuniform Exposure of the Skin**

Nonuniform exposures of the skin from x-rays, beta radiation, or radioactive materials on the skin, including hot particles, shall be assessed and recorded as specified in the table below [see 10 CFR 835.205(a)].

Table 2A-1. Methods of assessing and recording nonuniform exposures of the skin.

Area of Skin Irradiated	Method of Averaging, Method of Adding to Other Doses Received, and Recording Nonuniform Skin Dose
$\geq 100 \text{ cm}^2$ [see 10 CFR 835.205(b)(1)]	<ol style="list-style-type: none"> 1. Averaged over 100 cm^2 of skin receiving the maximum dose. 2. Added to any uniform dose equivalent also received by the skin. 3. Recorded as the shallow dose equivalent to any extremity or skin for the year.^a
$\geq 10 \text{ cm}^2$ and $< 100 \text{ cm}^2$ [see 10 CFR 835.205(b)(2)]	<ol style="list-style-type: none"> 1. Averaged over 1 cm^2 of skin receiving the maximum absorbed dose (D), reduced by the fraction (f), which is the irradiated area in square centimeters divided by 100 cm^2 ($H=f*D$). In no case, shall a value of <0.1 be used for "f". 2. Added to any uniform dose equivalent also received by the skin. 3. Recorded as the shallow dose equivalent to any extremity or skin for the year.^a
$< 10 \text{ cm}^2$ [see 10 CFR 835.205(b)(3)]	<ol style="list-style-type: none"> 1. Averaged over 1 cm^2 of skin receiving the maximum dose 2. Not added to any other shallow dose equivalent to any extremity or skin recorded as the dose equivalent for the year. 3. Recorded in an individual's radiation dose record as a special entry.^a
CFR = Code of Federal Regulations a. Recording of shallow dose equivalents resulting from nonuniform exposure of the skin is not required if the resulting dose is less than 1 rem [see 10 CFR 835.702(b)].	

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-1 of 3-41

CHAPTER 3 CONTENTS

CHAPTER 3, CONDUCT OF RADIOLOGICAL WORK	3-3
Part 1, Planning Radiological Work	3-3
Article 311, General	3-3
Article 312, Planning for Maintenance, Operations, and Modifications	3-3
Article 313, Infrequent or First-Time Activities	3-5
Article 314, Temporary Shielding	3-5
Article 315, Technical Work Documents	3-6
Article 316, Control of Internal Exposure	3-7
Part 2, Work Preparation	3-8
Article 321, Radiological Work Permits	3-8
Article 322, Use of Radiological Work Permits	3-9
Article 323, Radiological Work Permit Preparation	3-10
Article 324, Pre-Job Briefings	3-11
Article 325, Use of Personal Protective Equipment and Clothing	3-11
Part 3, Entry and Exit Provisions	3-13
Article 331, Controlled Areas	3-13
Article 332, Radiological Buffer Areas	3-13
Article 333, Radioactive Material, Soil Contamination, and Underground Radioactive Material Areas	3-16
Article 334, Radiation, High Radiation, Locked High Radiation, and Very High Radiation Areas	3-16
Article 335, Contamination, High Contamination, and Airborne Radioactivity Areas	3-17
Article 336, Member of the Public Entry Provisions	3-18
Article 337, Controlling the Spread of Contamination	3-19
Article 338, Monitoring for Personnel Contamination	3-19
Part 4, Radiological Work Controls	3-20
Article 341, General	3-20
Article 342, Work Conduct and Practices	3-20
Article 343, Logs and Communications	3-21
Article 344, Review of Work in Progress	3-21
Article 345, Stop Radiological Work Authority	3-22
Article 346, Response to Abnormal Situations	3-22
Article 347, Controls for Benchtop Work, Laboratory Fume Hoods, Sample Stations, Glovebags, and Gloveboxes	3-23
Article 348, Controls for Hot Particles	3-24
Part 5, Evaluation of Performance	3-25
Article 351, Conduct of Critiques	3-25

RADIOLOGICAL CONTROL MANUAL

Identifier:	PRD-183
Revision:	7
Page:	3-2 of 3-41

Article 352, Post-Job Reviews.....	3-26
Article 353, Lessons Learned	3-26
Part 6, Special Applications	3-26
Article 361, Plutonium Operations	3-26
Article 362, Uranium Operations.....	3-27
Article 363, Tritium Operations	3-27
Article 364, Accelerator Operations	3-27
Article 365, Radiation-Generating Devices	3-28
Part 7, Reserved.....	3-29
Part 8, Design and Control.....	3-29
Article 381, Radiological Design Criteria.....	3-29
Article 382, Control Procedures	3-30
Appendix 3A—Checklist for Reducing Occupational Radiation Exposure.....	3-31
Appendix 3B—Use of Protective Clothing and Contamination Control Practices	3-34
Appendix 3C—Physical Access Controls for High and Very High Radiation Areas	3-39
Appendix 3D—Guidelines for Personnel Contamination Monitoring with Hand-Held Instruments	3-40

TABLES

3-1. Guidelines for selecting protective clothing	3-12
3-2. Radiological Control training provisions	3-14

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-3 of 3-41

CHAPTER 3, CONDUCT OF RADIOLOGICAL WORK**Part 1, Planning Radiological Work****Article 311, General**

1. Written authorization is required to control access to and work in radiological areas [see 10 CFR 835.501(d)]. The level of detail included in such authorizations depends on facility hazards and the nature of the work force. Technical requirements for the conduct of work including construction, modifications, operations, maintenance, and decommissioning will incorporate radiological criteria to ensure safety and maintain radiation exposures ALARA. In general, efforts to reduce the individual dose will not be allowed to cause a concurrent increase in the collective dose.
2. The primary methods used to maintain exposures ALARA shall be facility and equipment physical design features [see 10 CFR 835.1001(a)]. Performance of certain activities such as maintenance and modifications may render permanently installed physical design features inadequate. In such instances, a special subset of design features, often referred to as engineering controls (e.g., temporary shielding, containment devices, and filtered ventilation systems), will be used, as appropriate, to control individual exposures. Design criteria are discussed in Articles 381 and 382.
3. When physical design features, including engineering controls, are impractical or inadequate, the basis should be documented and the work shall be augmented by administrative controls [see 10 CFR 835.1001(a) and (b)]. To accomplish this, the design and planning processes will incorporate radiological control considerations in the early planning stages. The checklist in Appendix 3-A will be used in reducing occupational radiation exposure.
4. To ensure adequate protection of the work force, planning for work in a radiological area also will include consideration of all other workplace hazards (e.g., industrial hygiene and safety, fire safety, and electrical safety), consistent with the principles of ISMS as discussed in Article 118.

Article 312, Planning for Maintenance, Operations, and Modifications

1. Maintenance and modification plans and procedures will be reviewed to identify and incorporate radiological control requirements such as engineering controls and dose and contamination reduction considerations. Performance of this review is the responsibility of line management, with support and concurrence from the Radiological Control organization.
2. The radiological hazard assessment and control process will be integrated with the processes used to assess and control other workplace hazards. Requirements and guidance for performing hazards assessments and implementing associated controls are contained in DOE O 440.1A, "Worker Protection Management for DOE Federal and Contractor Employees," and its associated guidance documents.
3. For routine tasks such as surveillances, tours, and minor nonradiological maintenance, performance of the above review and documentation of identified radiological protection

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-4 of 3-41

requirements may be conducted as part of the radiological work permit process (see Article 321) or other work authorization development process that may be required by 10 CFR 835.501(d).

4. This manual establishes trigger levels that require formal radiological review of work activities. The trigger levels are based on radiological conditions in existence or expected prior to implementation of the job-specific engineering and administrative controls.

The trigger levels for the Site are as follows:

- a. Individual dose exceeding 100 mrem TEDE.
 - b. A collective dose of 500 mrem TEDE.
 - c. Predicted airborne radioactivity concentrations greater than 1 DAC without respiratory protection and 100 DAC with respiratory protection.
 - d. Work area removable contamination greater than 100 times the values shown in Table 2-2.
 - e. Entry into areas where whole body dose rates in the work area are greater than 1 rem/hour deep-dose equivalent.
 - f. Potential radioactive releases to the environment are greater than or equal to 1 derived concentration guide (DCG). The DCGs are listed in DOE O 5400.5, "Radiation Protection of the Public and the Environment."
5. For nonroutine or complex tasks, a hazards analysis will be conducted using the ISMS and authorization basis process. This review is in addition to the formal radiological review discussed above. An integrated set of controls for all hazards (e.g., radiological, chemical, and physical) will be developed from this hazard analysis.
 6. At a minimum, the formal radiological review will consider the following:
 - a. Inclusion of radiological control hold points in the technical work documents.
 - b. Elimination or reduction of radioactivity through line flushing and decontamination.
 - c. Use of work processes and special tooling to reduce time in the work area.
 - d. Use of engineered controls to minimize the spread of contamination and generation of airborne radioactivity.
 - e. Specification of special radiological training or monitoring requirements.
 - f. Use of mockups for high exposure or complex tasks.
 - g. Engineering, design, and use of temporary shielding to reduce radiation levels.
 - h. Walkdown or dry run of the activity using applicable procedures.
 - i. Staging and preparation of necessary materials and special tools.
 - j. Maximization of prefabrication and shop work.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-5 of 3-41

- k. Review of abnormal and emergency procedures and plans.
 - l. Identification of points where signatures and second-party or independent verifications are required.
 - m. Establishment of success or completion criteria, with contingency plans to anticipate difficulties.
 - n. Development of a pre-job estimate of the collective dose to be incurred for the job.
 - o. Provisions for waste minimization and disposal.
7. Radiological control requirements identified as part of the above formal radiological review normally will be documented in the job plans, procedures, or work packages.
 8. The appropriate facility/project ALARA committee should review and approve plans for radiological work anticipated to exceed an individual dose of 1 rem TEDE or a collective dose of 5 rem TEDE.
 9. Optimization techniques such as cost-benefit analyses represent a fundamental part of radiological design analysis and work review. For review of minor activities with low associated doses, a cost-benefit evaluation is an intrinsic part of the engineering review process and a detailed evaluation is not necessary. For review and planning of major tasks involving higher collective dose expenditures, a detailed and documented evaluation should be performed.

Article 313, Infrequent or First-Time Activities

In addition to the planning provisions of Article 312, special management attention will be directed to radiological activities that are infrequently conducted (i.e., activities for which facility or worker planning and execution experience are insufficient to provide assurance of adequate radiological controls) or represent first-time operations. Planning for such activities will include:

1. Formal radiological review in accordance with Article 312.4.
2. Senior management review directed toward anticipation of concerns and emphasis on specification of protective measures.
3. Review and approval by the facility/project ALARA committee.
4. Enhanced line and Radiological Control organization management oversight during the initiation and conduct of the work.
5. The extent of the formal radiological review will be commensurate with the expected and potential hazards and required controls.

Article 314, Temporary Shielding

1. Temporary shielding is portable shielding used for a limited time, typically less than 1 year, which is not engineered as an integral part of the structure.
2. The installation, use, and removal of temporary shielding will be controlled by procedure.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-6 of 3-41

3. The effects of the additional weight of temporary shielding on systems and components, prior to installation, will be evaluated and established to be within the design basis.
4. Installed temporary shielding will be inspected and surveyed periodically to verify effectiveness and integrity. Installed temporary shielding will be evaluated periodically to assess the need for its removal or replacement with permanent shielding.
5. Radiation surveys will be performed during the alteration or removal of installed temporary shielding.
6. Installed temporary shielding will be visibly marked or labeled with the following or equivalent wording: “Temporary Shielding—Do Not Remove Without Permission from Radiological Control.”
7. Specific shielding applications, such as the shielding of low-activity sources or samples, that fall outside the recommendations of this article will be identified in facility/project procedures.
8. The following shielding applications are exempt from the requirements of this article:
 - a. Shielding for sources that generate a contact dose rate of less than 5 mrem/hour unshielded.
 - b. The marking or labeling of temporary shielding in areas that have not been entered since April 15, 1996, is required during the initial entry. The temporary shielding in those areas will be marked or labeled in accordance with Article 314.6.

Article 315, Technical Work Documents

1. Technical work documents such as procedures, work packages, or job or research plans will be used to control hands-on work with radioactive materials. Requirements for incidental or routine work activities that involve a low potential of worker exposure or workplace contamination, such as the collection of trash or used protective clothing, will be established in generally applicable procedures.
2. Technical work documents used to control radiological work activities will be reviewed and approved by the Radiological Control organization.
3. The following activities and potential conditions are “significant adverse radiological conditions” and require the use of radiological control hold points in facility/project technical work documents:
 - a. When Radiological Control organization actions are required to assess potentially significant changes in radiological conditions and ensure identification of conditions that could require implementation of more stringent controls (e.g., changing a contamination area to a high contamination area or establishing an airborne radioactivity area).
 - b. When the potential exists for the whole body dose to exceed 1 rem in 1 hour at 30 cm.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-7 of 3-41

- c. When the potential exists in an occupied work areas for airborne radioactivity levels to exceed 10 times the DACs provided in Appendixes A and C of 10 CFR 835.
 - d. When the potential exists for the unplanned or uncontrolled release of radioactive material greater than 1 DCG to the environment.
4. The radiological control hold point will include the criteria that must be met or action that must be taken to satisfy the hold point prior to continuing or in conjunction with subsequent steps in the planned activity.

Article 316, Control of Internal Exposure

1. The primary methods used to maintain individual internal doses ALARA shall be physical design features such as confinement, ventilation, and remote handling [see 10 CFR 835.1001(a)]. The design objective shall be, under normal conditions, to avoid releases of radioactive material to the workplace atmosphere. The objective, under all conditions, shall be to control inhalation of radioactive material to levels that are ALARA [see 10 CFR 835.1002(c)].
2. Administrative controls, including access restrictions and the use of specific work practices designed to control airborne radioactivity, shall be used as an alternative method to maintain internal doses ALARA if the physical design has been demonstrated and documented to be impracticable [see 10 CFR 835.1001(b)].
3. When engineering and administrative controls have been applied and the potential for airborne radioactivity still exists, respiratory protection should be used to limit internal exposures and will then be considered an administrative control. Use of respiratory protection should be considered under the following conditions:
 - a. Entry into airborne radioactivity areas.
 - b. During breach of contaminated systems or components.
 - c. During work in areas or on equipment with removable contamination levels greater than 100 times the values in Table 2-2.
 - d. During work on contaminated or activated surfaces with the potential to generate airborne radioactivity.
4. The selection of respiratory protection equipment will include consideration of worker safety, comfort, and efficiency. The use of positive pressure respiratory protection devices is recommended wherever practicable to alleviate fatigue and increase comfort. See Articles 531 through 535 for additional guidance on respiratory protection.
5. In specific situations, the use of respiratory protection may be inadvisable because of physical limitations or the potential for significantly increased external exposure. In such situations, a formal radiological review will be conducted in accordance with Article 312 to ensure that measures are implemented to assess available options, monitor and reduce worker exposure, and provide for follow-up monitoring, as required. Specific justification

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-8 of 3-41

- to accept the exposure, including a description of measures taken to mitigate the airborne radioactivity, will be documented as part of the review process.
6. The following controls are applicable to activities authorized in accordance with Article 316.5:
 - a. Stay-time controls, which control the amount of time a worker can remain in a radiological area, will be established for the entry to limit intake.
 - b. Evaluation of workplace airborne radioactivity levels will be provided using real-time (or continuous) air monitors or air samplers with expedited assessment and analysis of results.
 7. Any person with an open, unprotected wound (a wound not properly bandaged and protected with personal protective equipment) should not work in areas where radioactive contamination is possible and should not directly handle radioactive material or material suspected of being radioactively contaminated. Employees working in such areas should report the presence of open wounds to their managers. If an employee sustains a wound while in such an area or during handling of radioactive material, the employee should report immediately to Radiological Control personnel.
 8. Wounds must be assessed through the Site Occupational Medical Program. The Radiological Control organization, assisted by the Occupational Medical Program, will determine whether the wound represents a significant risk for internal contamination if properly bandaged and wearing the appropriate personal protective equipment. If the assessment indicates that the risk is negligible, then work may be performed in areas where radioactive contamination is possible.

Part 2, Work Preparation

Article 321, Radiological Work Permits

Radiological work permits (RWPs) are used at facilities or by projects to establish radiological controls for intended work activities. The RWP informs workers of area radiological conditions and entry requirements and provides a mechanism to relate worker exposure to specific work activities.

1. The following information is included in RWPs:
 - a. Description of the work involved.
 - b. Work-area radiological conditions.
 - c. Dosimetry requirements.
 - d. Pre-job briefing requirements, as applicable.
 - e. Training requirements for entry.
 - f. Protective clothing and respiratory protection requirements.
 - g. Radiological Control coverage requirements and stay-time controls, as applicable.
 - h. Radiological control hold points.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-9 of 3-41

- i. Limiting radiological conditions that may void the RWP.
 - j. Special dose or contamination reduction considerations.
 - k. Special personnel frisking considerations.
 - l. Technical work document number, as applicable.
 - m. Unique identifying number.
 - n. Date of issue and expiration.
 - o. Authorizing signatures.
2. All RWPs should be integrated with other work authorizations that address safety and health issues such as those for industrial safety and hygiene, welding, or confined space entry.
 3. If necessary to ensure appropriate accounting, RWP numbers will be used in conjunction with the Radiological Control Information Management System to relate the individual or collective dose to specific activities.

Article 322, Use of Radiological Work Permits

Facilities and projects use two different types of RWPs. General RWPs are used for entry and repetitive work in areas with known and stable low-hazard radiological conditions. Job-specific RWPs are used for work that is more complex and for entry into higher-hazard areas.

1. General or job-specific RWPs will be used to control the following activities:
 - a. Entry into radiation areas, high radiation areas, very high radiation areas, contamination areas, high contamination areas, and airborne radioactivity areas.
 - b. Handling of materials with removable contamination that exceeds the values of Table 2-2.
 - c. Work in localized benchtop areas, laboratory fume hoods, sample sinks, and containment devices that have the potential to generate contamination in areas that are otherwise free of contamination.
 - d. Work that disturbs the soil in soil contamination areas.
 - e. Work that involves digging in underground radioactive material areas.
2. Job-specific RWPs will be used to control nonroutine operations or work in areas with changing radiological conditions. A job-specific RWP will remain in effect only for the duration of a job.
3. General RWPs may be used to control routine or repetitive activities such as tours and inspections or minor work activities in areas with well-characterized and stable radiological conditions. General RWPs will not be approved for periods longer than 1 year.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-10 of 3-41

4. Radiological surveys will be routinely reviewed to evaluate the adequacy of RWP requirements. An RWP will be updated if radiological conditions change to the extent that the protective requirements must be modified.
5. All RWPs will be posted at the access point to the applicable radiological work area or otherwise made available at the work location. The Site normally uses the Radiological Control Information Management System access control station as an access point because all personnel must sign in at this point and acknowledge the RWP requirements and conditions.
6. Workers will acknowledge by signature, or through electronic means where automated access systems are in place, that they have read, understand, and will comply with applicable RWPs prior to initial entry to the area and after any revisions to the RWP.
7. Worker pocket or electronic dosimeter readings will be recorded in a format that identifies and provides linkage to an applicable RWP.
8. An alternative formal mechanism, such as written procedures or experiment authorizations, may be used in lieu of an RWP as the administrative control over radiological work activities. If an alternative mechanism is used, it should meet the standards established in this article and Articles 321 and 323.

Article 323, Radiological Work Permit Preparation

1. The responsibility for ensuring adequate planning and control of work activities resides with line management. The lead work group responsible for the planned activity or for an area should initiate the preparation of an RWP.
2. The RWP will be based on current radiological surveys and anticipated radiological conditions.
3. The RWP, including any revisions or extensions, will be approved by the supervisor responsible for the work or area and the appropriate Radiological Control management. The RWP review requirements are as follows:
 - a. **Radiological Control management:** Performs an independent review of the RWP and approves the RWP, acknowledging that all radiological controls for the work to be performed are included.
 - b. **Job controller or supervisor:** Reviews and approves the RWP, acknowledging acceptance of responsibility for the radiological work practices exercised by the radiological workers performing the work.
 - c. **Facility/project management:** Reviews and approves the RWP. The manager is responsible for the facility or area and recognizes facility evolutions that may result in changed radiological conditions affected by or affecting this RWP.
 - d. **Facility/project management or Radiological Control management:** Assigns other reviews, as deemed necessary, to review the RWP for completeness and compliance to current requirements.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-11 of 3-41

Article 324, Pre-Job Briefings

1. At a minimum, pre-job briefings will be held prior to the conduct of work anticipated to exceed the trigger levels identified in Article 312.4.
2. At a minimum, the pre-job briefing will include:
 - a. Scope of work to be performed.
 - b. Radiological conditions of the workplace.
 - c. Procedural and RWP requirements.
 - d. Special radiological control requirements.
 - e. Radiologically limiting conditions such as contamination or radiation levels that may void the RWP.
 - f. Radiological control hold points.
 - g. Communications and coordination with other groups.
 - h. Provisions for housekeeping and final cleanup.
 - i. Emergency response provisions.
3. Pre-job briefings will be conducted by the cognizant work supervisor or other individuals most familiar with the work to be performed and the required controls.
4. Workers and supervisors directly participating in the job, cognizant Radiological Control personnel, and representatives from involved support organizations should attend the briefing.
5. Records of actions taken to maintain doses ALARA shall be maintained; therefore, if pre-job briefings are used for ALARA purposes, records of the briefings shall be maintained [see 10 CFR 835.704(b)]. A summary of topics discussed and attendance at the pre-job briefing should be documented. This documentation will be maintained with the technical work documents.

Article 325, Use of Personal Protective Equipment and Clothing

1. Individuals shall wear protective clothing during work in contamination and high contamination areas [see 10 CFR 835.1102(e)] and should wear protective clothing during the following activities:
 - a. Handling of contaminated materials with removable contamination in excess of Table 2-2 levels.
 - b. Work in airborne radioactivity areas.
 - c. As directed by the Radiological Control organization, or as required by the RWP or other work authorization.
2. Protective clothing and shoes designated for radiological control will be:
 - a. Marked in accordance with Article 461.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-12 of 3-41

- b. Used only for radiological control purposes.
3. Protective clothing dress-out areas will be established directly adjacent to the work area, where possible. In cases where dress-out areas cannot be established directly adjacent, they will be located as close as practical to provide easy access to the work area and sufficient space for dress out. Workers will proceed directly to the radiological work area after donning personal protective equipment and clothing.
 4. General guidelines for protective clothing selection and use are provided in Table 3-1 and Appendix 3B, which also specifies the procedure for doffing potentially contaminated fire-fighting clothing.
 5. The use of lab coats as radiological protective clothing is appropriate for limited applications, such as those discussed in Appendix 3B where the potential for personal contamination is limited to the hands, arms, and upper front portion of the body. Lab coats should not be used as protective clothing for performing physical work activities in contamination, high contamination, or airborne radioactivity areas.
 6. Appropriate instructions for donning and removing protective clothing should be posted at the dress-out areas and step-off pads for the affected work areas.

Table 3-1. Guidelines for selecting protective clothing.

Work Activity	Removable Contamination Levels		
	Low (1 to 10 times Table 2-2 values)	Moderate (10 to 100 times Table 2-2 values)	High (>100 times Table 2-2 values)
	Recommended Protective Clothing		
Routine work	Full set of protective clothing	Full set of protective clothing	Full set of protective clothing, double gloves and double shoe covers
Heavy work	Full set of protective clothing and work gloves	Double set of protective clothing and work gloves	Double set of protective clothing and work gloves
Work with pressurized or large volume liquids, closed system breach	Full set of nonpermeable protective clothing	Double set of protective clothing (outer set nonpermeable) and rubber boots	Double set of protective clothing, nonpermeable outer clothing, and rubber boots

Note: For hands-off tours or inspections in areas with removable contamination at levels 1 to 10 times the values in Table 2-2, lab coats, shoe covers, and gloves may be used instead of full protective clothing.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-13 of 3-41

7. The use of personal protective equipment or clothing (including respiratory protection) beyond that authorized by the Radiological Control organization or other cognizant safety authorities detracts from work performance and is contrary to ALARA principles and waste minimization practices. Such use should not be authorized.
8. For radiological control purposes, company-issued clothing that is not specifically intended to protect individuals from contamination hazards, such as modesty clothing, work coveralls, and shoes, are considered the same as personal clothing.

Part 3, Entry and Exit Provisions

Article 331, Controlled Areas

The facility/project Radiological Control manager's approval is required prior to each radiologically controlled area access by untrained employees or visitors. Equivalent controls are provided through the assignment of a fully knowledgeable and briefed escort. The work may include one-time inspections, testing, management oversight, tours, engineering reviews, and other nonroutine activities.

1. All radiological workers shall complete radiation safety training commensurate with the hazards and required controls, as follows:
 - a. Prior to unescorted access to controlled areas [see 10 CFR 835.901(a)].
 - b. Prior to receiving an occupational dose during access to controlled areas [see 10 CFR 835.901(a)].
2. Training provisions for unescorted entry into controlled areas and radiological areas are specified in Table 3-2. Article 622 establishes training provisions that should be met prior to permitting members of the public in controlled areas.
3. Radiological Control special instruction signs may be posted to inform personnel "Do not loiter" in designated controlled areas to maintain exposures ALARA.

Article 332, Radiological Buffer Areas

1. Minimum requirements for unescorted entry into radiological buffer areas will include the following:
 - a. Completion of training in accordance with Table 3-2.
 - b. Use of a TLD (unless otherwise stated TLD is the primary dosimeter), as appropriate.
2. Contamination monitoring provisions for individuals who exit a radiological buffer area containing contamination areas, high contamination areas, or airborne radioactivity areas are specified in Article 338.

RADIOLOGICAL CONTROL MANUAL	Identifier: PRD-183 Revision: 7 Page: 3-14 of 3-41
------------------------------------	--

Table 3-2. Radiological Control training guidelines.

Activities	Minimum Training	RCM Article Citation
Entry as a member of the public ^a	Orientation	622
Unescorted entry into controlled areas and radioactive material areas or underground radioactive material areas where an individual is not likely to receive ≥ 0.1 rem in 1 year	General Employee Radiological Training	612, 613, and 621
Unescorted entry into radiological buffer areas ^b		
Unescorted entry into radiological buffer areas	Radiological Worker I	612, 613, 631, and 632
Unescorted entry into radioactive material areas or underground radioactive material areas (> 0.1 rem in 1 year)		
Unescorted entry into soil contamination areas for work that does not disturb the soil		
Unescorted entry into radiation areas		
Unescorted entry into high, locked high, or very high radiation areas	Radiological Worker II, or Radiological Worker I with high radiation option (see Article 632.3)	612, 613, 631, 632, and 633
Completion of specialized training developed as a requirement to work with radioactive materials incident to specialized tasks or where job-specific training provides equipment knowledge and controls	Radiological Worker II for Laboratory Personnel	612, 613, 631, 632, and 634
	Radiological Worker II for Fire Fighters	
Unescorted entry into contaminated areas ^c	Radiological Worker II	612, 613, 631, and 633
Unescorted entry into soil contamination areas to perform work that disturbs the soil		
Use of containment devices with high contamination levels ^d		

RCM = Radiological Control Manual

a. The facility Radiological Control manager may authorize exceptions to the escort requirements in accordance with Article 622.

b. Unescorted entry requires completion of training and practical demonstration of conducting a proper self-survey with beta-, gamma-, and alpha-contamination monitoring instrumentation.

c. Contaminated areas include contamination, high contamination, and airborne radioactivity areas.

d. The devices include gloveboxes and other containment devices with surface contamination levels exceeding 100 times Table 2-2 values.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183

Revision: 7

Page: **3-15** of 3-41

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-16 of 3-41

Article 333, Radioactive Material, Soil Contamination, and Underground Radioactive Material Areas

Minimum requirements for unescorted entry into radioactive material areas, soil contamination areas, and underground radioactive material areas include completion of training in accordance with Table 3-2. If individual doses are likely to exceed the applicable monitoring thresholds, individual monitoring shall be conducted in accordance with Articles 511 and Article 521 [see 10 CFR 835.402(a) and (c)].

Article 334, Radiation, High Radiation, Locked High Radiation, and Very High Radiation Areas

1. Minimum requirements for unescorted entry into radiation areas shall include completion of radiation safety training [see 10 CFR 835.901(b)] and will include the following:
 - a. Completion of training in accordance with Table 3-2.
 - b. Providing the worker's signature on the RWP.
 - c. Use of a TLD.
2. Physical controls to prevent inadvertent or unauthorized access to high and very high radiation areas are established in Appendix 3-C.
3. Minimum requirements for unescorted entry into high radiation areas shall include completion of radiation safety training [see 10 CFR 835.901(b)], use of a TLD [see 10 CFR 835.402(a)(5)], radiation monitoring during access, and use of supplemental alarming dosimeter [see 10 CFR 835.502(a)], and will include the following:
 - a. Completion of training in accordance with Table 3-2.
 - b. Providing the worker's signature on the RWP.
4. Minimum requirements for unescorted entry into a locked high radiation area (LHRA), where individual worker dose rates could exceed a whole body dose of 1 rem in 1 hour, shall include completion of radiation safety training [see 10 CFR 835.901(b)], use of a TLD [see 10 CFR 835.402(a)(5)], radiation monitoring during access, and use of supplemental alarming dosimeter [see 10 CFR 835.502(a)], and will include the following:
 - a. Completion of training in accordance with Table 3-2.
 - b. Providing the worker's signature on the RWP.
 - c. Determination of the individual current dose, based on primary and supplemental dosimeter readings.
 - d. Completion of the pre-job briefing, as applicable.
 - e. RCT coverage as determined by the Radiological Control organization.
5. Individuals shall be prevented from unauthorized or inadvertent entry to very high radiation areas [see 10 CFR 835.502(c)].

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-17 of 3-41

6. In addition to the controls required in Articles 334.2 and 334.3 when using a radiation generating device, a radiation survey will be performed prior to the first entry to the area after the radiation source has been secured or shielded to verify the termination of the very high radiation field.
7. Operations personnel will immediately notify the Radiological Control organization of operational or system changes that could result in significant changes in radiological hazards. Such notifications will facilitate Radiological Control organization actions to erect postings and implement required entry controls.
8. The number, issue, and use of keys will be strictly controlled where locked entryways are used to control access to high, locked high, and very high radiation areas.
9. The Radiological Control organization will maintain a list of high, locked high, and very high radiation areas.
10. Written procedures will be implemented to ensure the effectiveness and operability of barricades, devices, alarms, and locks. Determination of the effectiveness of these control devices also should consider individual training and response. Annual inspections of the physical access controls to high, locked high, and very high radiation areas will be performed to verify that controls are adequate to prevent unauthorized entry.

Article 335, Contamination, High Contamination, and Airborne Radioactivity Areas

1. Minimum requirements for unescorted entry into contamination areas shall include completion of radiation safety training [see 10 CFR 835.901(b)] and protective clothing as specified on the RWP [see 10 CFR 835.1102(e)] and will include the following:
 - a. Completion of training in accordance with Table 3-2.
 - b. Providing the worker's signature on the RWP.
 - c. Use of primary dosimetry (TLD), as appropriate.
2. Minimum requirements for unescorted entry into high contamination or airborne radioactivity areas shall include completion of radiation safety training [see 10 CFR 835.901(b)] and protective clothing as specified on the RWP [see 10 CFR 835.1102(e)] and will include the following:
 - a. Completion of training in accordance with Table 3-2.
 - b. Providing the worker's signature on the RWP.
 - c. Use of respiratory protection when specified by the RWP or other written authorization.
 - d. Completion of pre-job briefing for high contamination or airborne radioactivity areas, as applicable.
 - e. Use of primary dosimetry (TLD), as appropriate.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-18 of 3-41

3. Individuals exiting contamination, high contamination, or airborne radioactivity areas will remove protective clothing (see Appendix 3B for recommended procedure). When entering an uncontaminated area, these individuals shall be monitored, as appropriate, for the presence of contamination on their skin and clothing [see 10 CFR 835.1102(d)]. These individuals will perform whole-body frisking to detect personnel contamination in accordance with Article 338.
4. Exit points from contamination, high contamination, or airborne radioactivity areas should be equipped with the following:
 - a. Step-off pads located outside the exit point, contiguous with the area boundary.
 - b. Step-off pads maintained free of radioactive contamination.
 - c. Designated containers inside the area boundary for the collection of protective clothing and equipment.
 - d. Contamination monitoring equipment located as close to the step-off pad as background radiation levels permit.
5. Multiple step-off pads should be used at exits from high contamination areas. The use of multiple step-off pads is described in Appendix 3B. When the egress is from a high contamination area to a contamination area, one step-off pad is used as described in Appendix 3B.
6. Protective clothing and monitoring provisions specific to benchtop work, laboratory fume hoods, sample stations, and gloveboxes are identified in Article 347.
7. Article 421 provides requirements and guidance for removing materials and equipment from benchtop work areas, laboratory fume hoods, sample stations, and glove boxes or for retention in the contaminated tool crib in accordance with Article 442.5.

Article 336, Member of the Public Entry Provisions

1. Site procedures will identify area entry requirements and access restrictions for members of the public.
2. Members of the public with a demonstrated need to enter the following areas may be allowed access if such access is controlled with a combination of orientation and the use of escorts trained for the specific area:
 - a. Radiological buffer areas.
 - b. Radiation areas.
 - c. Contamination areas.
 - d. Radioactive material areas.
 - e. Soil contamination areas.
 - f. Underground radioactive material areas.
3. Members of the public will be prohibited from entering high radiation, very high radiation, high contamination, and airborne radioactivity areas.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-19 of 3-41

4. Orientation provisions for members of the public are identified in Article 622.

Article 337, Controlling the Spread of Contamination

The Site contractor policy is to control contamination at its source. Controls shall be implemented as necessary to prevent the spread of removable contamination outside of radiological areas under normal operating conditions [see 10 CFR 835.1102(a)]. The extent of these controls depends on the type and level of contamination present and the activities in and around the area. The following measures should be practiced to prevent the spread of contamination across the boundaries of contamination, high contamination, and airborne radioactivity areas:

1. Use solid barriers to enclose areas wherever practicable.
2. Mark and secure items such as hoses and cords that cross the boundary to prevent safety hazards and the spread of contamination. Markings may include radiological hazard warning labels, ribbon, or tape.
3. Control and direct airflow from areas of lesser to greater removable contamination or airborne radioactivity.
4. Use engineering controls and containment devices such as glovebags, gloveboxes, and tents.

Article 338, Monitoring for Personnel Contamination

1. Individuals shall be monitored as appropriate for the presence of surface contamination when exiting contamination, high contamination, and airborne radioactivity areas [see 10 CFR 835.1102(d)]. Individuals should perform a whole body frisk immediately upon entry into an uncontaminated area after exiting contamination, high contamination, or airborne radioactivity areas, or as directed by the Radiological Control organization or the RWP.
2. In addition to the above, individuals exiting a radiological buffer area containing contamination, high contamination, or airborne radioactivity areas should, at a minimum, perform a hand and foot frisk. This frisk is optional if the radiological buffer area exit is immediately adjacent to the location where the exiting individual already has performed a whole body frisk.
3. Where frisking cannot be performed at the exit from contamination, high contamination, or airborne radioactivity areas because of high background radiation levels, individuals will:
 - a. Remove all protective equipment and clothing at the exit.
 - b. Proceed directly to the nearest designated monitoring station.
 - c. Conduct a whole-body frisk.
4. Personnel frisking will be performed after removal of protective clothing and prior to washing or showering.
5. Guidelines for personnel frisking are provided in Appendix 3D.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-20 of 3-41

6. Personal items such as notebooks, papers and flashlights are subject to the same frisking requirements as the person carrying them and may be frisked by the individual carrying them, provided the individual has been trained to perform this function.
7. Instructions for personnel frisking should be posted adjacent to personnel frisking instruments or personnel contamination monitors.
8. The personnel frisking provisions in this article are not applicable at those facilities that contain only radionuclides such as tritium that cannot be detected by currently available hand-held or automated frisking instrumentation. At such facilities, additional emphasis should be placed on bioassay programs and routine area contamination survey and air sampling programs.

Part 4, Radiological Work Controls

Article 341, General

1. Radiological work activities shall be conducted as specified by the controlling written authorization [see 10 CFR 835.501(d)].
2. Prerequisite conditions such as tag-outs and system isolation will be verified in accordance with the technical work documents before work is initiated.

Article 342, Work Conduct and Practices

1. Contamination levels caused by ongoing work will be monitored and maintained ALARA. When contamination levels exceed the values shown in Table 2-2 and reach posting requirements for a high contamination area, or when high contamination levels double, and these conditions were not anticipated in the original work planning, work must be stopped and reassessed by the Radiological Control organization and job supervisor. The area must be decontaminated to a lower level or additional restrictions must be applied before work may continue.
2. Tools and equipment will be inspected to verify operability before being brought into contamination, high contamination, or airborne radioactivity areas.
3. The use of radiologically clean tools or equipment in contamination, high contamination, or airborne radioactivity areas will be minimized by the implementation of a contaminated tool crib in accordance with Article 442.5. When such use is necessary, tools or equipment with complex or inaccessible areas will be wrapped or sleeved to minimize contamination.
4. Engineering controls such as containment devices, portable or auxiliary ventilation, and temporary shielding will be installed in accordance with technical work documents and inspected prior to use.
5. The identity of components and systems will be verified prior to work.
6. Work activities and shift changes will be scheduled to prevent idle time in radiological areas.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-21 of 3-41

7. Where practicable, parts and components will be removed from areas with higher radiological hazards to areas with lower radiological hazards to perform work.
8. Upon identification of radiological concerns, such as inappropriate work controls or procedural deficiencies, workers should immediately report the concern to line supervision or the Radiological Control organization. If appropriate to control individual exposure to radiological hazards, the affected individuals should exit the radiological area until these issues are resolved and appropriate controls have been instituted.
9. Requirements for area cleanup normally will be included in technical work documents. Work activities will not be considered complete until support material and equipment have been removed and the area has been returned to at least pre-work status.
10. To minimize intakes of radioactive material, smoking, eating, drinking, or chewing will not be permitted in radiological buffer areas, contamination, high contamination, or airborne radioactivity areas. If the potential for personnel heat stress exists, drinking may be permitted within a contamination area when the following criteria are met:
 - a. The potential for heat stress cannot be reduced effectively by the use of administrative or engineering controls.
 - b. All drinking is from approved containers or sources.
 - c. An RCT monitors workers' hands and faces for contamination prior to drinking.
 - d. Participating workers are monitored as part of the bioassay program.
 - e. Applicable requirements and controls are described in approved procedures.

Article 343, Logs and Communications

1. Radiological Control personnel will maintain logs to document radiological occurrences, status of work activities, and other relevant information.
2. During continuous or extended daily operations, oncoming Radiological Control personnel will review logs and receive a turnover briefing from the personnel they are relieving.
3. Communication systems required by the RWP or technical work document will be checked for operability before being brought into the work area and periodically during work.
4. Workers will keep Radiological Control personnel informed of the status of work activities that affect radiological conditions.

Article 344, Review of Work in Progress

1. As part of their normal work review, both Radiological Control personnel and work supervisors should periodically review and provide oversight for ongoing jobs to ensure that prescribed radiological controls are being implemented.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-22 of 3-41

2. Radiological Control personnel should conduct frequent tours of the workplace to provide oversight of the adequacy of radiological work practices, posting, and area controls.
3. During the performance of jobs for which a pre-job dose estimate was made, the Radiological Control organization, in cooperation with line management, should periodically monitor collective dose accumulation and compare it with the pre-job dose estimate. Differences will be reviewed to identify causes and assess the need for corrective actions.

Article 345, Stop Radiological Work Authority

1. For any of the following reasons, RCTs and their supervisors, line supervision, and any worker shall have the authority and responsibility to stop radiological work activities [see DOE O 440.1A(g)]:
 - a. Inadequate radiological controls.
 - b. Radiological controls not being implemented.
 - c. A radiological control hold point not being satisfied.
2. Stop radiological work authority should be exercised in a justifiable and responsible manner.
3. Once radiological work has been stopped, it will not be resumed until proper radiological control has been reestablished.
4. Resumption of work involving radiological hazards will require the approval of the concerned employee, the line manager responsible for the work, and the Radiological Control director or designee.

Article 346, Response to Abnormal Situations

1. This manual and specific facility/project procedures for responding to abnormal situations establish requirements for alarm response. Facility/project alarm response procedures will address the general actions in Items 2 through 6 below, modified as necessary to reflect specific facility conditions.
2. Response to a continuous air monitor alarm will include the following actions:
 - a. Stop work activities and place the area in a safe condition (e.g., secure welding equipment and terminate activities that may result in more severe conditions).
 - b. All individuals exit the area.
 - c. Notify Radiological Control personnel.
3. Response to increasing or unanticipated radiation levels, as identified by a supplemental dosimeter or area radiation monitor alarm, will include the following actions:
 - a. Stop work activities and place the area in a safe condition (e.g., secure welding equipment and terminate activities that may result in more severe conditions).
 - b. Alert others.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-23 of 3-41

- c. All affected individuals exit the area.
- d. Notify Radiological Control personnel.
4. Response to a criticality alarm will include the following actions:
 - a. Immediately evacuate the area, without stopping to remove protective clothing or perform exit monitoring.
 - b. Report to designated assembly area.
5. Response to a personnel contamination monitor alarm will include the following actions:
 - a. Remain in the immediate area.
 - b. Notify Radiological Control personnel.
 - c. Take actions to minimize cross-contamination, such as putting a glove on a contaminated hand.
 - d. Take follow-up actions in accordance with Article 541.
6. Response to a spill of radioactive material will include the following actions:
 - a. Stop or secure the operation causing the spill.
 - b. Warn others in the area.
 - c. Isolate the spill area if possible.
 - d. Minimize individual exposure and contamination.
 - e. Secure unfiltered ventilation.
 - f. Notify Radiological Control personnel.

For radioactive spills involving highly toxic chemicals, workers will immediately exit the area without attempting to stop or secure the spill. They will then promptly notify Industrial Hygiene or the hazardous material team, and Radiological Control personnel.

Article 347, Controls for Benchtop Work, Laboratory Fume Hoods, Sample Stations, Glovebags, and Gloveboxes

The following provisions are applicable to radiological work that has the potential to generate radioactive contamination in localized benchtop laboratory work areas, laboratory fume hoods, sample stations, glovebags, and glovebox operations located in areas that are otherwise contamination free:

1. Provisions for RWPs are provided in Article 322.
2. Protective clothing should include, at a minimum, lab coats and gloves. Gloves should be secured at the wrist as necessary.
3. Shoe covers should be considered based on the potential for floor contamination.
4. Workers should monitor their hands periodically during work as appropriate with the work controls.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-24 of 3-41

5. Upon completion of work or prior to leaving the area, workers shall monitor those areas of their bodies that are potentially contaminated [see 10 CFR 835.1102(d)]. At a minimum, this includes hands, arms, and front portions of the body. A whole-body frisk is recommended.
6. If the potential exists for splashing or airborne radioactivity, such as when taking pressurized samples, additional controls such as rubber aprons, face shields, full protective clothing, or respiratory protection should be instituted.
7. Gloveboxes should be inspected for integrity and operability prior to use.
8. Gloveboxes should be marked with, or survey measurements should be posted to identify, whole-body and extremity dose rates.

Article 348, Controls for Hot Particles

“Hot” particles are small, discrete, highly radioactive particles capable of causing extremely high doses to a localized area in a short period of time. Hot-particle contamination may be present or be generated when contaminated systems are opened or when operations such as machining, cutting, or grinding are performed on highly radioactive materials.

1. A hot particle is defined as a particle, with an area smaller than 1 cm², causing a count rate greater than 6,000 counts per minute on a Geiger-Mueller pancake probe, which will in most cases generate a skin dose rate of greater than 100 mrem in 1 hour.
2. Measures for controlling hot particles, as identified in Items 3 through 7 of this article, will be implemented under the following conditions:
 - a. Upon identification of hot particles.
 - b. During new or nonroutine operations with a high potential for hot particles, based on previous history.
 - c. Upon direction of the Radiological Control organization.
3. Survey provisions for areas or operations with the potential for hot-particle contamination are established in Article 554.9.
4. Contamination area postings will be annotated to specifically identify the presence of hot particles and posting may specify controls.
5. Access to hot-particle contamination areas normally will be controlled by a job-specific RWP. The following controls will be considered for inclusion in the RWP:
 - a. Periodic personnel monitoring during the work activity, at a frequency based on the potential magnitude of personnel exposure.
 - b. Additional personal protective equipment and clothing.
 - c. Direct radiological control coverage during work and assistance during protective clothing removal.
 - d. Use of sticky pads or multiple step-off pads.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-25 of 3-41

6. Response to hot-particle skin or clothing contamination should include the following:
 - a. Immediate removal and retention of the hot particle for subsequent analysis.
 - b. Analysis of the particle.
 - c. Assessment of worker dose.
 - d. Evaluation of work-control adequacy.

Part 5, Evaluation of Performance

During the conduct of radiological work and the handling of radioactive materials, abnormal events may occur that could indicate a weakness or area of programmatic breakdown of radiological controls. Prompt, consistent gathering of facts related to such events is required to satisfy reporting and investigation requirements and to formulate corrective actions to prevent a recurrence. In addition, successful performance or completion of unique activities will be evaluated to identify and incorporate appropriate lessons learned. Analysis of the facts should reveal areas where improvements can be made or where methods can be identified to prevent the recurrence of undesired results.

Article 351, Conduct of Critiques

1. Critiques are meetings of the individuals knowledgeable about an event (either a success or an abnormal event) to document a chronological listing of the facts. The purpose of the critique is not to assign blame, but to establish and record the facts.
2. Critiques will be conducted for successes and abnormal events.
3. Critique leaders will be trained in the required elements of the critique process and the appropriate methods of conducting and controlling the critique.
4. Critique meetings should be conducted as soon as practicable after the event or situation is stabilized, or after a successful evolution is completed. Critiques of abnormal events should preferably be conducted before involved personnel leave for the day.
5. At a minimum, the general critique process should include the following elements:
 - a. Formal meetings, chaired by a critique leader.
 - b. Attendance by all members of the work force who can contribute.
 - c. Personal statement forms completed by selected personnel before the meeting.
 - d. Attendance records.
 - e. Recorded minutes signed by the critique leader and all contributors.
 - f. Pertinent personal statements that are signed and attached to the meeting minutes from individuals involved in the event.
 - g. A listing of the facts in chronological order.
 - h. Supporting materials including documents, records, photographs, parts, and logs maintained by the critique leader.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-26 of 3-41

6. Evaluation of complex evolutions or events may require multiple critiques.

Article 352, Post-Job Reviews

1. A post-job review is required for any job that exceeds the ALARA committee trigger level in Article 312.8, and is conducted in conjunction with the facility/project work activities.
2. As appropriate to the work in question, post-job reviews should include evaluation of:
 - a. Total and individual doses compared to pre-job estimates.
 - b. Efficacy of the radiological controls implemented for the work.
 - c. Any adverse events occurring during the work such as skin contamination, unexpectedly high individual exposures, or problems resulting from unnecessarily burdensome control requirements.
 - d. Conflicts between radiological safety requirements and other safety requirements.
 - e. Opportunities to improve performance or efficiency during repeated or similar work.
 - f. Significant differences between expected and actual radiological conditions or other issues affecting the work.
 - g. Worker feedback for possible improvements in radiological safety practices for repeated or similar work.

Article 353, Lessons Learned

The Lessons Learned Program compiles and distributes lessons learned reports of past radiological events at the Site and at other facilities. The Radiological Control organization, in conjunction with line management and training, should evaluate the Lessons Learned Program lessons learned reports and incorporate the applicable issues into the radiation protection program, the Radiological Control training program, and related operations.

Part 6, Special Applications**Article 361, Plutonium Operations**

Exposure to small quantities of plutonium is perceived as presenting greater risk than exposure to other radionuclides. Low levels of plutonium in the body are difficult to measure and biological removal processes for plutonium are slow. For these reasons:

1. Primary emphasis shall be placed on engineered features to contain plutonium and to prevent airborne and surface contamination [see 10 CFR 835.1001(a)].
2. In addition to the provisions in this manual, guidance contained in DOE-STD-1128-98, "Guide of Good Practices for Occupational Radiation Protection in Plutonium Facilities," should be used in plutonium operations. The standard provides specific guidance related to dosimetry, radiological monitoring, instrumentation, contamination control, and applicable radiological control procedures.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-27 of 3-41

Article 362, Uranium Operations

The health risk of uranium is unusual in that its chemical toxicity is more harmful in the human body than its radioactivity on a unit mass basis. In addition, processed uranium sometimes contains transuranic and other radionuclides from recycled materials. For these reasons, in addition to provisions throughout this manual, the guidance contained in DOE-STD-1136-2000 should be used for uranium operations. Specific guidance is provided in DOE-STD-1136-2000 for management controls, radiological monitoring, contamination control, and internal and external exposure controls.

Article 363, Tritium Operations

The following characteristics of tritium require consideration in the implementation of the radiation protection program at tritium facilities:

1. Tritium emits low-energy beta particles that cannot be monitored using external dosimeters, consequently the use of bioassay measurements is required to evaluate worker dose.
2. Worker exposure to tritium as water vapor causes a much greater dose than exposure to elemental tritium gas.
3. Normal personnel frisking techniques are ineffective for tritium. Consequently, a high reliance is placed on worker bioassay and routine contamination and air monitoring programs.
4. Because of its ability to permeate substances that it contacts, including human skin, tritium is difficult to contain. Special attention will be directed to the selection of personal protective equipment and clothing.
5. For the above reasons, guidance contained in DOE-HDBK-1079-94, "Primer on Tritium Safe Handling Practices," and DOE-HDBK-1129-99, "Tritium Handling and Safe Storage," should be used in tritium operations. These handbooks provide specific guidance related to internal dosimetry, contamination and air monitoring, tritium containment practices and techniques, and personal protective equipment and clothing selection.

Article 364, Accelerator Operations

Special considerations associated with accelerator facilities include the presence of extremely high dose rates, high energy and heavy particles, the generation of activation products, and detection and monitoring difficulties associated with pulsed or high-energy radiation. For these reasons:

1. In addition to the provisions in this manual, guidance contained in Stanford Linear Accelerator Center *Health Physics Manual of Good Practices for Accelerator Facilities* (Casey et al. 1988) should be used in accelerator operations. The Stanford manual provides specific guidance related to radiological monitoring, dosimetry, shielding design, use of interlocks, and procedures and other administrative controls.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-28 of 3-41

2. Consideration also should be given to the information provided in DOE O 420.2A, "Safety of Accelerator Facilities."
3. Safety devices and interlocks that are necessary to meet the high radiation area control requirements of 10 CFR 835.501 shall be operational prior to and during operation of an ionizing radiation beam [see 10 CFR 835.502(b)]. Operational status will be verified by testing. Safety devices and interlocks will be fail-safe.

Article 365, Radiation-Generating Devices

Special considerations associated with the use of radiation-generating devices include the presence of extremely high dose rates and the potential for uncontrolled exposures. Operation of these devices requires stringent physical and administrative controls to prevent overexposure to operating and support personnel and those in adjacent work areas. Facility/project procedures will contain the following provisions for applicable types of radiation-generating devices:

1. American National Standards Institute Standard ANSI N43.3, "Installations Using Non-Medical X-Ray and Sealed Gamma-Ray Sources, Energies up to 10 MeV," establishes acceptable guidelines for operations involving the irradiation of materials.
2. The provisions of HPS ANSI N43.2, "Radiation Safety for X-Ray Diffraction and Fluorescence Analysis Equipment," shall be adhered to for operations involving the following devices [see DOE O 5480.4 (2)(d)]:
 - a. Analytical diffraction and fluorescence.
 - b. Flash x-ray.
 - c. Sealed source irradiators used for diffraction studies.
3. Line management, in conjunction with the Radiological Control organization, will establish the radiological control requirements for incidental x-ray devices such as electron microscopes and electron beam welders.

Personnel operating cabinet x-ray systems such as those used by mailroom clerks and security are subject to the requirements of 21 CFR 1020.40, "Cabinet x-ray systems." These personnel are not required to be radiological workers solely for the purpose of operating these devices.

4. Devices for medical use will be registered with the appropriate regulatory agency.
5. Control requirements for radiographic devices include the following:
 - a. On-Site operations with devices containing sealed sources for radiographic use will be conducted in accordance with the requirements contained in 10 CFR 34, "Licenses for Radiography and Radiation Safety Requirements for Radiographic Operations."
 - b. Acceptable guidelines are established in ANSI N43.3 for on-Site operations with devices other than sealed sources for radiographic use.
 - c. On-Site operations conducted by off-Site subcontractors will be approved by line management in coordination with the Radiological Control organization. This

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-29 of 3-41

process will ensure that the subcontractor has a valid Nuclear Regulatory Commission or an agreement state license and that the operational and emergency procedures are current and available.

6. Required safety devices and interlocks at fixed installations shall be operational prior to and during generation of a radiation field [see 10 CFR 835.502]. Operational status will be verified by testing. Safety devices and interlocks will be fail-safe.

Part 7, Reserved**Part 8, Design and Control****Article 381, Radiological Design Criteria**

The design objectives listed below are applicable during the design of new facilities and modification of existing facilities. Additional design criteria are provided in DOE O 420.1A.

1. For areas of continuous occupancy (2,000 hours per year), the design objective shall be to maintain the average exposure level ALARA and below 0.5 mrem per hour. If occupancy is not continuous, the design objective shall be to maintain doses ALARA and below 20% of the occupational dose limits provided in Table 2-1 [see 10 CFR 835.1002(b)].
2. For control of airborne radioactivity, the design objective shall be to avoid releases to the workplace atmosphere under normal conditions and, under any conditions, to control inhalation by workers to levels that are ALARA. Under normal conditions, confinement and ventilation shall be used [see 10 CFR 835.1002(c)].
3. For materials used in facility construction and modification, the design objective shall be to select materials that facilitate operations, maintenance, decontamination, and decommissioning [see 10 CFR 835.1002(d)]. Components will be selected to minimize the buildup of radioactivity. Control of surface contamination should be achieved by containment of radioactive material.
4. In justifying facility design and physical controls, optimization methods shall be used [see 10 CFR 835.1002(a)].
5. Support facilities should be provided for donning and removal of protective clothing and for personnel monitoring, when required.
6. A neutron quality factor of 20 for conditions of unknown spectra (or doubling of the neutron quality factor associated with known neutron energies) should be used for design purposes only. Design analyses based on these neutron quality factors are intended to provide an estimate of the additional construction cost resulting from increases in the neutron quality factor. The results of these analyses should be used to ascertain the economic feasibility of incorporating such modifications in the final design. This quality factor is not used for determination of individual dose equivalents.
7. Existing facility designs that have office space and lunchrooms or eating areas within radiological areas, radioactive material areas, and radiological buffer areas require priority attention. Generally:

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-30 of 3-41

- a. Locating lunch rooms or eating areas, restrooms, drinking fountains, and showers and similar facilities and devices is strongly discouraged within these areas.
 - b. Locating office spaces within these areas is strongly discouraged. To the extent that such space is essential to support radiological work, steps will be taken to preclude unnecessary occupancy.
8. Facilities currently under construction should be evaluated and the criteria in Article 381 should be applied where practicable.

Article 382, Control Procedures

1. Administrative control and procedural requirements shall be developed and implemented as necessary to supplement facility design features, particularly when the design of existing facilities does not comply with current standards [see 10 CFR 835.1001(b)]. Administrative control procedures include access control measures, RWPs, and technical work documents.
2. Written procedures shall be developed as necessary to ensure compliance with the provisions of this manual that are derived from 10 CFR 835 [see 10 CFR 835.104]. These procedures shall be commensurate with the radiological hazards created by the activity and the education, training, and skills of the individuals who are exposed to these hazards [see 10 CFR 835.104].
3. Written authorizations, including specific radiation protection measures, shall be required to control entry into and work within radiological areas [see 10 CFR 835.501(d)]. These authorizations may include RWPs, technical work documents, administrative procedures, and other administrative controls.
4. The combination of design features and administrative control procedures shall be sufficient to ensure that, during routine operation, Table 2-1 dose limits for general employees are met and to ensure that doses are ALARA [see 10 CFR 835.1003(a)].

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-31 of 3-41

Appendix 3A

Checklist for Reducing Occupational Radiation Exposure

Preliminary Planning and Scheduling Work

- Plan in advance.
- Cancel or do not perform unnecessary work.
- Determine expected radiation levels.
- Estimate the collective dose.
- Sequence jobs.
- Schedule the work.
- Select a trained and experienced work force.
- Identify and coordinate resource requirements.
- Plan access to and egress from the work area.
- Plan for installation of temporary shielding.
- Plan for decontamination.

Preparation of Technical Work Documents

- Include special radiological control requirements in technical work documents.
- Perform ALARA pre-job review.
- Select and optimize engineering and administrative controls to control doses.
- Specify requirements for standard tools.
- Consider special tools including robots.
- State staging requirements for materials, parts, and tools.
- Incorporate radiological control hold points.
- Analyze personal protective equipment requirements to ensure optimization of hazard control, risks, and costs.
- Minimize the discomfort of workers.
- Revise estimates of collective dose.
- Prepare radiological work permits (RWPs).

Temporary Shielding

- Remove or shield sources of radiation.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-32 of 3-41

- Design shielding to include stress considerations.
- Control installation and removal by written procedure.
- Inspect after installation.
- Conduct periodic radiation surveys.
- Prevent damage caused by the weight of heavy temporary shielding.
- Balance radiation exposure received in installation against exposure saved by installation.
- Shield travel routes.
- Shield components with abnormally high radiation levels early in the maintenance period.
- Shield all positions occupied by workers.
- Perform directional surveys to improve the shielding design by locating the source of radiation.
- Use mockups to plan temporary shielding design and installation.
- Consider using water-filled shielding.

Rehearsing and Briefing

- Rehearse.
- Use mockups duplicating working conditions.
- Use photographs and videotapes.
- Conduct briefings of workers in accordance with Article 324.

Performing Work

- Work in the lowest radiation levels possible.
- Perform as much work as practicable outside radiation areas.
- Provide for service lines (air, welding, and ventilation).
- Provide communication (e.g., closed-circuit television or two-way radios).
- Comply with technical work documents and RWPs.
- Post radiation levels.
- Keep nonessential personnel out of radiation areas.
- Control radiation exposure while controlling exposure to other hazards.
- Track radiation exposures.
- Assist in radiation and radioactivity measurements.
- Delegate radiological control monitoring responsibilities.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-33 of 3-41

- Evaluate the size of the work crew as work progresses.
- Compare actual dose against pre-job estimates.
- Coordinate personnel at the job site to reduce nonproductive time.
- Reevaluate methods used to control radiation doses.
- Compare the actual collective dose against the pre-job estimate of the collective dose.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-34 of 3-41

Appendix 3B

Use of Protective Clothing and Contamination Control Practices

Selection of Protective Clothing

1. Workers will inspect protective clothing prior to use for tears, holes, or split seams that diminish protection. Any defective items will be replaced with intact protective clothing.
2. Protective clothing as prescribed by a radiological work permit will be selected based on the contamination level in the work area, the anticipated work activity, worker health considerations, areas of the body likely to be exposed to removable contamination, and regard for nonradiological hazards that may be present. Table 3-2 provides general guidelines for selection. As referenced in the table, a full set and double set of protective clothing typically includes the following items:

Full set of protective clothing:

- a. Coveralls.
- b. Cotton glove liners.
- c. Gloves.
- d. Shoe covers.
- e. Rubber overshoes.
- f. Hood.

Double set of protective clothing:

- a. Two pairs of coveralls.
- b. Cotton glove liners.
- c. Two pairs of gloves.
- d. Two pairs of shoe covers.
- e. Rubber overshoes.
- f. Hood.

Donning Protective Clothing

1. Cotton glove liners may be worn inside standard gloves for comfort, but will not be worn alone or considered as a layer of protection.
2. Shoe covers and gloves should be sufficiently durable for the intended use. Leather or canvas work gloves should be worn in lieu of or in addition to standard gloves for work activities requiring additional strength or abrasion resistance.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-35 of 3-41

3. Use of industrial safety equipment such as hard hats in contamination, high contamination, and airborne radioactivity areas should be controlled by the radiological work permit. Reusable industrial safety equipment designated for use in such areas should be distinctly colored or marked.
4. Shoe covers and gloves will be secured or taped at the coverall legs and sleeves when necessary to prevent worker contamination. Tape should be tabbed to permit easy removal.
5. Supplemental pocket or electronic dosimeters should be worn outside the protective clothing in a manner accessible to the worker. Workers should protect such dosimeters from contamination by placing them in an outer coverall pocket or in plastic bags or pouches.
6. Personal street clothing should not be worn under protective clothing for entry to high contamination areas or during work conditions requiring a double set of protective clothing.

Doffing Protective Clothing

Potentially contaminated protective clothing should be doffed without spreading contamination and in particular without contaminating the skin. Workers will be instructed not to touch the skin or place anything in the mouth during protective clothing removal.

Instructions for protective clothing removal comparable to the sequence presented below should be posted adjacent to the step-off pad in accordance with Article 325.6. The instructions can be placed in another area if space or conditions do not allow the posting at the step-off pad.

Recommended Sequence for Doffing a Full Set of Protective Clothing at the Step-Off Pad. Before stepping out of the contamination area or airborne radioactivity area to the step-off pad, the worker should:

1. Remove exposed tape.
2. Remove rubber overshoes.
3. Remove gloves.
4. Remove hood from front to rear.
5. Remove respiratory protection, as applicable.
6. Remove coveralls, inside out, touching inside only.
7. Take down barrier closure, as applicable.
8. Remove tape or fastener from inner shoe cover.
9. Remove each shoe cover, placing each shoe onto a clean step-off pad.
10. Remove cloth glove liners.
11. Replace barrier closure, as applicable.
12. Commence whole-body frisking.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-36 of 3-41

13. Monitor badge and dosimeter.

The sequence for the removal of primary and supplemental dosimetry depends on where the dosimetry was worn and the potential for contamination. The sequence for removal of respiratory protection devices may be altered if the potential for inhalation of airborne contamination or the spread of surface contamination can be reduced by keeping respiratory protection devices on until all protective garments have been removed.

Recommended Sequence for Doffing a Double Set of Protective Clothing Using Two Step-Off Pads. Before stepping to the inner step-off pad, the worker should:

1. Remove exposed tape.
2. Remove rubber overshoes.
3. Remove outer gloves.
4. Remove hood from front to rear.
5. Remove respiratory protection, as applicable.
6. Remove outer coverall, inside out, touching inside only.
7. Remove tape from inner coverall and sleeves.
8. Remove each outer shoe cover, stepping on inner step-off pad as each shoe cover is removed.

Before stepping to the outer step-off pad, the worker will:

9. Remove inner rubber gloves.
10. Remove inner coveralls, inside out, touching the inside only.
11. Take down the barrier closure, as applicable.
12. Remove tape or fastener from the inner shoe cover.
13. Remove each inner shoe cover, placing each shoe on a clean outer step-off pad.
14. Remove cotton glove liners.
15. Replace barrier closure, as applicable.
16. Commence whole-body frisking.
17. Monitor badge and dosimeter.

The sequence for the removal of primary and supplemental dosimetry depends on where the dosimetry was worn and the potential for contamination. The sequence for removal of respiratory protection devices may be altered if the potential for inhalation of airborne contamination or the spread of surface contamination can be reduced by keeping respiratory protection devices on until all protective garments have been removed.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-37 of 3-41

Use of Multiple Step-Off Pads

Multiple step-off pads should be used to control egress from high contamination areas. These pads define interim control measures within the posted area to limit the spread of contamination. The following controls apply:

1. The inner step-off pad should be located immediately outside the highly contaminated work area, but still within the posted area.
2. Egress from high surface contamination areas may be through contamination areas to a step-off pad.
3. The worker should remove highly contaminated outer clothing prior to stepping on the inner step-off pad.
4. Additional secondary step-off pads, still within the posted area, may be used as necessary to restrict the spread of contamination out of the immediate area.
5. The final or outer step-off pad should be located immediately outside the contamination area.

Doffing Potentially Contaminated Firefighter Clothing

To facilitate the rapid egress of firefighters whose protective clothing is potentially contaminated, Radiological Control personnel should direct the firefighter in doffing firefighter clothing, which is commonly called bunker gear, using the guidelines listed below. The clothing items should be doffed into a suitable drum with a bag liner, surveyed at the earliest opportunity, and returned to the Fire Department if the clothing meets appropriate radiological release criteria.

The procedure requires that an assistant help the firefighter remove the firefighter clothing.

1. Firefighter and Assistant: Remove the firefighter's self-contained breathing apparatus, as follows.
 - a. Firefighter: Place regulator in demand mode (as applicable).
 - b. Firefighter: Disconnect the self-contained breathing apparatus hose from the regulator and carefully pull down (if applicable) on the regulator.
 - c. Firefighter: Release the waist belt and chest strap.
 - d. Firefighter: Loosen both self-contained breathing apparatus shoulder straps.
 - e. Assistant (in appropriate radiological protective clothing): Support and remove the unit, and place it in the designated container.
2. Assistant: Loosen strap on helmet.
3. Firefighter: Bend forward (away from the radiological buffer area).
4. Assistant: Remove the helmet. Remove any duct tape from gloves. Place the helmet and tape in appropriate containers.
5. Firefighter: Extend arms horizontally.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-38 of 3-41

6. Assistant: Roll back the cuff of each sleeve to the edge of the gloves, remove the firefighter's gloves and place in an appropriate container, and give the firefighter new gloves.
7. Firefighter: Don new gloves.
8. Assistant: Remove the face-piece-carrying strap, if applicable, from around the firefighter's neck by placing the face-piece-carrying strap over the firefighter's head and down to the hose piece.
9. Assistant: Release the topcoat buckle, open the collar strap, and lower the collar.
10. Firefighter: Lean forward, reach to the back of the hood, grasp the hood at the bottom on the outside, and pull the hood over the head and down, clearing the face-piece hose.
11. Firefighter: Lean forward slightly, away from radiological buffer area, grasp the face piece, and push the face piece down away from the chin, then forward away from the body.
12. Firefighter: Unfasten the bunker coat, grasp the outside of the coat, and pull the coat slightly off shoulders. Remove gloves, then swing arms behind.
13. Assistant: Remove coat by pulling on the sleeves. Place coat in appropriate container.
14. Assistant: Change own gloves and assist firefighter in donning a new set of gloves.
15. Firefighter: Remove suspenders from shoulders, grasp top edge of bunker pants, and release connectors securing bunker pants.
16. Firefighter: Push bunker pants down over the outside of the boots.
17. Assistant: Help firefighter step out of boots and bunker pants into the radiological buffer area. Place remaining gear in appropriate container.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-39 of 3-41

Appendix 3C**Physical Access Controls for High
and Very High Radiation Areas**

1. One or more of the following shall be used for each entrance or access point to a high radiation area where radiation levels could cause an individual to exceed a whole-body dose of 1 rem in any 1 hour at 30 cm from the source or from any surface that the radiation penetrates [see 10 CFR 835.502(b)]:
 - a. 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 defining a high radiation area.
 - b. A device that functions automatically to prevent use or operation of the radiation source or field while personnel are in the area.
 - c. A control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the high radiation area and the supervisor of the activity are made aware of the entry.
 - d. Entryways that are locked, except during periods when access to the area is required, with positive control over each entry.
 - e. Continuous direct or electronic surveillance that is capable of preventing unauthorized entry.
 - f. A control device that automatically generates audible and visual alarm signals to (1) alert personnel in the area before use or operation of the radiation source and in sufficient time to permit evacuation of the area and (2) activate a secondary control device that will prevent use or operation of the source.
2. In addition to the above requirements, additional measures shall be implemented to ensure that individuals are not able to gain unauthorized or inadvertent access to very high radiation areas when dose rates are in excess of the posting requirements of Table 2-3 [see 10 CFR 835.502(c)].
3. Physical access controls over high and very high radiation areas shall be established in a manner that does not prevent an individual from leaving the area [see 10 CFR 835.502(d)].

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 3-40 of 3-41

Appendix 3D

Guidelines for Personnel Contamination Monitoring with Hand-Held Instruments

General Approach

1. Verify that the hand-held contamination monitoring instrument is in service, has a valid source check, is set to the proper scale, and that the audio output can be heard during frisking.
2. Hold the monitoring probe less than 1/2 in. from the surface being surveyed for beta and gamma contamination and approximately 1/4 in. for alpha contamination.
3. Move the probe slowly over the surface, with the probe face (lengthwise if rectangular) achieving maximum coverage to the surface being monitored, approximately 2 in. per second.
4. If the count rate increases during frisking, pause for 5 to 10 seconds over the area to provide adequate time for instrument response.
5. If the count rate increases to a value greater than a preestablished limit or the instrument alarms, remain in the area and notify Radiological Control personnel.
6. The whole-body frisk should take at least 2 to 3 minutes.

Sequence

1. Frisk the hands before picking up the probe.
2. Perform the frisk in the following order:
 - a. Head (pause at mouth and nose for approximately 5 seconds).
 - b. Neck and shoulders.
 - c. Arms (pause at each elbow for approximately 5 seconds).
 - d. Chest and abdomen.
 - e. Back, hips, and seat of pants.
 - f. Legs (pause at each knee for approximately 5 seconds).
 - g. Shoe tops.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: **3-41** of 3-41

- h. Shoe bottoms (pause at sole and heel for approximately 5 seconds).
 - i. Personnel and supplemental dosimeters.
3. Return the probe to its holder and leave the area. The probe should be placed on the side or face up to allow the next individual to monitor his/her hands before handling the probe.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 4-1 of 4-17

CHAPTER 4 CONTENTS

CHAPTER 4, RADIOACTIVE MATERIALS	4-2
Part 1, Radioactive Material Identification, Storage, and Control	4-2
Article 411, General	4-2
Article 412, Radioactive Material Labeling	4-2
Article 413, Radioactive Material Packaging	4-5
Article 414, Radioactive Material Storage	4-5
Part 2, Release and Transportation of Radioactive Material and Equipment	4-6
Article 421, Release to Controlled Areas	4-6
Article 422, Release to Uncontrolled Areas	4-8
Article 423, Transportation of Radioactive Material	4-8
Part 3, Sealed Radioactive Source Controls	4-11
Article 431, Sealed Radioactive Source Controls	4-11
Part 4, Solid Radioactive Waste Management	4-13
Article 441, Requirements	4-13
Article 442, Waste Minimization	4-13
Article 443, Mixed Waste	4-14
Part 5, Control of Radioactive Liquids and Airborne Radioactivity	4-14
Article 451, Minimization and Control of Radioactive Liquid Waste	4-14
Article 452, Control of Radioactive Drains	4-14
Article 453, Control of Airborne Radioactivity	4-15
Part 6, Support Activities	4-15
Article 461, Control and Monitoring of Personal Protective Equipment and Clothing	4-15
Article 462, Laundry	4-16
Article 463, Decontamination	4-16
Article 464, Vacuum Cleaners and Portable Air-Handling Equipment	4-16

TABLES

4-1. Radioactive material labeling	4-3
4-2. Exceptions from radioactive material labeling requirements.	4-4

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 4-2 of 4-17

CHAPTER 4, RADIOACTIVE MATERIALS**Part 1, Radioactive Material Identification, Storage, and Control****Article 411, General**

1. Materials in contamination, high contamination, or airborne radioactivity areas shall be considered contaminated until they are surveyed and released [see 10 CFR 835.1101(a)]. Any equipment or system component removed from a process that may have had contact with radioactive material will be considered contaminated until it is disassembled to the extent required to perform an adequate survey, surveyed, and shown to be free of contamination at levels exceeding the Table 2-2 values. These survey and release provisions do not apply to airborne radioactivity areas where only gaseous, short-lived radionuclides (with a half-life of 1 hour or less) are present. Detailed provisions for the release of materials from radiological areas to controlled and uncontrolled areas are provided in Article 421 and 422.
2. Radioactive material located within contamination, high contamination, or airborne radioactivity areas does not require specific labeling or packaging if sufficient information is provided to allow individuals to take appropriate protective actions [see 10 CFR 835.606(a)]. The information may be provided by means of postings, pre-job briefings, training, or other appropriate means.
3. The Radiological Control organization will develop response and notification requirements associated with a loss of radioactive material, including searches, internal investigations, documentation, and reporting. The Radiological Control organization will be notified in case of a loss of radioactive material.

Article 412, Radioactive Material Labeling

1. The regulations in 10 CFR 835 require labeling of individual containers of radioactive material and radioactive items except under certain specified conditions in which existing postings and control measures provide adequate warning [see 10 CFR 835.601(a) and 835.606(a)].
2. Postings and access control requirements for radiological areas generally provide sufficient personnel protection to negate the need for individual container or item labeling; however, items having removable contamination in excess of the Table 2-2 values will be labeled when used, handled, or stored in areas other than contamination, high contamination, or airborne radioactivity areas.
3. Required labels shall include the standard radiological warning trefoil and the words "CAUTION" or "DANGER" and "RADIOACTIVE MATERIAL" [see 10 CFR 835.605]. The "DANGER" label will be used when an individual exposed to, using, or handling the material could receive a dose equivalent exceeding any applicable administrative control level in 1 hour. The radiation-warning trefoil shall be black or magenta and imposed on a yellow background [see 10 CFR 835.601(a)].
4. Required labels shall provide sufficient information to permit individuals handling, using, or working in the vicinity of the labeled material to take appropriate actions to control

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 4-3 of 4-17

exposures [see 10 CFR 835.605]. The following information should be included on radioactive material labels to the extent appropriate to the radiological hazard created by the material and the education, training, and skills of the individuals who may be exposed to the hazards:

- a. Radionuclide(s).
 - b. Nature of material (e.g., a sealed radioactive source, a contaminated component, or an activated target).
 - c. Radiological hazard information (e.g., radiation and contamination levels).
 - d. Total quantity of radioactive material (in subunits or multiple units of curies).
 - e. Required precautions.
 - f. Name of surveyor.
 - g. Date of survey.
5. If an item is too small to be labeled with all of the desired information, the label should be applied to the device or storage location with sufficient information available to trace the item to the appropriate label.
 6. If a label is applied to packaged radioactive material, the label should be applied to the outside of the package or should be visible through the package.
 7. Radioactive materials and containers should be labeled in accordance with Table 4-1.
 8. Items and containers may be excepted from labeling requirements under the conditions listed in Table 4-2.

Table 4-1 Radioactive material labeling.

Material or Item	Required Labeling	Supplemental Labeling
Equipment, components, and other items that are radioactive or potentially radioactive, or have been exposed to radioactive contamination or activation sources.	Standard radiation warning trefoil, and	“CONTAMINATED” or “POTENTIALLY CONTAMINATED”
Sealed and unsealed radioactive sources or associated storage containers.	“CAUTION” or “DANGER”	
Equipment, components, and other items with actual or potential internal contamination.	and	“INTERNAL CONTAMINATION” or “POTENTIAL INTERNAL CONTAMINATION”
Components, equipment, or other items with fixed contamination.	“RADIOACTIVE MATERIAL” [see 10 CFR 835.605]	“FIXED CONTAMINATION”
CFR = Code of Federal Regulations		

RADIOLOGICAL CONTROL MANUAL	Identifier: PRD-183 Revision: 7 Page: 4-4 of 4-17
------------------------------------	---

Table 4-2. Exceptions from radioactive material labeling requirements.

Exception Criteria	Items Typically Excepted ^a
Material that is used, handled, or stored in radiological areas or radioactive material areas [see 10 CFR 835.606(a)(1)].	All radioactive material in radiological areas and radioactive material areas. This exception will not be applied to items (a) with removable contamination exceeding the Table 2-2 values and (b) stored outside of contamination, high contamination, or airborne radioactivity areas.
Material having a total quantity of radioactive material below one-tenth of the 10 CFR 835, Appendix E, values [see 10 CFR 835.606(a)(2)].	Items having extremely low levels of radioactive material content such as low-activity sealed radioactive sources, laundered personal protective equipment, and tools and equipment having low levels of fixed contamination.
Material that has been packaged, labeled, and marked in accordance with the applicable (e.g., DOE or the Department of Transportation) radioactive material transportation requirements [see 10 CFR 835.606(a)(3)].	Radioactive material packages awaiting shipment.
Material that is inaccessible, or accessible only to individuals authorized to handle or use them, or to work in the vicinity [see 10 CFR 835.606(a)(4)].	Material stored in locked areas or areas having strict physical and administrative entry controls that preclude unauthorized entry, or radioactive samples being handled or transported by authorized personnel.
Material that is installed in manufacturing, process, or other equipment [see 10 CFR 835.606(a)(5)].	Equipment or material such as piping, tanks, valves, instrument sensors, and test sources that are installed in immobile systems.
Material that consists solely of nuclear weapons or their components [see 10 CFR 835.606(a)(6)].	Nuclear weapons components.
<p>CFR = Code of Federal Regulations DOE = Department of Energy a. Caution must be exercised to ensure that the listed items actually meet the criteria established in the first column.</p> <p>Note: Caution also should be exercised to ensure that other applicable requirements (e.g., member of the public dose limits [see Table 2-1], training provisions [see Table 3-2], as low as reasonably achievable [ALARA] requirements [see Article 117], controlled area dose expectation [see Article 232]) will be met in the absence of radioactive material labels.</p>	

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 4-5 of 4-17

Article 413, Radioactive Material Packaging

1. Radioactive material that is outside contamination, high contamination, or airborne radioactivity areas and is confirmed or suspected of having removable radioactive contamination levels greater than Table 2-2 values should be securely wrapped in plastic or placed in a closed container.
2. Radioactive material with sharp edges or projections should be taped or additionally protected to ensure package integrity.
3. Radioactive material with removable or potentially removable contamination levels in excess of 100 times Table 2-2 values should have additional packaging controls such as double-wrapping or the use of plastic bags inside containers.
4. Yellow plastic wrapping material (or plastic wrapping materials emblazoned with yellow markings) should be used for packaging radioactive material and will not be used for nonradiological purposes. Translucent or clear plastic bags clearly marked with yellow stripes on both sides and the standard radiation symbol also may be used to package radioactive material.
5. The amount of combustible material used in packaging should be minimized.

Article 414, Radioactive Material Storage

1. Radioactive material in quantities exceeding the applicable 10 CFR 835, Appendix E, quantities shall be used, handled, and stored in a radioactive material area or other area posted in accordance with Articles 234, 235, or 236, as appropriate [see 10 CFR 835.2(a), radioactive material area, and 10 CFR 835.603 and 604].
2. Decontamination or disposal of radioactive material is the preferred alternative to long-term storage.
3. Each radioactive material area will be approved by the Radiological Control director or designee.
4. A custodian will be assigned responsibility for each radioactive material area. A custodian may have responsibility for more than one storage area.
5. The custodian should conduct walk-throughs of radioactive material areas monthly to check integrity of containers and wrapping materials.
6. The custodian will conduct annual or more frequent reviews of each radioactive material area, with emphasis on treatment, decontamination, movement of material to long-term storage locations, and disposal of unneeded material.
7. Storage of nonradioactive material in a radioactive material area is discouraged.
8. Outdoor storage of radioactive material is discouraged. In cases where outdoor storage is necessary, the integrity of containers or wrapping materials used should be ensured to prevent degradation from weathering and subsequent release of radioactive material.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 4-6 of 4-17

Material with high-integrity packaging such as the dry storage fuel casks and Type A drums do not require coverings for outside storage, nor do items with fixed contamination.

9. Radioactive material should be stored in a manner that reduces combustible loading. The use of cardboard containers for storage is discouraged.
10. Flammable or combustible materials should not be stored adjacent to radioactive material areas.
11. Fire protection measures such as smoke detectors, water sprinklers, and fire extinguishers should be considered when establishing a radioactive material area.
12. The area within a 2,000-ft radius of the Radiological and Environmental Sciences Laboratory (CFA-690) should, as far as practicable, be a low background-radiation area. New programs, projects and facilities requiring or using radioactive or fissile materials in excess of the quantities listed in 10 CFR 835, Appendix E, should not be located in this area. Existing usage of radioactive materials in this portion of the Central Facilities Area should not be increased, and additional radioactive materials will not be introduced into this area, except with the specific written approval of the Radiological and Environmental Sciences Laboratory director.

Part 2, Release and Transportation of Radioactive Material and Equipment

Article 421, Release to Controlled Areas

Once materials and equipment have been brought into radiological areas controlled for surface contamination or airborne radioactivity, comprehensive and time-consuming evaluations of the potential for contamination are required prior to releasing the material or equipment to a controlled area. Likewise, exposure of certain materials and equipment to a beam of neutrons or other particles produced in a nuclear reactor or particle accelerator may activate that material or equipment, resulting in the creation of radioactive material requiring controlled use, storage, and disposal. The necessity to evaluate the radiological characteristics of these materials and equipment and to implement appropriate controls provides substantial impetus to limit the amount of material and equipment brought into radiological areas and to prevent contamination or activation of materials and equipment that do enter these areas.

1. Accessible surfaces of material or equipment that has entered contamination, high contamination, or airborne radioactivity areas shall be surveyed prior to release from these areas to controlled areas [see 10 CFR 835.1101(a)]. Guidance for conducting these surveys is provided in the footnotes to Table 2-2.

Survey types and methods used are based on technical evaluations, including an analysis of radionuclides of concern. Radiological buffer area surveys may be used as the release survey provided that the survey meets the radiological criteria described in DOE O 5400.5 for unconditional release.

2. If an assessment of the prior use of the material or equipment indicates that inaccessible surfaces are not likely to be contaminated in excess of applicable limits, a complete

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 4-7 of 4-17

survey of accessible surfaces and documentation of the assessment may be an appropriate basis to release materials to the controlled area [see 10 CFR 835.1101(a)(2)].

3. If an assessment of the prior use of the material or equipment indicates that inaccessible surfaces are likely to be contaminated to levels in excess of the Table 2-2 values, then the material shall not be released from the radiological area, except as permitted under Article 421.5 or 421.6 [see 10 CFR 835.1101(a)(2)]. If it is necessary to release the material or equipment from the radiological area, the material or equipment will be disassembled to the extent necessary to perform adequate surveys.
4. Removable contamination levels shall be less than Table 2-2 values prior to releasing material and equipment for unrestricted use in controlled areas [see 10 CFR 835.1101(a)(1) and (a)(2)].
5. Material and equipment with fixed contamination levels that exceed the total contamination values specified in Table 2-2 and removable contamination levels less than the Table 2-2 values may be released for restricted use in controlled areas outside of radiological areas [see 10 CFR 835.1101(c) and (c)(1)]. The material or equipment shall be monitored routinely and clearly marked or labeled to alert individuals to the contaminated status [see 10 CFR 835.1101(c)(2)]. Written procedures should be developed to establish requirements for monitoring of the material or equipment and surrounding areas, control of access to these areas, authorized uses of the material or equipment, and contingency plans for the spread of radioactive contamination.
6. Material and equipment with total or removable contamination levels exceeding Table 2-2 values may be moved on-Site from one radiological area to another if appropriate monitoring is performed and appropriate controls are established and implemented [see 10 CFR 835.1101(b)]. These controls should include provisions for containment to the extent practicable, labeling in accordance with Article 412, monitoring and control of the transfer route and participating individuals, and control of spills.
7. The requirements of 10 CFR 835.1101 apply only to material and equipment that are radioactive as a result of the deposition of radioactive contamination. Although DOE has not established any specific controls over the release of other radioactive materials (e.g., activated materials, materials that are naturally radioactive, and volumes-contaminated substances) to controlled areas, the release of these materials is subject to other requirements of 10 CFR 835. The following regulatory requirements and guidance are applicable to the release of this type of material and equipment.
 - a. Controls shall be adequate to ensure compliance with the radiation safety training requirements of 10 CFR 835.901. Release of material and equipment to controlled areas may result in occupational or nonoccupational exposure of individuals to radiation. Chapter 6 contains provisions for implementing an appropriate training program.
 - b. Controls shall be adequate to ensure compliance with the 100 mrem in a year controlled area maximum TEDE [see 10 CFR 835.602]. Site-specific criteria

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 4-8 of 4-17

ensures that radioactive material and equipment released to the controlled area, in combination with other sources of radiation in the controlled area, will not result in any individual exceeding this dose expectation.

- c. Controls shall be adequate to ensure that the ALARA process is properly implemented [see 10 CFR 835.101 and 10 CFR 835.1001 through 1003]. Given the low levels of radioactivity that are likely to be present in material and equipment being considered for release to controlled areas, the controls should not be burdensome. Options that should be considered include retention in radiological areas, placement in specified areas with appropriate access restrictions and usage controls, posting, labeling or color-coding, storage for decay, removal of radioactive components, and disposal as radioactive waste.
8. When radioactive materials are moved outside of radiological areas, controls will be established to ensure that no unmonitored individual is likely to exceed a dose equivalent that would require monitoring in accordance with Articles 511 and 521.
9. Records for release of materials will describe the property, the survey date, the identity of the individual who performed the survey, the type and identification number of the survey instruments used, and the survey results. For small items and packages of similar items (such as boxes of tools or boxes of fasteners), creating a separate survey record for each item is not necessary. However, the survey record or log entry should provide traceability to the individual removing the item from the radiological area.

Article 422, Release to Uncontrolled Areas

1. Radiological criteria for releasing material to uncontrolled areas are described in DOE O 5400.5.

The survey that is required prior to release to uncontrolled areas may be a release survey from radiological buffer areas established for contamination control.

2. Guidance will be obtained from DOE O 5400.5 for getting approvals, on a case-by-case basis, for releasing material that has been contaminated in depth or volume, such as activated material or smelted contaminated material.
3. The criteria for unrestricted release of materials established in DOE O 5400.5 may be more stringent than those established in this manual for release to controlled areas.

Note: Such releases normally will be conducted in accordance with Table 2-2 and employ a documented technical basis when appropriate.

4. Material not immediately released after it is surveyed should be controlled to prevent contamination while awaiting release.
5. Radiological labeling should be removed from or defaced on material prior to release for unrestricted use.

Article 423, Transportation of Radioactive Material

1. Requirements are established in 49 CFR 171, "General Information, Regulations, and Definitions"; 172, "Hazardous Materials Table, Special Provisions, Hazardous Materials

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 4-9 of 4-17

Communications, Emergency Response Information, and Training Requirements”; and 173, “Shippers—General Requirements for Shipments and Packagings”; and 175, “Carriage by Aircraft”; 176, “Carriage by Vessel”; 177, “Carriage by Public Highway”; and 178, “Specifications for Packagings”; for inspecting and surveying packages, containers, and transport conveyances prior to transport via the public transportation system. These regulations apply to radioactive material transportation in commerce.

2. Two DOE orders, DOE O 460.1B, “Packaging and Transportation Safety,” and DOE O 460.2, “Departmental Materials Transportation and Packaging Management,” are used as the basis for providing requirements that conform with 49 CFR, “Transportation,” requirements for transportation of radioactive material using any conveyance. Radioactive material transportation activities performed in accordance with applicable transportation requirements (e.g., Department of Transportation or DOE requirements) are excluded, by 10 CFR 835.1(b)(4), from the requirements of 10 CFR 835. However, radioactive material transportation (as defined in 10 CFR 835) does not include preparation of materials for shipment, packaging and labeling, or performance of radiological monitoring required for occupational radiation protection. Therefore, these activities shall be conducted in accordance with 10 CFR 835 [see 10 CFR 835.2(a), radioactive material transportation, and 10 CFR 835.1(b)] and will be conducted in accordance with this manual.
3. When radioactive material exceeding a Type A quantity (as defined in 10 CFR 71, “Packaging and Transportation of Radioactive Material”) is received, radiation and contamination monitoring of the received packages shall be performed if the package is labeled in accordance with applicable transportation requirements (e.g., a Radioactive White I, Yellow II, or III label) [see 835.405(b)(1)] or the package has been transported as low specific activity material on an exclusive-use vehicle [see 835.405(b)(2)].
 - a. The external surfaces of all packages received from transportation should be monitored to determine the external radiation and contamination levels, unless the packaged materials are not capable of creating an external radiation or contamination hazard. These surveys are used to demonstrate compliance with Department of Transportation regulations and applicable DOE orders and to identify appropriate postings and access control measures. These measures will be established as soon as practicable after receipt.
 - b. Monitoring for radiation and contamination shall be performed when a received package containing greater than a Type A quantity of radioactive material shows evidence of degradation, such as packages that are crushed, wet, or damaged [see 835.405(b)(3)].
 - c. Monitoring for radiation and contamination of received packages of radioactive material shall be performed as soon as practicable following receipt, but no later than 8 hours following the beginning of the working day following the receipt of the package [see 835.405(d)].

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 4-10 of 4-17

4. The removable contamination values in Table 2-2 are more limiting than the 49 CFR 173.443, "Contamination control," requirements and should be used as the controlling values for on-Site and off-Site transportation when using a conveyance that is owned by DOE. However, when a shipment is received from an off-Site destination, by a non-DOE conveyance, the 49 CFR 173.443 contamination values will be applied to all subsequent on-Site transfers to the ultimate on-Site destination.
5. Only the removable contamination values in Table 2-2 apply to shipping requirements. However, surveys should be conducted for both fixed and removable contamination [see 10 CFR 835, Appendix D]. Fixed contamination may be masked by direct radiation from the container or the contents of the shipping container. The shipment will be labeled as required to identify direct radiation hazards.
6. On-Site transfers over nonpublic thoroughfares will be performed in accordance with written procedures adhering to pre-approved routes. The procedures or other measures should include requirements to ensure appropriate monitoring and control of the radioactive material and should be approved by the Radiological Control organization. Radioactive material should not be carried through designated food preparation, serving, or eating areas.
7. On-Site transfers over public thoroughfares by non-DOE conveyance will be performed in accordance with Department of Transportation, state, and local shipping requirements and pre-approved agreements. On-Site transfers over public thoroughfares by DOE conveyance should be performed in accordance with DOE G 460.1-1, "Packaging and Transportation Safety," and other applicable DOE orders and will conform to state and local shipping requirements and pre-approved agreements.
8. Before shipment and upon receipt of a radioactive material shipment, a visual inspection of packages should be performed to ensure that packages are not damaged. The inspection should identify dents, flaking paint, debris, package orientation, and any indication of leakage.
9. Before shipment and upon receipt of a radioactive material shipment, packages should be inventoried against the shipping manifest to ensure accountability.
10. Transport conveyances should be inspected visually prior to loading to ensure the trailers are acceptable for the intended use.
11. Transport conveyances should be radiologically surveyed before loading, especially when using commercial carriers specializing in radioactive transport. The surveys should be adequate to identify any contamination remaining on the vehicle from previous radioactive material transport evolutions, so that neither DOE nor the Site contractor would be held liable.
12. 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.
13. The Site emergency plan should describe appropriate responses for potential on-Site radioactive material transportation accidents.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 4-11 of 4-17

14. Drivers of DOE and non-DOE motor vehicles should have a copy of their emergency response plan, or the emergency response information required by 49 CFR 172.600, “Applicability and general requirements,” during transport on-Site or during off-Site transportation.
15. If packages containing quantities of radioactive material in excess of a Type A quantity (as defined at 10 CFR 71.4) are expected to be received from radioactive material transportation, arrangements shall be made to either take possession of the package when the carrier offers it for delivery or receive notification as soon as practicable after arrival of the package at the carrier’s terminal and to take possession of the package expeditiously after receiving such notification. [see 10 CFR 835.405(a)].
16. Written procedures for safely opening packages will be developed and maintained. These procedures should include due consideration of the type of package and potential hazards present.

Part 3, Sealed Radioactive Source Controls

Article 431, Sealed Radioactive Source Controls

Sealed radioactive sources having activities equal to or exceeding the values specified in 10 CFR 835, Appendix E [see 10 CFR 835.2(a)], are considered accountable sealed radioactive sources.

1. Written procedures should be established and implemented to control accountable sealed radioactive sources. These procedures should establish requirements for source acquisition, receipt, storage, transfer, inventory, leak testing, usage, and disposal of sources when no longer needed.
2. Accountable sealed sources and all other sealed radioactive sources having activities exceeding one-tenth of the 10 CFR 835, Appendix E, values, or their storage containers, shall be labeled with the radiation symbol and “CAUTION” or “DANGER” and “RADIOACTIVE MATERIAL” [see 10 CFR 835.605]. The label also shall provide sufficient information to control exposures [see 10 CFR 835.605]. Because of the wide variety of labels that manufacturers affix to sealed radioactive sources, these labels are excepted from the normal color scheme of magenta or black on yellow [see 10 CFR 835.606(b)]. If the size or configuration of the source precludes application of a suitable label, the label should be attached to the source container or mechanism.

Note: Consumer product exempt sources marked as radioactive by the manufacturer normally should be considered to meet 10 CFR 835.605 labeling requirements.

3. Each accountable sealed radioactive source shall be inventoried at intervals not to exceed 6 months [see 10 CFR 835.1202(a)]. This inventory shall:
 - a. Establish the physical location of each accountable sealed radioactive source.
 - b. Verify that the associated posting and labeling are adequate.
 - c. Establish that storage locations, containers, and devices are adequate.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 4-12 of 4-17

4. Each accountable sealed radioactive source shall be subject to a source leak test upon receipt, when damage is suspected and at intervals not to exceed 6 months [see 10 CFR 835.1202(b)]. Source leak tests shall be capable of detecting radioactive material leakage equal to or exceeding 0.005 μCi (as indicated by the presence of 0.005 μCi or more activity on the leak test sample) [see 10 CFR 835.1202(b)].
5. Periodic leak tests need not be performed if the source has been documented as removed from service. Such sources shall be stored in a controlled location and subject to periodic inventory in accordance with Article 431.3 and subject to leak testing prior to being returned to service [see 10 CFR 835.1202(c)].
6. As allowed by 10 CFR 835.1202(d), if a source is located in an area that is unsafe for human entry or is otherwise inaccessible (such as resulting from operational or environmental constraints), then periodic inventories and leak tests need not be performed. When the conditions that restrict access to the area have been terminated, the inventory and integrity test should be performed before allowing uncontrolled access to the area.
7. If an accountable sealed radioactive source is found to be leaking radioactive material, then controls shall be established to prevent the escape of radioactive material to the workplace [see 10 CFR 835.1202(e)]. These controls should include wrapping or containing the source, applying appropriate labels, and removing the source from service.
8. Both accountable and nonaccountable sealed radioactive sources shall be used, handled, and stored in a manner commensurate with the hazards associated with the operations involving the sources [see 10 CFR 835.1201].
9. Sealed radioactive sources having activities below one-tenth of 10 CFR 835, Appendix E, values should be labeled consistent with Article 412 and should be controlled to ensure their retention and proper use and storage.
10. Procurement of radioactive sources should be coordinated with the Radiological Control organization.
11. Receipt surveys of radioactive material shipments should be performed by the Radiological Control organization in accordance with Article 423.
12. Sealed radioactive sources, including radiography sources, should not be brought on-Site by external organizations without the prior knowledge and approval of the Radiological Control organization.
13. A custodian should be appointed to coordinate sealed radioactive source procurement, issue, inventory, leak testing, disposal, and other aspects of the sealed radioactive source control program.
14. Exempt sources may be controlled using the processes established to meet 10 CFR 835.1202 to reduce the need for redundant administrative processes. However, they will not be subject to the leak testing and inventory activities.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 4-13 of 4-17

Part 4, Solid Radioactive Waste Management**Article 441, Requirements**

1. DOE O 435.1, "Radioactive Waste Management"; DOE M 435.1-1, "Radioactive Waste Management Manual"; and the DOE G 435.1-1 series describe how solid radioactive waste is treated, packaged, stored, transported, and disposed of.
2. Radiological operations generating radioactive waste shall be designed and developed to promote minimization and permit segregation, monitoring, treatment, storage, and disposal [see DOE O 435.1 and DOE M 435.1].
3. Radioactive waste minimization goals and practices shall be developed and implemented [see DOE O 435.1 and DOE M 435.1].

Article 442, Waste Minimization

A radioactive waste minimization program shall be in effect to reduce the generation of radioactive waste and the spread of contamination from contamination, high contamination, or airborne radioactivity areas [see DOE O 435.1 and DOE M 435.1]. The following practices should be evaluated and instituted as appropriate to support waste minimization:

1. Restrict material entering radiological buffer areas and other areas surrounding radiological areas to only that required to perform work.
2. Restrict quantities of hazardous materials such as 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 these materials.
3. Substitute recyclable or burnable items in place of disposable ones and reuse equipment, chemicals, solvents, and cleaners when practical.
4. Select consumable materials such as protective coverings and clothing that are compatible with waste-processing systems, volume reduction, and waste-form acceptance criteria.
5. 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.
6. Survey potentially contaminated material from radiological areas to separate uncontaminated from contaminated materials.
7. Segregate known uncontaminated waste from potentially contaminated waste.
8. Segregate reusable items such as protective clothing, respirators, and tools at the step-off pad.
9. Minimize the number and size of radioactive material areas.
10. Emphasize training in waste reduction philosophies, techniques, and improved methods.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 4-14 of 4-17

Article 443, Mixed Waste

Requirements specified in the Resource Conservation and Recovery Act (42 USC 6901, 1976) and Toxic Substances Control Act (15 USC 2601, 1976) apply to waste that contains both radioactive and hazardous materials.

1. Technical and administrative controls should be established to minimize the volume of mixed waste generated and the amount of radioactivity in such waste. Volume reduction methods include process optimization, materials substitution, and new technology development.
2. Materials suspected of being mixed waste should be identified and segregated as soon as practical in the generating process to avoid combining mixed waste with other waste forms.

Part 5, Control of Radioactive Liquids and Airborne Radioactivity**Article 451, Minimization and Control of Radioactive Liquid Waste**

Criteria for minimizing the generation of radioactive liquid waste are provided in DOE O 435.1, DOE M 435.1-1, and the DOE G 435.1-1 series. Radioactive liquid waste discharge requirements are provided in DOE O 5400.5.

Article 452, Control of Radioactive Drains

Radioactive drain systems are designed to transport radioactive liquids. Improper use may cause an environmental release.

1. Radioactive drain systems should not discharge to the environment or be used to dispose of nonradioactive liquids. Drain systems that have been specifically approved by regulatory agencies, meet the intent of this requirement.
2. Existing radioactive drains should be evaluated to ensure the following:
 - a. Verification of the existing radioactive drain piping configuration.
 - b. Installation of flow-indicating devices in leak-off lines.
 - c. Use of plugs to prevent nonradioactive input.
 - d. Consideration of alternative work controls before systems are drained for maintenance.
 - e. Controls prohibiting unauthorized use of drains.
3. Modifications to the design or operation of existing radioactive drain systems should be controlled to include:
 - a. Design considerations that prevent nonradioactive drain connections into radioactive drains.
 - b. Procedural and design controls to prevent cross-connections of radioactive drains with nonradioactive systems.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 4-15 of 4-17

- c. Management review of subsequent changes to the design of radioactive drain systems or radioactive drain controls.
- d. Management controls to restrict the introduction of hazardous waste into radioactive drain systems.

Article 453, Control of Airborne Radioactivity

1. The Radiological Control organization should be notified when engineering controls that prevent worker exposure to airborne radioactivity, such as barriers, gloveboxes, and glovebags, are compromised. An evaluation should be made of continuing operations with compromised engineering controls. The use of respiratory protection to continue activities under these conditions is not the preferred method of controlling worker exposures. Implementation of short-term engineering modifications that provide a commensurate level of worker protection is the preferred alternative.
2. Preventive maintenance and surveillance procedures should be established to ensure that equipment controls are maintained in an operable condition for containment of airborne radioactivity.

Part 6, Support Activities**Article 461, Control and Monitoring of Personal Protective Equipment and Clothing**

1. Except for disposable, single-use items, protective clothing designated for radiological control use should be specifically identified by color, symbol, or appropriate labeling.
2. Protective clothing designated for radiological control use should not be used for nonradiological work.
3. Launderable items specifically designated for training purposes should be appropriately marked.
4. Personal protective equipment and clothing should not be stored with personal street clothing.
5. Cleaned personal protective equipment such as face shields and respirators that comes into contact with the wearer's face and company-issued clothing (other than protective clothing used for contamination control purposes) should be surveyed prior to use. Contamination levels should be below Table 2-2 contamination values prior to reuse. The use of statistically representative sampling is acceptable.
6. Laundered protective clothing should be surveyed and should meet the following criteria prior to reuse:
 - a. Beta-gamma radioactivity less than 10,000 dpm/100 cm².
 - b. Alpha radioactivity less than 1,000 dpm/100 cm² for transuranics and other alpha emitters in the same Table 2-2 category, and less than 10,000 dpm/100 cm² for uranium.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 4-16 of 4-17

7. The Site contractor will work with the contracted laundry provider to continue efforts to reduce contamination levels on reusable personal protective equipment and clothing.
8. Cleaned personal protective equipment and laundered protective clothing should be inspected prior to use. Clothing should be free of tears, separated seams, deterioration, and damage or repaired in a manner that provides the original level of protection.

Article 462, Laundry

Laundry service at the Site is subcontracted. The following specifications apply:

1. Clothing and equipment should be laundered according to facility, color, type, and level of contamination.
2. Clothing and equipment should be screened before laundering to segregate those that are damaged, present special handling problems, or require disposal.

Article 463, Decontamination

1. All RWPs and technical work documents should include provisions to control contamination at the source to minimize the amount of decontamination required.
2. Work preplanning should include consideration of the handling, temporary storage, and decontamination of materials, tools, and equipment.
3. Decontamination activities should be controlled to prevent the spread of contamination.
4. Water and steam are the preferred decontamination agents. Other cleaning agents should be selected based on their effectiveness, hazardous properties, amount of waste generated, and ease of disposal.
5. Facility line management should be responsible for directing decontamination efforts.
6. Efforts should be made to reduce the level of contamination and the number and size of contaminated areas that cannot be eliminated.

Article 464, Vacuum Cleaners and Portable Air-Handling Equipment

Improper use of vacuum cleaners and portable air-handling equipment may result in the generation of airborne radioactivity, removable contamination, and high dose rates.

1. Vacuum cleaners and portable air-handling equipment used in areas established to control removable surface contamination or airborne radioactivity (except areas where only tritium is present) should be equipped with high-efficiency particulate air (HEPA) filters.
2. All HEPA filters used in vacuum cleaners and portable air-handling equipment should meet the applicable efficiency and construction requirements for the devices in which they are installed. The maximum flow rate of the device should not exceed the flow rate at which the HEPA filter was efficiency tested.
3. In addition, the device should be tested prior to initial use, when units have undergone any type of service that may compromise the integrity of the HEPA filter or its sealing surfaces, and annually. The filter integrity test is an in-place test that consists of injecting a challenge aerosol upstream from the HEPA filter. A challenge aerosol is a synthetic

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 4-17 of 4-17

hydrocarbon used for in-place HEPA-filter integrity testing because of its wide range of particulate sizes and preponderance of particulate 0.3 micron in diameter, the smallest particulate a HEPA filter is designed to filter. Upstream and downstream challenge aerosol concentrations are measured. The ratio of downstream-to-upstream concentrations represents the HEPA filter leak rate. The maximum allowable HEPA filter leak rate is 0.03% unless a different value has been established by a technical basis.

4. Maintenance on the equipment should be conducted in accordance with the manufacturer's instructions.
5. Appropriate standards for system design, construction, maintenance, and testing are provided in ASME N509-2002, "Nuclear Power Plant Air-Cleaning Units and Components"; ASME N510-1989, "Testing of Nuclear Air Treatment Systems"; and ASME AG-1-1997, "Code on Nuclear Air and Gas Treatment." Several of the DOE 3020 series of technical standards (e.g., DOE-STD-3020-97, "Specification for HEPA Filters Used by DOE Contractors"; DOE-STD-3022-98, "DOE HEPA Filter Test Program"; DOE-STD-3025-99, "Quality Assurance Inspection and Testing of HEPA Filters"; and DOE-STD-3026-99, "Filters Test Facility Quality Program Plan") provide additional information applicable to HEPA-filtered systems.
6. Vacuum cleaners used for radiological work will be checked before use to verify that they are:
 - a. Marked and labeled in accordance with Article 412 and with the testing expiration date.
 - b. Controlled by written work authorizations for other than low-risk routine cleanup.
 - c. Controlled to prevent use in nonradiological applications.
 - d. Designed to ensure HEPA-filter integrity under the conditions specified for use.
 - e. Constructed and controlled to prevent unauthorized or accidental access to the inner surfaces of the vacuum.
7. Radiation and contamination surveys should be performed periodically for vacuum cleaners in use and labels on these units will be updated. The frequency of radiation surveys should depend on the specific use of the vacuum cleaner.
8. Airborne radioactivity levels should be monitored when a vacuum cleaner is used in a high contamination area.
9. A criticality safety evaluation should be performed and documented prior to the use of a vacuum cleaner for fissile material.

RADIOLOGICAL CONTROL MANUAL

Identifier:	PRD-183
Revision:	7
Page:	5-1 of 5-19

CHAPTER 5 CONTENTS

CHAPTER 5, RADIOLOGICAL HEALTH SUPPORT OPERATIONS	5-2
Part 1, External Dosimetry	5-2
Article 511, General Provisions	5-2
Article 512, Technical Provisions for External Dosimetry	5-3
Article 513, Pocket and Electronic Dosimeters	5-4
Article 514, Area Monitoring Dosimeters	5-5
Article 515, Nuclear Accident Dosimeters	5-5
Part 2, Internal Dosimetry	5-6
Article 521, General Provisions	5-6
Article 522, Technical Provisions for Internal Dosimetry	5-7
Article 523, Technical Provisions for Dose Assessment	5-8
Part 3, Respiratory Protection Program	5-9
Article 531, General Provisions	5-9
Article 532, Medical Assessment	5-9
Article 533, Use of Respiratory Protection	5-9
Article 534, Heat Stress	5-10
Article 535, Half-Face Respirators	5-10
Part 4, Handling Radiologically Contaminated Personnel	5-11
Article 541, Skin Contamination	5-11
Article 542, Contaminated Wounds	5-11
Article 543, Handling Individuals Exposed to Airborne Radioactivity	5-12
Part 5, Radiological Monitoring	5-12
Article 551, General Provisions	5-12
Article 552, Radiation Exposure Monitoring	5-14
Article 553, Area Radiation Monitors	5-14
Article 554, Contamination Monitoring	5-15
Article 555, Airborne Radioactivity Monitoring – Approved Routine Facility	5-16
Part 6, Instrumentation and Calibration	5-17
Article 561, Standardization	5-17
Article 562, Inspection, Calibration, and Performance Tests	5-17
Article 563, Maintenance	5-18
Article 564, Calibration Facilities	5-18

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 5-2 of 5-19

CHAPTER 5, RADIOLOGICAL HEALTH SUPPORT OPERATIONS**Part 1, External Dosimetry****Article 511, General Provisions**

1. Personnel dosimetry shall be provided to and used by individuals as follows:
 - a. Radiological workers who are expected to receive from external sources an effective dose equivalent of 100 mrem or more in a year or a dose equivalent to the extremities, lens of the eye, or skin of 10% or more of the corresponding limits specified in Table 2-1 [see 10 CFR 835.402(a)(1)].
 - b. Declared pregnant workers who are expected to receive from external sources a dose equivalent of 50 mrem or more to the embryo/fetus during the gestational period [see 10 CFR 835.402(a)(2)].
 - c. Occupationally exposed minors likely to receive a dose in excess of 50 mrem in a year from external sources [see 10 CFR 835.402(a)(3)].
 - d. Members of the public entering a controlled area likely to receive a dose in excess of 50 mrem in a year from external sources [see 10 CFR 835.402(a)(4)].
 - e. Individuals entering a high or very high radiation area [see 10 CFR 835.402(a)(5)].
2. Neutron dosimetry shall be provided when an individual is likely to exceed any of the criteria provided in Article 511.1 from neutrons [see 10 CFR 835.401(b)(2) and 10 CFR 835.402(a)].
3. Dosimeters should be issued only to individuals knowledgeable of their proper use and worn only by those to whom the dosimeters were issued.
4. To minimize the number of individuals in the dosimetry program, issuing dosimeters is discouraged except to individuals entering areas where the likelihood of external exposure exceeds the monitoring thresholds established in Article 511.1.
5. Individuals should return dosimeters for processing as scheduled or upon request.
6. Individuals should wear their TLD (unless otherwise stated, TLD is the primary dosimeter) on the chest area, on or between the waist and the neck, or in the manner prescribed by radiological control procedures or work authorizations.
7. The practice of taking TLDs off-Site is discouraged, except to storage areas established at town facilities.
8. Individuals should not wear dosimeters issued by their resident facilities while being monitored by a dosimeter at another facility unless authorized by the Radiological Control director or designee.

Note: Transportation Safeguard Division couriers who have been provided with primary dosimeters from Sandia National Laboratories (SNL) should not be issued Site primary dosimeters (TLDs). However, facilities may issue supplemental direct-reading dosimeters

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 5-3 of 5-19

to the SNL couriers, and may elect to maintain records of the dose indicated by the supplemental direct-reading dosimeters (DRDs) or electronic dosimeters (ED). Transportation Safeguard Division dosimeters are processed quarterly by SNL. Therefore, the records should not be retained more than one quarter beyond the date when SNL processes the Transportation Safeguard Division dosimeters. The supplemental DRD and ED record provide objective evidence of dose received at the Site. The information would support SNL in performing a dose investigation for the couriers if an anomalous primary dosimeter reading were obtained.

9. Individuals should not expose their dosimeters to security x-ray devices, excessive heat, or medical sources of radiation.

Note: If such exposure inadvertently occurs, individuals should report the event to the appropriate facility Radiological Control personnel.

10. An individual whose dosimeter is lost, damaged, or contaminated should place work in a safe condition, immediately exit the area, and report the occurrence to the Radiological Control organization. The individual should be restricted from entry into radiological areas until a review has been conducted and management has approved reentry. A dose assessment should be performed for each instance of a lost, damaged, or contaminated personnel dosimeter.

Article 512, Technical Provisions for External Dosimetry

1. External dosimetry programs shall be adequate to demonstrate compliance with Table 2-1 limits [see 10 CFR 835.402(b)]. The requirements for accreditation of personnel external dosimetry monitoring programs by the DOE Laboratory Accreditation Program (DOELAP) are specified in DOE-STD-1095-95, "Department of Energy Laboratory Accreditation Program for Personnel Dosimetry Systems." Technical basis documents on the personal photon-beta dosimeter and the neutron dosimeter have been developed for the external dosimetry program. Personnel external dosimeters include, but are not limited to, TLDs, track-etch dosimeters, film badges, and neutron-sensitive film. External dosimetry programs implemented to meet the requirements of Article 511.1 shall meet at least one of the following criteria:
 - a. Accredited by DOELAP [see 10 CFR 835.402(b)(1)],
Or
 - b. Excepted from accreditation by the DOELAP [see 10 CFR 835.402(b)(1)],
Or
 - c. Otherwise approved by the DOE Assistant Secretary for Environment, Safety and Health [see 10 CFR 835.402(b)(2)].
2. The technical basis document addresses dosimeters used for monitoring radiation outside the scope of DOELAP, such as dosimetry associated with high-energy accelerators and extremity dosimeters.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 5-4 of 5-19

3. The Site contractor should participate in intercomparison studies for external dosimetry programs.
4. Multiple dosimeters should be issued to individuals to assess the deep-dose equivalent in nonuniform radiation fields. Nonuniform radiation fields exist when the dose to a portion of the whole body will exceed the dose to the TLD by more than 50% and the anticipated whole-body dose is greater than 100 mrem. Standard HPS N 13.41-1997, "Criteria for Performing Multiple Dosimetry," describes the methodology used to determine the dose of record when multiple dosimeters are used and when TLDs are relocated on workers.
 - a. When the radiation field is well characterized and the worker's orientation is known, relocation of the TLD is permitted in lieu of issuing multiple dosimeters. Under such conditions, the individual's TLD will be relocated to the portion of the whole body likely to receive the highest dose. Radiological Control personnel should determine the location of the TLD.
 - b. Dosimeter relocation will be conducted to conform to facility procedures or specific work authorizations such as RWPs.
5. A dose assessment should be performed for each instance of a lost, damaged, or contaminated personnel dosimeter.
6. Permanent monitoring programs implemented at the discretion of the Site contractor (i.e., for personnel monitoring that is not required by Article 511.1) need not be accredited under the DOELAP. Programs implemented outside the scope of DOELAP should include:
 - a. Documented assessment of each individual's potential occupational dose to support the decision to operate outside the DOELAP. Such assessments should be based on facility design reviews, the results of a comprehensive workplace-monitoring program, and if available, the result of previous individual monitoring results.
 - b. Comprehensive routine surveys of areas that may be entered by these individuals to ensure that individual doses are not likely to exceed Article 511.1 monitoring thresholds.

Article 513, Pocket and Electronic Dosimeters

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

1. Each individual entering a high radiation or very high radiation area shall be monitored by a supplemental dosimetry device or other means capable of providing an immediate estimate of the individual's integrated deep-dose equivalent during the entry. [see 10 CFR 835.502(a)(2)]. At any facility/project a supplemental, alarming, electronic dosimeter should be used by individuals entering into a high radiation, locked high radiation area, or very high radiation area (see Article 334 for entry requirements). Supplemental ED also will be issued when planned activities could cause an individual to

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 5-5 of 5-19

exceed 50 mrem or 10% of a facility administrative control level from external gamma radiation in 1 work day, whichever is greater, or when required by an RWP. While not an issue with electronic dosimeters because of their large measurement range, pocket dosimeters, which are used only in special cases, will be selected with the lowest range applicable (typically 0 to 200 mR) for anticipated personnel exposures.

2. Supplemental dosimeters, in general a DRD or an ED, should be worn adjacent to the TLD and located in accordance with Article 511.6.
3. Supplemental dosimeters should be read periodically while in use. Work should be stopped if a DRD exceeds 75% of full scale.
4. Individual exposures above 100 mrem for a job will be specifically authorized by appropriate ALARA review and RWP. If specified exposure limits are reached or exceeded, work will be stopped and Radiological Control management consulted prior to continuing the work.
5. The energy dependence and radiation sensitivity of supplemental dosimeters, particularly to low-energy beta and neutron radiation, will be considered in determining their applicability and need for correction factors.
6. When the dose totals from the DRD or ED differ from the TLD by more than 50% and the TLD dose is greater than 100 mrem, an investigation will be initiated to explain the difference.

Article 514, Area Monitoring Dosimeters

Establishment and maintenance of a comprehensive area-monitoring program can minimize the number of areas requiring personnel dosimeters and would demonstrate that doses outside radiological areas are negligible. Minimizing the number of personnel dosimeters issued reduces dosimetry program operational costs and costs associated with maintaining personnel with enhanced training and qualifications.

1. Area monitoring dosimeters should be used to record and document radiation levels in routinely occupied areas adjacent to areas where radiation exists and radiological operations are conducted. This monitoring provision does not apply when the radiation arises solely from low-energy beta sources (e.g., C-14 or tritium).
2. Area monitoring dosimeter results should be used to support dosimetry investigations where individuals express concerns about their work environments and exposure to ionizing radiation.
3. Area monitoring dosimeters should be used in controlled areas to supplement existing monitoring programs and to provide data in the event of an emergency.

Article 515, Nuclear Accident Dosimeters

1. Facilities that possess fissile material in sufficient quantities to potentially constitute a critical mass that could result in excessive exposure of individuals to radiation from a nuclear accident shall provide nuclear accident dosimetry to all affected individuals [see 10 CFR 835.1304(a)].

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 5-6 of 5-19

2. The nuclear accident dosimetry system shall include the following:
 - a. A method to conduct initial screening of potentially exposed individuals to identify those who have received significant doses [see 10 CFR 835.1304(b)(1)].
 - b. Equipment and methods sufficient to analyze appropriate biological samples [see 10 CFR 835.1304(b)(2)].
 - c. A system of fixed nuclear accident dosimeter units [see 10 CFR 835.1304(b)(3)] capable of measuring the estimated neutron dose and approximate neutron spectrum.
 - d. Personnel nuclear accident dosimeters [see 10 CFR 835.1304(b)(4)].
3. The fixed dosimeters discussed above should be capable of the following:
 - a. Determining the neutron dose from 10 rads to approximately 10,000 rads with an accuracy of $\pm 25\%$.
 - b. Measuring fission gamma radiation from 10 rads to approximately 10,000 rads in the presence of neutron radiation with an accuracy of approximately $\pm 25\%$.
4. Personnel nuclear accident dosimeters should be capable of measuring an absorbed dose in or on a phantom from 10 rads to approximately 1,000 rads with an accuracy of $\pm 25\%$.
5. An analysis of the fixed dosimetry system needs should be documented and should consider such factors as the nature of operations, the structural design of the facility, area accessibility, the number of dosimeters and their location, and the effect of intervening shielding. The analysis should be reevaluated as necessary to ensure that facility modifications do not impair the capabilities of the fixed dosimetry system.

Part 2, Internal Dosimetry

Article 521, General Provisions

1. The following individuals shall participate in an internal dosimetry program:
 - a. Radiological workers who are likely to receive a CEDE of 100 mrem or more from all radionuclide intakes in a year [see 10 CFR 835.402(c)(1)].
 - b. Declared pregnant workers likely to receive intakes resulting in a dose equivalent to the embryo/fetus of 50 mrem or more during the gestational period [see 10 CFR 835.402(c)(2)].
 - c. Occupationally exposed minors likely to receive a CEDE in excess of 50 mrem from all radionuclide intakes in a year [see 10 CFR 835.402(c)(3)].
 - d. Members of the public who enter a controlled area and are likely to receive an intake resulting in a CEDE exceeding 50 mrem in a year [see 10 CFR 835.402(c)(4)].
2. The estimation of internal dose shall be based on bioassay data rather than air concentration values unless one of the following conditions exists [see 10 CFR 835.209(b)]:

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 5-7 of 5-19

- a. Bioassay data are unavailable.
 - b. Bioassay data are inadequate.
 - c. Internal dose estimates based on representative air concentration values are demonstrated to be as or more accurate.
3. Individuals should participate in follow-up bioassay monitoring when their routine bioassay results indicate an intake in the current year with a CEDE of 100 mrem or more.
 4. Individuals whose routine duties may involve exposure to surface or airborne contamination or to radionuclides readily absorbed through the skin, such as tritium, should be considered for participation in the bioassay program.
 5. The bioassay program should establish appropriate frequencies for the collection of bioassay samples such as urine or fecal samples and participation in bioassay monitoring such as whole body or lung counting. Individuals should participate at the frequency required by the bioassay program.
 6. Individuals should be notified promptly of positive bioassay results and the results of dose assessments and subsequent refinements. Dose assessment results shall be provided in terms of rem or millirem [see 10 CFR 835.2(b), dose term definitions, and 10 CFR 835.4].

Article 522, Technical Provisions for Internal Dosimetry

1. All bioassay programs implemented to demonstrate compliance with Article 521.1 shall meet at least one of the following criteria:
 - a. Accredited by DOELAP in accordance with the provisions in DOE-STD-1112-98, "The Department of Energy Laboratory Accreditation Program for Radiobioassay" [see 10 CFR 835.402(d)(1)],
Or
 - b. Excepted from accreditation by DOELAP [see 10 CFR 835.402(d)(1)],
Or
 - c. Otherwise approved by the Assistant Secretary for Environment, Safety and Health [see 10 CFR 835.402(d)(2)].
2. A Site wide technical basis document shall be developed for the internal dosimetry program.
3. Baseline bioassay monitoring of individuals who are likely to receive intakes resulting in a CEDE greater than 100 mrem in 1 year should be conducted before they begin work that may expose them to internal radiation exposure.
4. Routine bioassay monitoring methods and frequencies should be established for individuals who are likely to receive intakes resulting in a CEDE greater than 100 mrem in a year. The technical basis for the methods and frequency of bioassay monitoring should be documented.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 5-8 of 5-19

5. Management will determine whether a termination bioassay monitoring is required when a radiological worker terminates employment or concludes work involving the potential for internal exposure. The number of people failing to achieve this monitoring should be reviewed periodically and used to determine whether further efforts to get cooperation are warranted.
6. Bioassay monitoring should be performed when any of the following occurs:
 - a. Facial or nasal contamination is detected that indicates a potential for internal contamination exceeding any monitoring threshold established in Article 521.
 - b. Airborne monitoring indicates the potential for intakes exceeding 100 mrem CEDE.
 - c. Upon direction of the Radiological Control organization when an intake is suspected.
7. Levels of intake that warrant the consideration of medical intervention are established for Site-specific radionuclides. The effectiveness of medical intervention, such as blocking or chelating agents, should be documented using bioassay results.
8. A preliminary assessment of any intakes detected should be conducted prior to permitting an employee to return to radiological work.
9. Internal dosimetry program personnel should use radionuclide standards from or traceable to the National Institute of Standards and Technology.
10. Internal dosimetry program personnel should participate in the conduct of intercomparison studies and will use the "DOE Phantom Library."
11. Bioassay programs implemented at the discretion of the Site contractor—that is, personnel monitoring not required by Article 521.1—need not be accredited under DOELAP. Programs implemented outside the scope of DOELAP should include:
 - a. Documented assessment of each individual's potential occupational exposure to support the decision to operate outside the DOELAP.
 - b. Comprehensive monitoring of the areas that may be entered by these individuals to ensure that individual doses are not likely to exceed the Article 521.1 monitoring thresholds.

Article 523, Technical Provisions for Dose Assessment

1. Interpretations of bioassay results and subsequent dose assessments should include the following:
 - a. Radionuclide characteristics such as the chemical and physical form.
 - b. Bioassay results and the individual's previous exposure history.
 - c. Exposure information such as route of intake and time and duration of exposure.
 - d. Biological models used for dosimetry of radionuclides.
 - e. Models to estimate intake or deposition and to assess dose.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 5-9 of 5-19

- f. Intradepartmental coordination between the Radiological Control organization and the Occupational Medical organization for doses that may require medical intervention.

Part 3, Respiratory Protection Program

Respiratory protection equipment includes respirators with particulate or gas-filtering cartridges, supplied air respirators, self-contained breathing apparatus, and air-line supplied-air suits and hoods.

Article 531, General Provisions

1. Use of respiratory protection shall be reduced to the minimum practicable by implementing engineering controls and work practices to contain radioactivity at the source [see 29 CFR 1910.134].
2. Respiratory protection requirements at facilities/projects are controlled by the Site Industrial Hygiene Respiratory Protection Program.
3. Respirator shall be issued based on the specific types required by the specific conditions only to individuals who are trained, fitted, and medically qualified to wear the specific type of respirator to be issued [see 29 CFR 1910.134 and ANSI Z88.2-1992].
4. Positive controls should be maintained for the issue, use, and return of respirators to ensure that only qualified individuals wear respirators.
5. Facility safety analyses should not take credit for the use of respiratory protection for routine work involving potential exposure to airborne radioactive materials.

Article 532, Medical Assessment

Each prospective respirator wearer shall have a medical assessment prior to being fit-tested in accordance with Articles 531.2 and 531.3 [see 29 CFR 1910.134 and ANSI Z88.2-1992].

Article 533, Use of Respiratory Protection

The use of respiratory protection devices can impair worker mobility and vision, causing workers discomfort and stress. For these reasons, the issue and use of respiratory protective devices must be controlled.

Individuals using respiratory protection shall:

1. Perform fit checks of close-fitting respirators to ensure a proper seal before entering areas requiring respirator use.
2. Be clean shaven in the area of fit, if applicable.
3. Use corrective lenses, if required, that are approved for respirators.
4. Be trained to leave the work area when experiencing respirator failure.
5. Be trained to remove their respirators to avoid life-threatening situations when or before exiting an area after respirator failure [see 29 CFR 1910.134 and ANSI Z88.2-1992].

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 5-10 of 5-19

Article 534, Heat Stress

Heat stress may result from working in areas of high heat, humidity, and radiant heat; working in protective clothing; and using respirators, particularly where other protective equipment is required. Heat stress has occurred at ambient temperatures lower than 70°F (21°C) when multiple sets of protective clothing or plastic suits were in use or strenuous work was required.

Note: Removal of personal protective equipment will take precedence over radiological controls when necessary to prevent personnel injury.

1. The planning stages for work in hot environments should address heat stress controls in accordance with the Site Industrial Hygiene Respiratory Protection Program.
2. Job supervisors should inform their personnel of heat stress precautions prior to commencing work on job assignments in hot environments. Precautions that should be considered during work that includes a high probability of heat stress include the following:
 - a. Engineering controls to moderate the work area environment.
 - b. Appropriate stay-time controls.
 - c. Use of protective clothing made of materials that wick perspiration away from the body.
 - d. Use of body cooling devices.
 - e. Provision of beverages at or near the work site, using appropriate contamination controls.
 - f. Relaxation of protective clothing requirements.
3. If an individual begins to feel symptoms of heat illness, the individual should immediately notify the nearest coworker, exit the area, remove personal protective equipment, notify the supervisor, and rest in a cool area. In such cases, medical assistance should be provided.

Article 535, Half-Face Respirators

Half-face respirators have limited applications in the radiation protection program because of the design of the facial seal area. As a result, their permitted protection factor is low. Full-face respirators are generally preferred over half-face respirators because of the significant increase in protection offered with minimal loss of worker comfort.

1. The use of half-face respirators is permitted in situations where intakes of radioactive material will be low, such as those resulting in a few millirem, and where industrial and safety considerations warrant, such as during the operation of heavy equipment.
2. The use of half-face respirators must have the approval of the Radiological Control director or his designee for use with radiological material.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 5-11 of 5-19

Part 4, Handling Radiologically Contaminated Personnel**Article 541, Skin Contamination**

1. When workers detect skin contamination, they should notify the Radiological Control organization.
2. The extent of skin contamination should be determined prior to or in conjunction with initiating decontamination procedures.
 - a. Decontamination should be initiated as soon as practicable to reduce the individual dose. This action may be concurrent with further actions to determine the extent of skin contamination. Contaminants should be retained, as practicable, to aid in the analysis process. Skin contamination measurements may be used to evaluate dose.
3. Skin decontamination methods should be established for Site-specific radionuclides as appropriate. Skin abrasion should be avoided during the decontamination process. Intrusive decontamination methods such as tissue removal require medical assistance.
4. Skin dose assessments are required if the dose exceeds 100 mrem. Particles (with an area less than 1 cm²) causing a count rate exceeding 6,000 counts per minute (on a survey instrument with a pancake Geiger-Mueller (GM) probe) for 1 hour, may cause a 100 mrem dose to the skin.
5. Individuals with skin contamination that triggers the need for dose assessment should be informed of the initial dose estimate to their skin as soon as practicable, preferably prior to the end of their work day.
6. Individuals with skin contamination for which dose assessment was not performed should be informed of the nature of the contamination and an upper estimate on the potential dose (such as less than 10 mrem) as soon as practicable, preferably prior to the end of their work day.
7. An assessment of skin exposure requires time to conduct a detailed evaluation. Requirements for assessments are provided in Appendix 2A. Promptly after completion, the results should be explained to the affected individuals.

Article 542, Contaminated Wounds

1. Emergency medical care should be administered immediately for injuries involving radioactive materials in accordance with the National Council on Radiation Protection (NCRP) Report 65, *Management of Persons Accidentally Contaminated with Radionuclides* (NCRP 1980). Medical treatment of injuries takes precedence over radiological control considerations.
2. The treatment of contaminated injuries should include the following:
 - a. Treatment of contaminated wounds by medically qualified personnel.
 - b. Monitoring of wounds and associated bandages for contamination including alpha emitters if applicable.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 5-12 of 5-19

- c. Identification of the radionuclides involved.
 - d. Medical determination of the need for therapeutic intervention such as blocking or chelating agents.
 - e. Initiation of appropriate bioassay monitoring.
 - f. Determination of the need for work restrictions.
3. An injured individual should be counseled promptly on the medical and radiological implications resulting from contaminated wounds that result in internal doses greater than 2% of Table 2-1 limits. The counseling should be performed by senior Radiological Control personnel and medical professionals.

Article 543, Handling Individuals Exposed to Airborne Radioactivity

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

1. Identify individuals potentially exposed to airborne radioactivity.
2. Obtain nasal smears for a qualitative indication of intakes where appropriate.
3. Analyze air samples to determine airborne concentrations where appropriate.
4. Determine the duration of potential exposure to airborne radioactivity.
5. Perform bioassay appropriate for the type and quantity of radionuclides involved.
6. Evaluate dose prior to permitting the worker to return to radiological work.

Part 5, Radiological Monitoring**Article 551, General Provisions**

Workplace monitoring provides a basis for posting and labeling, development of RWPs and other work authorizations, implementation of ALARA measures, issuance of individual monitoring devices, and verification of the efficacy of design measures and engineering controls. Development of a workplace monitoring program sufficient to meet the provisions of this chapter should include consideration of the following factors to ensure the adequacy of the program.

1. Radiological monitoring of radiation exposure levels, contamination, and airborne radioactivity shall be conducted to:
 - a. Characterize workplace conditions and detect changes in those conditions [see 10 CFR 835.401(a)(2) and (3)].
 - b. Verify the effectiveness of physical design features and engineering and process controls [see 10 CFR 835.401(a)(5)].
 - c. Demonstrate regulatory compliance [see 10 CFR 835.401(a)(1)].

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 5-13 of 5-19

- d. Detect the gradual buildup of radioactive material in the workplace [see 10 CFR 835.401(a)(4)].
 - e. Identify and control potential sources of personnel exposure [see 10 CFR 835.401(a)(6)].
 - f. For high or very high radiation areas, monitor as necessary during access to determine the exposure rates to which the individuals are exposed. [see 10 CFR 835.502(a)(1)].
2. Monitoring shall be performed only by individuals who have the appropriate education, training, and skills [see 10 CFR 835.103]. The instruments used shall be [see 10 CFR 835.401(b)]:
 - a. Periodically maintained and calibrated.
 - b. Appropriate for the types, levels, and energies of radiation to be detected.
 - c. Appropriate for existing environmental conditions.
 - d. Routinely tested for operability.
 3. Monitoring for radiation, contamination, and airborne radioactive materials should be performed as specified in technical work documents and RWPs.
 4. Portable instruments used to perform radiation monitoring will be response-checked daily or prior to operation during normal work periods. When response checks indicate abnormal operation, the instrument should be taken out of service.

Note: During nonworking and reduced activity periods, such as weekends and holiday periods, in areas where only operational or safety-related tours and routine inspections are conducted, daily response checks of the portable survey instruments are not required.
 5. Weekly performance checks, using a known source will be conducted on in-use portable instruments. When performance checks are not within $\pm 20\%$ of the expected value, the instrument should be taken out of service. When performance checks are not feasible, such as with instruments used to measure neutrons or tritium, compensatory actions should be established to ensure proper instrument performance.
 6. Sample/smear counting instruments (scalers) should be performance-checked daily or prior to operation. Facilities will determine performance check/response check requirements for contamination monitors (e.g., portal, hand and foot) and document in a technical procedure or Engineering Design File.
 7. Emergency equipment such as Fire Department kits and facility emergency kits will be performance checked monthly and after use.
 8. Neutron, unique research and development, and tritium instruments will be performance checked monthly or prior to use or as established in a technical basis document.
 9. Monitoring of radiological conditions should include a sufficient number of survey points to characterize the radiation present to verify boundaries and the effect on adjacent areas.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 5-14 of 5-19

10. Monitoring should be performed before, during, and at the completion of work that has the potential for causing changes in levels of radiation and radioactivity.
11. Monitoring frequencies should be established based on potential radiological conditions, probability of change in conditions, and area occupancy factors.
12. Monitoring results should be reviewed by the cognizant facility/project Radiological Control foreman to ensure that all required surveys have been performed and that the documentation is accurate and complete as a record. Periodic trending reports should be submitted to cognizant Radiological Control management.
13. Results of current surveys or survey maps should be available to inform personnel of the radiological conditions.
14. Survey results should be made available to line management and used in support of pre- and post-job evaluations, preparation or selection of appropriate RWPs, ALARA preplanning, contamination control, and management of radiological control operations.

Article 552, Radiation Exposure Monitoring

1. In addition to the requirements of Article 551, routine radiation monitoring programs should be established to ensure that surveys are performed at a frequency that is consistent with the existing and potential hazards and activities planned in the area. Survey frequencies in routinely occupied areas will be as established in facility approved routines using the following guidelines:
 - a. Quarterly, in office space located in radiological buffer areas and other areas surrounding radiological areas where the potential exists for external radiation exposure.
 - b. Annually, for operating HEPA-filtered ventilation units. An alternate survey frequency may be established based on a documented technical evaluation of system use and accessibility.
 - c. Upon entry, and when levels are expected to change in high radiation areas.
2. Radiation monitoring should include dose rate measurements of the general area, dose rates at a distance of 30 cm from a source or surface of interest to evaluate potential whole-body exposures, and dose rates on contact with potential sources of radiation where a potential exists for hands-on work or other direct contact.

Article 553, Area Radiation Monitors

1. In addition to the requirements and recommendations of Article 551, area radiation monitors should be installed in frequently occupied locations with the potential for unexpected increases in dose rates and in remote locations where a local indication of dose rates is required prior to personnel entry.
2. The necessity and placement of area radiation monitors for worker protection should be documented and assessed when changes to facilities, systems, or equipment occur.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 5-15 of 5-19

3. If installed instrumentation is removed from service for maintenance or calibration, a radiation monitoring program providing similar detection capability should be maintained, consistent with the potential for unexpected increases in radiation dose rates.
4. Where an area radiation monitor is incorporated into a safety interlock system, the circuitry should be configured so that a failure of the monitor either prevents entry into the area or prevents operation of the radiation-producing device. If the circuitry is required to ensure compliance with the high radiation area access control requirements of 10 CFR 835.502, then the circuitry shall be fail-safe.

Article 554, Contamination Monitoring

1. In addition to the requirements of Article 551, contamination monitoring programs should be established to ensure that surveys are performed at a frequency that is consistent with the existing and potential hazards and activities planned in the area. Survey frequencies in routinely occupied areas are as established in facility-approved routines using the following guidelines:
 - a. Prior to transfer of equipment and material from high contamination areas within the same radiological buffer area unless precautions such as bagging or wrapping are taken prior to transfer.
 - b. Monthly for change areas.
 - c. Weekly for step-off pads when in use.
 - d. Daily in high-potential areas.
 - e. Weekly, in routinely occupied radiological buffer areas.
 - f. During initial entry into a known or suspected contamination area, periodically during work, at completion of job, or as specified in a radiological work permit.
 - g. Annually, in areas of fixed contamination.
2. Site buses and other government vehicles should be periodically surveyed. Survey frequencies should be based on historical and current use of a vehicle.
3. Contamination surveys should incorporate techniques to detect both removable and fixed contamination.
4. Smear surveys for removable contamination should be recorded in units of disintegrations per minute per 100 cm² (dpm/100 cm²). For smear surveys of small items covering less than 100 cm², the results should be recorded in units of dpm per area smeared. If contamination levels exceed the range of the available count rate meters, the smears should be analyzed by holding an appropriate exposure rate meter within ½ in. and the results should be recorded in units of rad or millirad per hour.
5. Large area wipes are encouraged and should be used to supplement standard smear techniques in areas outside of contamination areas and high contamination areas. If an evaluation indicates that an area wiped is contaminated, a more thorough contamination

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 5-16 of 5-19

smear survey should be performed. If no contamination is detected on large area wipes, no smear survey is necessary.

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

Article 555, Airborne Radioactivity Monitoring

Survey frequencies in routinely occupied areas are as established in facility-approved routines using the following guidelines:

1. In addition to the requirements of Article 551, air monitoring programs should be established to ensure that airborne radioactivity monitoring is performed at a frequency that is consistent with the existing and potential hazards and activities planned in the area. Selection of air monitoring equipment should be based on the specific job being monitored. Air monitoring equipment includes portable and fixed air sampling equipment and continuous air monitors.
2. Air sampling equipment shall be used where an individual is likely to receive an annual exposure of 40 or more DAC-hours [see 10 CFR 835.403(a)(1)]. This intake generally represents a CEDE to an individual of approximately 100 mrem. Samples also shall be taken as necessary to characterize the hazard in areas where respiratory protection devices have been prescribed for protection against airborne radionuclides [see 10 CFR 835.403(a)(2)]. Air samples should be adequate to evaluate the concentrations of airborne radioactive materials at the individual’s work locations.
3. Continuous(or real-time) air monitors are used to provide early warning to individuals of events that could lead to substantial unplanned exposures to airborne radioactivity. Such exposures could result from a breakdown of engineered controls or improper establishment of boundaries during work that creates airborne radioactivity. Real-time air monitoring shall be performed as necessary to detect and provide warning of airborne radioactivity concentrations that warrant immediate action to terminate inhalation of airborne radioactive material [see 10 CFR 835.403(b)].
4. Air sampling equipment should be positioned to measure air concentrations to which individuals are exposed. If this cannot be achieved, a program of personal breathing-zone air sampling should be initiated.
5. Air monitoring equipment shall be routinely calibrated and maintained on an established frequency [see 10 CFR 835.401(b)]. Air monitoring equipment should be calibrated at least once each year. Continuous air monitors should be capable of measuring 1 DAC when averaged over 8 hours (8 DAC-hours) under laboratory conditions.
6. Real-time air monitoring equipment required by Article 555.3 should have alarm capability and sufficient sensitivity to alert individuals that immediate action is necessary to minimize or terminate inhalation exposures.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 5-17 of 5-19

7. A technical basis document should be developed for the airborne-radioactivity monitoring program. The technical basis document should provide the basis for air monitor selection, placement, and operation.
8. The proper operation of continuous air monitoring (CAM) equipment should be verified weekly by performing an operational check. Operational checks should include (1) positive airflow indications, (2) non-zero response to background activity, (3) internal check of 60 Hz electronic checks when available (4) instrument response with a check source, (5) complete a CAM Filter change. Facility Radiological Control personnel should routinely review response check data, if a CAM shows an increase in rate of failure during the weekly check then an increase in response checks may be warranted or the CAM should be taken out of service until repairs have been completed.

Part 6, Instrumentation and Calibration

Article 561, Standardization

Standardization of the use of commercially available radiological instrumentation at the Site is encouraged.

Article 562, Inspection, Calibration, and Performance Tests

1. Radiological instruments shall be used only to measure the radiation for which their calibrations are valid [see 10 CFR 835.401(b)(2)]. Two standards, ANSI N323-1978, "Radiation Protection Instrumentation Test and Calibration," and ANSI Z540.1-1994, "Calibration Laboratories and Measuring and Test Equipment General Requirements," provide the guidance for establishing and operating a radiological instrumentation calibration program. Calibrations should use National Institute of Standards and Technology traceable standards, intrinsic standards, or international standards approved by the Health Physics Instrument Laboratory manager. When traceability to international or national standards of measurement is not cost effective, traceability requirements may be satisfied by any one of the following:
 - a. Participation in a suitable program of interlaboratory comparisons or proficiency testing.
 - b. Internationally accepted standards.
 - c. Suitable reference materials.
 - d. Ratio or reciprocity-type measurements.
 - e. Mutual consent standards that are clearly specified and mutually agreed upon by all parties concerned.
2. Calibration procedures will be developed for each radiological instrument type and should include frequency of calibration, precalibration requirements, primary calibration requirements, periodic performance test requirements, calibration record requirements, and maintenance requirements.
3. All radiological monitoring instruments, including pocket and electronic dosimeters and area radiation monitors, shall be maintained and calibrated at an established frequency

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 5-18 of 5-19

[see 10 CFR 835.401(b)(1)]. Calibration frequencies will be determined and documented based on the guidance in National Conference of Standards Laboratories Recommended Practice RP-1, "Establishment and Adjustment of Calibration Intervals," or national consensus standard ANSI N323.

4. The effects of environmental conditions including interfering radiation on an instrument shall be known prior to use [see 10 CFR 835.401(b)(3)].
5. Operational tests should be used to assess instrumentation designs that include alarms or that involve a process control. An operational test should be developed to test all components involved in an alarm or trip function and performed at least annually.
6. In unusual and limited situations, using an instrument in an application other than that envisioned by the manufacturer may be necessary. Special calibrations should be performed for use of instrumentation outside manufacturer's specifications. The instrument should be adjusted, calibrated, and labeled to identify the special conditions and used only under the special conditions for which it was calibrated.
7. Measures should be implemented to ensure that individuals using an instrument can verify its calibration status.
8. Instruments whose "as found" readings indicate that the instrument may have been used while out of calibration should be reported to the Radiological Control organization. The Radiological Control organization should conduct and document reviews of surveys performed with the instrument while it was out of calibration and consider the need for additional surveys.

Article 563, Maintenance

1. A program for preventive and corrective maintenance of radiological instrumentation should be established and documented.
2. Preventive and corrective maintenance should be performed using components and procedural recommendations at least as stringent as those specified by the manufacturer of the instrument.
3. Radiological instruments should undergo calibration prior to use following any preventive or corrective maintenance or any adjustment that voids the previous calibration. A battery change normally is not considered maintenance.
4. Radiological instruments containing internal calibration sources should be maintained by authorized maintenance or repair personnel. If the internal source needs to be removed, it should be removed in accordance with a technical work document.

Article 564, Calibration Facilities

1. Radiological monitoring instrument inspections, calibrations, performance tests, calibration equipment selection, and quality assurance should be performed in accordance with the recommendations of ANSI N323-1978. Responsible individuals should complete the following actions:

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: **5-19** of 5-19

- a. Locate activities in a manner to control radiation exposure to operating personnel and to personnel in adjacent areas.
- b. Minimize sources of interference, such as backscatter and nonionizing radiation, during the calibration of instrumentation and correct for any interference as necessary.
- c. Operate in accordance with the referenced standards.
- d. Generate records in accordance with the referenced standards.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 6-1 of 6-15

CHAPTER 6 CONTENTS

CHAPTER 6, TRAINING AND QUALIFICATION	6-2
Part 1, Radiological Control Training and Qualification.....	6-2
Article 611, Purpose.....	6-2
Article 612, Standardization	6-2
Article 613, General Provisions.....	6-3
Article 614, Instructor Training and Qualifications.....	6-5
Part 2, General Employee Radiological Training	6-5
Article 621, Site Personnel	6-5
Article 622, Radiological Safety Training and Orientation for Members of the Public.....	6-6
Part 3, Radiological Worker Training	6-7
Article 631, General Provisions.....	6-7
Article 632, Radiological Worker I	6-8
Article 633, Radiological Worker II	6-8
Article 634, Specialized Radiological Worker Training.....	6-9
Part 4, Radiological Control Technician and Radiological Control Technician Foreman Qualification	6-9
Article 641, General Provisions.....	6-9
Article 642, Radiological Control Technician.....	6-9
Article 643, Qualification Standards for Radiological Control Technicians	6-10
Article 644, Oral Examination Boards.....	6-10
Article 645, Continuing Training.....	6-11
Article 646, Radiological Control Technician Foremen	6-11
Article 647, Subcontracted Radiological Control Technicians	6-11
Part 5, Other Radiological Training	6-12
Article 651, Management Training.....	6-12
Article 652, Technical Support Personnel.....	6-12
Article 653, Planners.....	6-13
Article 654, Radiological Control Personnel.....	6-13
Article 655, Radiographers and Radiation Generating Device Operators	6-13
Article 656, Emergency Response Personnel.....	6-14
Part 6, Training For Special Applications	6-15
Article 661, Plutonium Facilities	6-15
Article 662, Uranium Facilities	6-15
Article 663, Tritium Facilities	6-15
Article 664, Accelerator Facilities	6-15

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 6-2 of 6-15

CHAPTER 6, TRAINING AND QUALIFICATION

Part 1, Radiological Control Training and Qualification

Article 611, Purpose

The provisions of this chapter ensure that individuals are trained to work safely in and around radiological hazards and to maintain their individual radiation exposure and the radiation exposures of others ALARA. Training provisions in this chapter apply to individuals entering controlled areas at the facility/project and other individuals who are responsible for developing and implementing radiological control measures.

Article 612, Standardization

Requirements are established in 10 CFR 835.901 for radiation safety training programs for two classes of individuals: (1) individuals who are permitted unescorted access to controlled areas or occupationally exposed to radiation and (2) individuals who are permitted unescorted access to radiological areas or perform unescorted assignments as a radiological worker. In this manual, these training programs are referred to as General Employee Radiological Training (GERT) and Radiological Worker I and II training, respectively. In addition, 10 CFR 835.103 establishes requirements for the education, training, and skills of individuals who are responsible for developing and implementing measures necessary for ensuring compliance with 10 CFR 835. In establishing local training programs, DOE core courses will be used to the extent practicable and supplemented with Site-specific information.

1. Radiation safety training programs are necessary to ensure compliance with 10 CFR 835.901. Training programs for members of the public, general employees, and radiological workers will be developed consistent with Parts 2, 3, and 6 of this chapter to ensure compliance with these requirements. Additional training programs consistent with those discussed in Parts 5 and 6 of this chapter may be necessary to provide appropriate compliance with the education, training, and skills requirements of 10 CFR 835.103. Affected individuals may include, but not be limited to, managers, supervisors, technical specialists, researchers, clerks, and engineers.
2. DOE core course training material, Site-specific training materials, or other equivalent courses are used when required to satisfy the training requirements of both 10 CFR 835.901 and 10 CFR 835.103. DOE standardized courses that are available include:
 - a. General Employee Radiological Training.
 - b. Radiological Worker I and II training.
 - c. Radiological Control Technician training.
 - d. Radiological Assessor training.
 - e. Radiological Support Personnel training.
 - f. Radiological Control Training for Supervisors.
 - g. Higher-Level Training for Supervisors.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 6-3 of 6-15

- h. Radiological Safety Training for Plutonium Facilities.
 - i. Radiological Safety Training for Tritium Facilities.
 - j. ALARA Training for Technical Support Personnel.
 - k. Radiological Safety Training for Radiation Producing Devices.
 - l. Radiological Contamination Control Training for Laboratory Research.
 - m. Radiological Safety Training for Uranium Facilities.
 - n. Radiological Safety Training for Accelerator Facilities.
3. Successful completion of the entire core academic component of a DOE core course at one DOE site within the past 2 years normally will be recognized. Allowances also may be made for individuals who have successfully completed other types of radiological control training. Documentation of previous training should include the individual's name, date of training, topics covered, and name of the certifying official. However, under these circumstances, any additional radiological control training necessary for the individuals to perform radiological work or to enter specific areas, including Site-specific aspects of the radiation safety training, shall be completed [see 10 CFR 835.901(c)]. Site-specific training for GERT and Radiological Worker I and II training may be included with other Site orientation training.
4. At sites with multiple facilities, the training may be facility-specific if personnel access is limited to those facilities for which training has been completed.

Article 613, General Provisions

1. Radiation safety training shall include the following topics, to the extent appropriate to each individual's prior training, work assignments, and degree of exposure to potential radiological hazards:
 - a. Risks of exposure, including prenatal radiation exposure, to radiation and radioactive materials [see 10 CFR 835.901(c)(1)].
 - b. Basic radiological fundamentals and radiation protection concepts [see 10 CFR 835.901(c)(2)].
 - c. Physical design features, administrative controls, limits, policies, procedures, alarms, and other measures implemented at the facility to manage doses and maintain doses ALARA, including both routine and emergency actions [see 10 CFR 835.901(c)(3)].
 - d. Individual rights and responsibilities as related to implementation of PLN 260 [see 10 CFR 835.901(c)(4)].
 - e. Individual responsibilities for implementing ALARA measures [see 10 CFR 835.901(c)(5)].
 - f. Individual exposure reports that may be requested [see 10 CFR 835.901(c)(6)].

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 6-4 of 6-15

2. Prior to permitting an individual to enter a radiological area unescorted or perform unescorted radiological work, training commensurate with the hazard in the area and required controls shall be completed [see 10 CFR 835.901(b)]. Table 3-2 provides guidance about the level of training appropriate for each defined area. Examinations and performance demonstrations shall be used to demonstrate satisfactory completion of initial radiological worker training [see 10 CFR 835.901(b)]. Examinations shall be used to demonstrate satisfactory completion of biennial Radiological Worker training and any additional training provided to address significant changes in radiation protection policies and procedures. Examinations should be written, unless, the Radiological Control director approves alternatives to accommodate special needs. Alternative examinations will be equivalent in content to written examinations. The examination process will require the following:
 - a. Exclusion of true/false questions and open-book examinations.
 - b. Use of questions randomly selected from the question bank.
 - c. Acknowledgment by signature that the student participated in a post-examination review.
 - d. Measuring of competence in required skills using performance-based examinations.
 - e. Remedial actions for failure to meet the minimum score.
 - f. Use of questions that test what the student is expected to remember months after the training rather than to test short-term memory of theoretical material.
3. Training will address both normal and abnormal situations in radiological control.
4. General Employee Radiological Training and radiological worker training shall be completed at intervals not to exceed 24 months [see 10 CFR 835.901(e)]. This biennial training should not be limited to subjects with which the students are already familiar, but will include applicable lessons learned and topics that will increase the students' knowledge of radiological hazards and controls. Training also shall be provided to affected individuals when a significant change has been made to the radiation protection program [see 10 CFR 835.901(e)]. Changes to the radiation protection program will be incorporated into the training program on a periodic basis.
5. Measures should be implemented to ensure that each individual's current training status can be assessed as necessary to ensure appropriate job assignments and to permit effective entry control. Appropriate measures include electronic databases or wallet-sized training certificates that identify current training status.
6. Site-specific training and refresher training should include changes in requirements and applicable updates of lessons learned from operations and maintenance experience and occurrence reporting, for the Site and across the DOE complex.
7. Verification of the effectiveness of radiation safety training should be accomplished by evaluating workers in the workplace, generally accomplished during the management self-assessment program. This verification is in addition to performance evaluations

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 6-5 of 6-15

routinely performed by facility training departments. The results will be documented and may be used to identify the need for remedial training.

8. Training programs developed for radiation safety should meet the requirements for performance-based training.
9. Reading and comprehension skills in the English language are generally necessary for radiation safety training. The Radiological Control director is authorized to approve alternative measures for those lacking reading and comprehension skills in the English language until adequate English language skills can be achieved. Training in an alternate language should be equivalent to training in English. The alternative measures should be sufficient to ensure that the affected individuals can respond appropriately to any audible or visible warnings that they may encounter in the facility. Orientation and the use of trained escorts provide an alternate to training with the concurrence of the Radiological Control director.
10. Additional requirements for personnel training are established in DOE O 5480.20A, "Personnel Selection, Qualification, and Training for DOE Nuclear Facilities."
11. The Site Radiological Control director or designee will concur in radiation safety training material.
12. Requirements and guidance for training records and course documentation are provided in Article 725.

Article 614, Instructor Training and Qualifications

1. All instructors should be qualified in accordance with the Instructor Qualification Program or possess equivalent qualifications. Training also may be conducted by Radiological Control management to provide feedback, lessons learned, or expectations.
2. Instructors should have the technical knowledge, experience, and instructional skills required to fulfill their assigned duties.
3. Instructors-in-training should be monitored by a qualified instructor.
4. Subject-matter experts without instructor qualification may provide training in their areas of expertise. However, these subject-matter experts should be trained as instructors when this occurs routinely.

Part 2, General Employee Radiological Training

A summary of the employee activities requiring GERT is provided in Table 3-2. In special cases, escorted access to controlled areas is allowed without completing the training, however, facility/project employees should complete GERT to ensure that they are personally aware of the hazards and controls associated with access to controlled areas.

Article 621, Site Personnel

1. Site general employees shall complete radiation safety training prior to unescorted access to controlled areas and prior to receiving occupational radiation exposure during access to controlled areas [see 10 CFR 835.901(a)]. This training shall address the radiation safety

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 6-6 of 6-15

training topics in Article 613.1 to the extent appropriate for the degree of exposure to radiological hazards that may be encountered and the required controls [see 10 CFR 835.901(a)].

2. General Employee Radiological Training will include DOE core course training materials, as applicable, and will be expanded to include Site-specific information such as Site-specific radiation types, alarm responses, and policies.
3. Site general employees may challenge GERT core knowledge requirements by passing a comprehensive examination. If unsuccessful in one attempt, the entire GERT standardized core training should be completed. Challenges should not apply to the Site-specific portions.
4. Additional training beyond GERT should be required for unescorted entry into radiological buffer areas or areas posted for radiological control other than controlled areas. As stated in Table 3-2, GERT is adequate for unescorted entry in radiologically controlled areas where an individual is likely to receive less than or equal to 0.1 rem in a year. In radiological buffer areas, GERT should be supplemented with completion of training and practical demonstration of conducting a proper self-survey with beta-, gamma-, and alpha-contamination monitoring instrumentation.
5. Information may be communicated by classroom lecture, videotape, or other appropriate methods.
6. To complete requalification training during alternate years, the GERT and Radiological Worker I and II newsletter should be distributed for self-study.
7. When Radiological Control management has approved the use of an escort in lieu of training, then the escort shall have completed the level of training required for the areas to be entered and the work to be performed and shall ensure that the escorted individual complies with the requirements of PLN-260 [see 10 CFR 835.901(d)].

Article 622, Radiological Safety Training and Orientation for Members of the Public

1. Members of the public shall receive radiation safety training prior to being permitted unescorted access to controlled areas [see 10 CFR 835.901(b)]. This training shall address the radiation safety training topics in Article 613.1 to the extent appropriate for the degree of exposure to radiological hazards that may be encountered and the required controls [see 10 CFR 835.901(a)].
2. The facility/project will continuously escort members of the public in controlled areas. However, when members of the public are trained in accordance with Article 622.1, the following additional criteria should be met prior to permitting unescorted access to controlled areas:
 - a. Prior approval by the Radiological Control director.
 - b. Appropriate limitations on the areas to be entered and the activities to be undertaken to prevent occupational exposure.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 6-7 of 6-15

- c. Enhanced training to provide information commensurate with the areas to be entered and activities to be undertaken while unescorted.
3. Members of the public, including tour groups and visiting dignitaries, who enter controlled areas and are continuously escorted, should receive a radiological safety orientation. This orientation should include the following topics and be commensurate with the hazards present in the areas to be entered and the required controls:
 - a. Risk of low-level occupational radiation exposure, including cancer and genetic effects.
 - b. Risk of prenatal radiation exposure.
 - c. Members of the public and management responsibilities for radiation safety.
 - d. Adherence to radiological posting and labeling.
 - e. Applicable emergency procedures.
 - f. Training for issuance of dosimeters, where applicable.
 - g. Verification that the personnel have not recently received medical treatment including radiopharmaceuticals that could impair radiological control surveys.
4. Information may be communicated by classroom lecture, videotape, or other appropriate methods. An examination is not required.
5. Sign-in logs may be used as radiation safety training and orientation records as required by Article 725.

Part 3, Radiological Worker Training

A summary of the employee activities requiring radiological worker training is provided in Table 3-2. In special cases, escorted access is allowed without completing the training, however, facility/project employees should complete it to ensure that they are personally aware of the hazards and controls associated with access to radiological areas.

Article 631, General Provisions

1. Each individual shall demonstrate knowledge of the radiation safety training topics established in Article 613.1, commensurate with the hazards in the area and required controls, by successful completion of an examination and appropriate performance demonstrations prior to being permitted unescorted access to radiological areas and prior to performing unescorted assignments as a radiological worker [see 10 CFR 835.901(b)]. Radiological worker training will include the DOE core course training materials, as applicable, and Site-specific information.
2. Workers may challenge DOE Radiological Worker I or II core knowledge requirements by passing a comprehensive examination. If unsuccessful in one attempt, the entire standardized core Radiological Worker I or II training will be completed. Challenges will not apply to the Site-specific portions.
3. Radiological Worker I training is not a prerequisite for Radiological Worker II training.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 6-8 of 6-15

4. Radiological Worker II training includes all of the requirements of Radiological Worker I training and expands on the topic of hands-on work with radioactive materials. Radiological Worker II training prepares the worker to deal with radioactive contamination.
5. Individuals with current Radiological Worker I training may be upgraded to allow unescorted access to other areas by completing only the additional training provided in Radiological Worker II training.
6. To complete requalification training during alternate years, the GERT and Radiological Worker I and II newsletter should be distributed for self-study.
7. If an escort is used in lieu of training, then the escort shall have completed the level of training required for the areas to be entered and the work to be performed and shall ensure that the escorted individual complies with PLN-260 [see 10 CFR 835.901(d)].

Article 632, Radiological Worker I

1. Site-specific Radiological Worker I initial training and High/Locked High/Very High Radiation Area training (see Article 632.3) should encompass at a minimum the following practical factors:
 - a. Entering and exiting simulated radiological buffer areas and radiation areas (and high radiation areas when such training is included).
 - b. Performance of frisking for personnel contamination, if applicable.
 - c. Proper response to alarm situations.
2. Course length will vary depending on the amount of Site-specific material.
3. Unescorted worker access to high, locked high, and very high radiation areas may be permitted upon successful completion of Radiological Worker I training and High/Locked High/Very High Radiation Area training. Individuals who complete this training will not be allowed to enter contamination, high contamination, or airborne radioactivity areas unescorted, nor will they be allowed to enter soil contamination areas during activities that will disturb the soil.
4. Performance demonstrations may be requested by an individual or required by a manager during Radiological Worker I requalification.

Article 633, Radiological Worker II

1. Site-specific Radiological Worker II training should encompass, at a minimum, the following practical factors:
 - a. Donning of protective clothing, if applicable.
 - b. Entering a simulated radiological buffer area, contamination area, and high radiation area to perform a task, if applicable.
 - c. Proper response to simulated abnormal situations.
 - d. Proper response to simulated alarms or faulty radiological control equipment.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 6-9 of 6-15

- e. Removing protective clothing and equipment and subsequently exiting the simulated area, if applicable.
 - f. Performance of frisking for personnel contamination, if applicable.
 - g. Verification of instrument response and source check.
2. Course length will vary depending on the amount of Site-specific material.
 3. Performance demonstrations may be requested by an individual or required by a manager during Radiological Worker II requalifications.

Article 634, Specialized Radiological Worker Training

Specialized radiological worker training should be completed, involving special controls for radiological hazards. This training is in addition to Radiological Worker II training and will be provided to personnel performing jobs that have the potential for significant radiological consequences. Such jobs may involve special containment devices, the use of mockups, and ALARA considerations. In some cases, pre-job briefings and walkthroughs provide an acceptable alternative to specialized radiological worker training. The need for specialized radiological worker training will be determined by the facility/project performing the work, with the assistance from the Radiological Control organization and the training department.

Part 4, Radiological Control Technician and Radiological Control Technician Foreman Qualification**Article 641, General Provisions**

Training and qualification of RCTs and RCT foremen will address routine operations and also focus on recognizing and handling situations in both normal and changing radiological conditions. Newly qualified technicians and those still in training should be given the opportunity to work with qualified, experienced technicians to foster development.

Article 642, Radiological Control Technician

1. Because of the nature of their duties (e.g., monitoring the workplace, implementing administrative controls and entry controls), RCTs would generally be expected to have responsibility for implementing measures necessary for ensuring compliance with 10 CFR 835. Therefore, RCTs generally will be subject to the education, training, and skills requirements of 10 CFR 835.103. Training for RCTs will include the standardized core course training materials, as applicable, which will be expanded to include Site-specific information.
2. RCT candidates who have prerequisite knowledge such as college credit, registration by the National Registry of Radiation Protection Technologists, operational experience, or related qualifications may satisfy individual sections of the standardized core course training requirements by passing comprehensive challenge examinations.
3. Entry-level prerequisites should be established to ensure that RCTs meet the standards for physical condition and education. At a minimum, these standards should include the following:

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 6-10 of 6-15

- a. High school education or equivalency.
 - b. Fundamentals of mathematics, physics, chemistry, and science.
 - c. Systems and fundamentals of process, operations, and maintenance.
 - d. Reading and comprehension level sufficient to follow procedures, write RWPs, prepare survey maps, write reports, and prepare shipping and transfer paperwork.
 - e. Ability to work in a support role including communicating verbal instructions to others.
 - f. Physical requirements to handle personal protective equipment and other equipment and assist others in work locations, commensurate with assignment.
4. All RCTs are encouraged to pursue registration by the National Registry of Radiation Protection Technologists.

Article 643, Qualification Standards for Radiological Control Technicians

Qualification standards define the requirements for demonstrating completion of training. Signatures on the forms in qualification standards provide documentation of satisfactory knowledge and proficiency.

1. The qualification standards from the standardized core course will be supplemented to include Site-specific elements.
2. Qualification standards for RCTs will include on-the-job training to provide hands-on experience directly applicable to the job.

Article 644, Oral Examination Boards

The use of oral examination boards provides an opportunity to identify areas of strengths and weaknesses related to the performance of RCT duties and RCT foremen functions. Using oral examination boards also provides the opportunity to identify additional training requirements to enhance RCT and RCT foremen training programs. The functions and composition of the oral examination boards are described below.

1. An oral examination board will determine the initial qualification for RCT and RCT foreman positions.
2. The Radiological Control director or designee will designate the board members and appoint a chairperson.
3. The board constituted to evaluate RCT qualifications should be composed of at least three people including an RCT foreman, a Radiological Control staff member, and a line management operations department supervisor or staff member, as applicable. Instructors of RCTs may participate as nonvoting members.
4. The board will assess the candidate's response to normal and emergency situations. Questions should be of the type not normally covered in a written examination. Written examination results will be evaluated during preparation for the board.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 6-11 of 6-15

5. The board constituted to evaluate RCT foreman qualifications will not include peers or subordinates as voting members.

Article 645, Continuing Training

1. Following initial qualification, RCTs will begin a 2-year cycle of continuing training required for requalification.
2. Requalification should include completion of continuing training including practical training and satisfactory performance on quarterly written examinations. A final oral examination board or direct work observation may be used. Requalification of RCTs registered with the National Registry of Radiation Protection Technologists may be extended to allow completion of oral exam or direct work observation every 4 years.
3. Continuing training will provide improvement in the knowledge and skills of RCTs.
4. Continuing training will include Site-specific and DOE-wide changes in requirements and updates of lessons learned from operating experience and industry events.
5. Continuing training will include written examinations as applicable, demonstrations of proficiency controlled by qualification standards, and oral or practical examinations as required to complete requalification.
6. Infrequently performed tasks such as those for emergency response may require annual training. Other tasks may require training prior to initiation.

Article 646, Radiological Control Technician Foremen

1. Because of the nature of their duties, RCT foremen generally are considered subject to the education, training, and skill requirements of 10 CFR 835.103. In addition, training and education standards for RCT foremen should be consistent with DOE-STD-1107-97.
2. Supervisory and leadership capabilities are recommended for RCT foremen to direct the work of RCTs; interact effectively with crafts, line supervisors, professional staff, and managers; and be able to respond and direct others in emergency and abnormal situations.
3. All RCT foremen should participate in training conducted in accordance with Article 645, and their knowledge of facility radiological control hazards, programs, and procedures should be reassessed every 4 years.
4. Initial oral examination boards or direct work evaluations should focus on the ability to analyze situations and supervise subordinates. The RCT foremen's depth of knowledge should exceed that expected of an RCT.

Article 647, Subcontracted Radiological Control Technicians

1. Because their responsibilities closely parallel those of Site contractor RCTs, subcontracted RCTs generally are considered subject to the education, training, and skill requirements of 10 CFR 835.103 and should have the same knowledge and qualifications required of Site contractor RCTs performing the same duties. To obviate the need for full training as an RCT, the training and qualification program will include the following:

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 6-12 of 6-15

- a. Review of resumes to identify RCTs with experience in jobs similar to those for which they will be employed.
 - b. Written examination to verify appropriate knowledge level.
 - c. Approval of the duties RCTs will be authorized to perform by the facility Radiological Control manager's signature on the qualification documents.
 - d. Training in facility procedures and equipment associated with the authorized duties.
 - e. Training on recent operating experience.
 - f. Ongoing observation of on-the-job performances by the RCT foreman.
2. Subcontracted RCTs who work at a facility for extended time periods (more than 6 months) should receive continuing training commensurate with their assigned duties. Completion of an initial oral examination in accordance with Article 644 is encouraged. Subcontracts for RCT service normally should be obtained from companies with an established RCT training and qualification program.

Part 5, Other Radiological Training

Article 651, Management Training

1. Training and education standards for line managers of radiation protection programs (or elements of those programs) should be consistent with DOE-STD-1107-97.
2. Line managers who manage, supervise, or provide oversight of radiation protection programs generally are considered subject to the education, training, and skill requirements of 10 CFR 835.103 and should be knowledgeable in the principles of this manual.
3. Such training will be based on DOE core course training materials supplemented by Site-specific procedures and will be completed by new personnel prior to formally assuming line supervision and management responsibilities. This training should include the following:
 - a. Guidance on handling personnel interactions.
 - b. Emphasis on being factual.
 - c. Fundamentals of communicating risks.
 - d. Importance of keeping management informed.

Article 652, Technical Support Personnel

Appropriate technical support personnel (such as engineers, schedulers, and procedure writers) may be considered subject to the education, training, and skill requirements of 10 CFR 835.103 and should be trained in the ALARA fundamentals and dose reduction techniques. They also should participate in selected portions of job-specific and specialized training, particularly in situations using mockups.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 6-13 of 6-15

Article 653, Planners

Planners who develop detailed work plans involving or associated with radioactivity or radioactive materials should have radiological worker training to the level required by the workers using the work plans. Planners will receive training consistent with DOE-HDBK-1110-97, "ALARA Training for Technical Support Personnel," in accordance with 10 CFR 835.103.

Article 654, Radiological Control Personnel

1. Radiological Control senior staff (see Article 143) and management generally are considered subject to the education, training, and skill requirements of 10 CFR 835.103 and should have:
 - a. A combination of education and experience commensurate with their job responsibilities.
 - b. Periodic training based on an assessment of job responsibilities to maintain and enhance proficiency.
 - c. Periodic training to remain cognizant of changes to the facility, operating experience, procedures, regulations, and quality assurance requirements.
2. Radiological support personnel may include but are not limited to dosimetry technicians, instrument technicians, instrument calibration technicians, medical personnel, record clerks, whole-body-counter technicians, and laboratory personnel. Radiological support personnel generally are considered subject to the education, training, and skill requirements of 10 CFR 835.103 and should have:
 - a. Applicable training on standardized core course topics from Radiological Worker I and II and Radiological Control Technician Training and additional job-specific topics.
 - b. Training appropriate to the tasks to be performed.
 - c. Continuing training to provide continued improvement in knowledge and skills.
3. Training and education standards for Radiological Control senior staff and support personnel should be consistent with DOE STD-1107-97.
4. Certification and involvement with professional industry organizations are encouraged.

Article 655, Radiographers and Radiation Generating Device Operators

1. Radiographers generally are considered subject to the education, training, and skill requirements of 10 CFR 835.103 and should have training in accordance with 10 CFR 34.43.
 - a. Facility and operation managers should ensure that industrial radiographers are trained initially as required by the NCRP Report No. 61, *Radiation Safety Training Criteria for Industrial Radiography* (NCRP 1978). On the job and annual retraining shall be performed in accordance with NCRP 61, Sections 3.3.2 and 3.3.3. Training also should include periodic reviews of case histories of

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 6-14 of 6-15

radiography accidents. The training records shall be maintained as required by Article 725.

- b. Non-Site contractor radiographers and their assistants who provide services in facility/project areas shall provide certification of their training. Adequate training may be demonstrated by providing documented evidence of being trained in accordance with NCRP 61, or by being named as a qualified user for the proposed task on Nuclear Regulatory Commission license or a current agreement state license, or by providing documented evidence of being trained in accordance with such a license. The facility or operations manager should be provided with this documentation and should maintain a list of certified radiographers.
2. Radiation generating device operators not performing radiography generally would be considered subject to the education, training, and skill requirements of 10 CFR 835.103 and will have training appropriate for the radiation source involved and commensurate with the level of hazard.
 - a. Personnel operating cabinet x-ray systems such as those used by mailroom clerks and security are subject to the requirements of 21 CFR 1020.40. These personnel are not required to complete Radiological Worker training to operate these devices.
 - b. X-ray users (except as noted elsewhere in this manual) shall be at least Radiological Worker I trained. Facility or operations managers shall ensure that operators of x-ray-producing equipment are trained initially and every 2 years thereafter in the fundamentals of x-ray safety, use of radiation detection instrumentation (including dosimeters) for their x-ray equipment and facility, x-ray inspection, maintenance and record-keeping procedures, and operations and emergency procedures.

Article 656, Emergency Response Personnel

Provisions should be in place to accommodate rapid Site and radiological area access by on-Site and off-Site emergency workers such as firefighters, medical personnel, and security personnel.

1. Emergency response personnel from both on-Site and off-Site locations, may be required to work in radiological areas.
2. Each individual authorized to perform emergency actions likely to result in occupational doses exceeding the values of the limits provided in Table 2-1 shall be trained and briefed beforehand on the known or anticipated hazards to which the individual will be subjected [see 10 CFR 835.1302(d)].
3. Such training will be based on DOE radiological worker core course and Site-specific training materials.
4. If such workers are not trained, trained escorts will be assigned.
5. Training will make it clear that lifesaving has priority over radiological controls.
6. Records of this training will be maintained.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: **6-15** of 6-15

Part 6, Training For Special Applications**Article 661, Plutonium Facilities**

The content of DOE-HDBK-1145-2001, "Radiological Safety Training for Plutonium Facilities," will be considered in addition to DOE core training materials at plutonium facilities.

Article 662, Uranium Facilities

The content of DOE-HDBK-1113-98, "Radiological Safety Training for Uranium Facilities," will be considered in addition to DOE core training materials at uranium facilities.

Article 663, Tritium Facilities

The content of DOE-HDBK-1105-2002, "Radiological Training for Tritium Facilities," will be considered in addition to DOE core training material at tritium facilities.

Article 664, Accelerator Facilities

The content of DOE-HDBK-1108-2002, "Radiological Safety Training for Accelerator Facilities," will be considered in addition to DOE core training material at accelerator facilities.

RADIOLOGICAL CONTROL MANUAL

Identifier:	PRD-183
Revision:	7
Page:	7-1 of 7-14

CHAPTER 7 CONTENTS

CHAPTER 7, RADIOLOGICAL RECORDS	7-2
Part 1, General Provisions.....	7-2
Article 711, Purpose.....	7-2
Article 712, Records Management Program	7-2
Article 713, Recordkeeping Standards.....	7-3
Part 2, Employee Records.....	7-3
Article 721, Employment History.....	7-3
Article 722, Personnel Radiological Records.....	7-4
Article 723, Other Personnel Radiological Records.....	7-6
Article 724, Medical Records.....	7-6
Article 725, Radiological Training and Qualification Records.....	7-6
Part 3, [Reserved]	7-8
Part 4, Radiological Control Procedures.....	7-8
Article 741, Policies, Procedures, and Radiological Work Permits	7-8
Article 742, As Low As Reasonably Achievable Program Records	7-8
Article 743, Quality Assurance Records.....	7-8
Part 5, Radiological Monitoring.....	7-9
Article 751, Area Monitoring Records.....	7-9
Article 752, Radiation Monitoring.....	7-10
Article 753, Airborne Radioactivity Monitoring	7-10
Article 754, Contamination Monitoring.....	7-10
Article 755, Sealed Radioactive Source Leak Tests and Inventories	7-11
Part 6, Instrumentation and Calibration Records	7-11
Article 761, Calibration and Operational Checks.....	7-11
Article 762, Special Calibration Records.....	7-12
Part 7, Records Management	7-12
Article 771, Media	7-12
Article 772, Microfilm	7-12
Article 773, Computerization of Records	7-12
Article 774, Retention	7-13
Article 775, Physical Protection of Records.....	7-13
Part 8, Radiological Reporting.....	7-13
Article 781, Reports to Individuals.....	7-13
Article 782, Annual Radiation Report	7-14

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 7-2 of 7-14

CHAPTER 7, RADIOLOGICAL RECORDS**Part 1, General Provisions****Article 711, Purpose**

Practices for preparing and retaining Radiological Control records are prescribed in this chapter. The work force and management are required to use records to document radiological safety afforded to individuals on-Site. Records of the radiation protection program may be required to support worker health studies and future disputes or claims. Therefore, these records will be high quality, readily retrievable, and managed for the prescribed retention period. Consideration will be given to cross-referencing related records to aid retrievability. Records will be handled so that personal privacy is protected. Proven electronic and digital records and processes may be acceptable if they are demonstrated to be of adequate quality.

Article 712, Records Management Program

1. A radiological records management program will be established. This program will ensure that auditable records and reports are controlled through the stages of creation, distribution, use, arrangement, storage, retrieval, media conversion (if applicable), and disposition. The records management program shall be sufficient to ensure that records are maintained as necessary to document compliance with 10 CFR 835 [see 10 CFR 835.701(a)] and should include records of the following:
 - a. Radiological Control policy statements.
 - b. Radiological Control procedures.
 - c. Individual radiation doses.
 - d. Internal and external dosimetry policies and procedures (including technical basis documents).
 - e. Personnel training (course records and individual records).
 - f. Implementation of the ALARA program.
 - g. Radiological instrumentation test, maintenance, and calibration.
 - h. Radiological surveys.
 - i. Area monitoring dosimetry results.
 - j. Radiological work permits.
 - k. Radiological performance indicators and assessments.
 - l. Quality assurance measures.
 - m. Radiological incident and occurrence reports (and critique reports, if applicable).
 - n. Sealed radioactive source accountability and control.
 - o. Release of material to controlled areas.
 - p. Reports of loss of radioactive material.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 7-3 of 7-14

2. When radiological services (e.g., dosimetry and laboratory analyses) are purchased, a clear agreement should be in place for the responsibility of record keeping during performance of the service. Records of results should reside in the custody of the originating organization.
3. Detailed information concerning an individual's exposure shall be made available to that individual, upon request, consistent with the Privacy Act of 1974, which contains requirements to protect the privacy of individual records [see 10 CFR 835.702(f) and 801(d)].

Article 713, Record-keeping Standards

1. Radiological control records should be accurate and legible. The records should include the following:
 - a. Identification of the facility, specific location, function, and process.
 - b. Signature or other identifying code of the preparer and date.
 - c. Legible entries in black ink.
 - d. Corrections identified by a single line-out, initialed and dated.
 - e. Supervisory signature or other identifying code to ensure review and proper completion of forms.
2. The Radiological Control organization will maintain a file of names, signatures, codes, and initials for future identification of the individual who certified, signed, or initialed a record.
3. Radiological control records should not include:
 - a. Opaque substances for corrections.
 - b. Shorthand or other nonstandardized terms.
4. Similar procedural standards should be established for computerized or digital records.
5. Unless otherwise specified, Radiological Control records shall use units of curie, roentgen, rad, and rem including multiples of these units [see 10 CFR 835.4]. Use of the International System of Units (becquerel, gray, and sievert) will be limited to calculational, scientific, or reference purposes.

Part 2, Employee Records**Article 721, Employment History**

1. Efforts shall be made to obtain records of prior years' occupational doses for each radiological worker whose occupational exposure is monitored in accordance with Article 511.1 or 521.1. If formal records of previous occupational doses cannot be obtained, a written estimate signed by the individual may be accepted [see 10 CFR 835.702(d)]. Where practical, the association between the radiation dose and job function should be preserved for trending purposes and future worker health studies. The following information should be maintained:

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 7-4 of 7-14

- a. Previous work history detailing radiological work assignments, to the extent practical, and yearly occupational doses at other DOE and non-DOE facilities.
- b. Nuclear Regulatory Commission Form 4 or an equivalent that documents previous occupational radiation doses.
- c. Ongoing work history documenting work assignments and radiation doses. The facility and occupational codes defined in DOE O 231.1A will be used for this process.
- d. Standardized DOE forms to document previous and ongoing radiation doses.

Article 722, Personnel Radiological Records

1. Individual monitoring records shall be maintained to demonstrate compliance with regulatory limits [see 10 CFR 835.701(a)].
 - a. Records of doses received by all individuals for whom monitoring is required shall be maintained [see 10 CFR 835.702(a)]. Records of zero dose for these individuals also should be maintained.
 - b. These records shall be sufficient to evaluate compliance with all applicable dose limits and monitoring and reporting requirements [see 10 CFR 835.702(c)(1) and (2)].
2. Radiation dose records shall contain information sufficient to identify each person, including social security, employee number, or other unique identifier [see 10 CFR 835.702(c)(2)].
3. Procedures, data, and supporting information required to reconfirm an individual's dose at a later date shall be maintained [see 10 CFR 835.702(g)].
4. External dose records shall include applicable extremity, skin, lens of the eye, and whole-body dose monitoring results [see 10 CFR 835.702(c)(3)]. These doses are usually measured with personnel dosimeters, but records may include:
 - a. Evaluations resulting from anomalous dose results such as unexpected high or low doses.
 - b. Dose reconstructions from lost or damaged dosimeters, or for unbadged workers.
 - c. Evaluations of nonuniform radiation doses.
5. Internal dose records shall include CEDE [see 10 CFR 835.702(c)(4)(i)], committed dose equivalent to the affected organs and tissues [see 10 CFR 835.702(c)(4)(ii)], and identity of radionuclides [see 10 CFR 835.702(c)(4)(iii)]. The supporting information typically includes the following:
 - a. Applicable whole-body and lung counting results including the chest wall thickness measurements where applicable.
 - b. Applicable urine, fecal, and specimen analysis results including estimated intake.
 - c. Dose assessment, as required.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 7-5 of 7-14

6. Records of the summation of external dose and committed dose equivalent to any organ or tissue receiving a reportable dose shall be maintained for the individual receiving such dose [see 10 CFR 835.702(c)(5)(ii)].
7. The TEDE received by each individual monitored in accordance with Article 511.1 or 521.1 shall be maintained for each year during which the individual is monitored [see 10 CFR 835.702(c)(5)(i)].
8. The dose equivalent to the embryo/fetus of a declared pregnant worker shall be maintained [see 10 CFR 835.702(c)(6)] and will be maintained with the occupational dose records for that worker.
9. Individual dose records shall include the cumulative TEDE. [see 10 CFR 835.702(c)(5)(iii)].
10. Efforts shall be made to obtain records of doses during prior years for each radiological worker monitored in accordance with Article 521 or 522 [see 10 CFR 835.702(e)]. If an individual's previous employer is not responsive to initial efforts to obtain these records, at least two additional attempts will be made. Records of lifetime occupational dose will be maintained with the individual's occupational dose records.
11. Counseling of individuals about radiological concerns will be documented and the documentation retained. The counseled individual should sign the documentation to acknowledge participation.
12. Records of authorization to exceed administrative control levels will be retained.
13. Planned special exposures shall be accounted for separately from the dose received from nonemergency or nonplanned special exposure [see 10 CFR 835.204].
14. Records of nonuniform dose to the skin need not be retained in an individual's dose records if the dose is less than 2% of the limit for the skin in Table 2-1 [see 10 CFR 835.702(b)] (see Article 723 for requirements for records of radiological incidents and occurrences).
15. A personnel exposure questionnaire (PEQ) is used by dosimetry and Radiological Control personnel to estimate the dose received by an individual (external or internal) when the dose cannot be determined by normal means. The three signature spaces are required to be completed to verify independence in the dose assessment. The PEQ becomes part of the individual's dose records. After the PEQ investigation, the responsible line manager may determine that a critique report or occurrence report is required for further investigation and corrective action. Events requiring completion of a PEQ include, but are not limited to:
 - a. Lost TLD badges.
 - b. Lost TLD inserts.
 - c. Entry into a radiation area, high radiation area, locked high radiation area, or very high radiation area without proper dosimetry.
 - d. Crushed or damaged TLD badge.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 7-6 of 7-14

- e. Malfunction during TLD processing.
 - f. Contaminated TLD badges.
 - g. Failure to wear a TLD badge when required.
 - h. Doses that seem unreasonable for the exposure situation.
16. Dose reconstruction, special studies, evaluations, and interpretations to support activities such as exposure questionnaire reviews, evaluation of nonuniform exposures to radiation, investigations of incidents, and internal dose assessments are part of the Site radiological records. In those cases where recordable doses are determined to have occurred, the results of these evaluations, consisting of a summary report that (1) describes the data, (2) explains the techniques used to evaluate the data, and (3) lists the doses to be assigned, are required to be provided to Site Radiation Dosimetry Records.

Article 723, Other Personnel Radiological Records

1. The complete records of radiological incidents and occurrences involving personnel dose will be retained in, or cross-referenced to, the individual's dose records.
2. Records related to doses exceeding Table 2-1 limits shall be maintained in the individual dose records and include the following information:
 - a. Planned special exposures.
 - b. Other nonauthorized doses exceeding limits.
 - c. Authorized emergency doses [see 10 CFR 835.702(a) and 10 CFR 835.1301(b)].
3. Records of employee radiological safety concerns that have been formally investigated and documented will be maintained.
4. Records of the formal written declaration of pregnancy, including the estimated conception date, and revocations of declarations of pregnancy shall be maintained [see 10 CFR 835.704(d)]. Records indicating an end to the pregnancy (therefore, the conditions of Article 215 do not apply) also should be maintained.

Article 724, Medical Records

Maintenance of records of nonoccupational radiation doses such as significant therapeutic or diagnostic radiation doses for medical purposes is encouraged. Where practical, maintenance of records of preemployment nonoccupational radiation doses is encouraged.

Article 725, Radiological Training and Qualification Records

1. Records of training and qualification in radiological control are maintained to demonstrate that an individual received appropriate information to perform the work assignment in a safe manner. Qualification standard records are retained for on-the-job and practical factor training as well as for formal classroom training.
2. Formal records or summary reports of training and qualification should be readily available to first-line supervision and management of involved personnel to aid in making work assignments.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 7-7 of 7-14

3. Personnel training records shall be controlled and retained [see 10 CFR 835.704(a)]. At a minimum, these records should include the following:
 - a. Course title.
 - b. Attendance sheets with the instructor's name.
 - c. Employee's name, identification number, and signature.
 - d. Date of training.
 - e. Identification of the examination or evaluation form, including sufficient data to identify which test each individual completed.
 - f. Verification document or record confirming satisfaction of the training requirement.
 - g. Documentation related to exceptions for training requirements and extensions of qualification.
 - h. Quizzes, tests, responses, and acknowledgments of training, with the date and signature of the individual trained.
 - i. Special instructions given to females, their supervisors, and coworkers about prenatal radiation doses, acknowledged by the worker's signature.
4. Records shall be retained for the following types of radiation safety training [see 10 CFR 835.704(a)]:
 - a. General Employee Radiological Training.
 - b. Radiological worker training.
 - c. Periodic training.
 - d. Training for members of the public for unescorted access.
5. Records should be retained for the following types of radiation safety training:
 - a. Instructor training.
 - b. Radiological control technicians and RCT foremen.
 - c. Training of other Radiological Control personnel.
 - d. Respiratory protection training.
 - e. Qualifications for special tests or operations.
 - f. Orientation of members of the public.
 - g. Training of emergency response personnel.
6. Records shall be maintained as necessary to demonstrate that individuals who are responsible for the development and implementation of measures necessary to ensure compliance with 10 CFR 835 have the appropriate education, training, and skills to execute these responsibilities [see 10 CFR 835.103 and 10 CFR 835.701(a)]. These

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 7-8 of 7-14

records should include records of the training provided in accordance with Parts 4 and 5 of Chapter 6.

7. The following instructional materials should be maintained:
 - a. Course name, with revision and approval date.
 - b. Instructor's manuals, course content, or lesson plans containing topical outlines.
 - c. Video and audio instructional materials including the dates and lessons for which they were used.
 - d. Handouts or other materials retained with the master copy of the course.
 - e. Job-specific training documents such as instrument use, radiological procedures, radiological work permit special training requirements, pre-job briefings, and mockup training.

Part 3, [Reserved]**Part 4, Radiological Control Procedures****Article 741, Policies, Procedures, and Radiological Work Permits**

Radiation protection program records will consist of policy statements, procedures, work authorizations, and supporting data. The records should be maintained in a chronological sequence that will allow correlation with the corresponding support information. For example, procedures for performing radiation surveys will be identifiable with the survey results. Completed RWPs will be maintained.

Article 742, As Low As Reasonably Achievable Program Records

Records of actions taken to maintain occupational exposures ALARA shall be maintained [see 10 CFR 835.701(a)]. These records shall include facility design and control measures [see 10 CFR 835.704(b)] and should include:

- a. Plans and goals of the ALARA program.
- b. Minutes of ALARA committees and other committees where radiological safety issues are discussed formally.
- c. Records of pre-job briefings and post-job evaluations.
- d. Records of temporary shield and portable ventilation installation and removal.

Article 743, Quality Assurance Records

Records of quality assurance reviews and audits developed for radiological control functions shall be retained to ensure that sufficient records are specified, prepared, reviewed, approved, and maintained to accurately reflect completed work [see 10 CFR 835.704(c)]. Additional information about quality assurance records is provided in DOE O 414.1A, "Quality Assurance," and 10 CFR 830.122, "Quality assurance criteria." Quality assurance records should include:

- a. Assessment plans.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 7-9 of 7-14

- b. Assessment results.
- c. Assignment of corrective actions.
- d. Completion and verification, if required, of corrective actions.

Part 5, Radiological Monitoring

Article 751, Area Monitoring Records

1. Radiological control programs require the performance of radiation, airborne radioactivity, and contamination monitoring to determine existing conditions in a given location. Maps with sufficient detail to permit identification of original survey and sampling locations will be maintained. Radiological monitoring results will be recorded on appropriate standard forms and include the following common elements:
 - a. Date, time, and purpose of the survey.
 - b. General and specific location of the survey.
 - c. Name and signature or code of the surveyor and analyst.
 - d. Pertinent information required to interpret the survey results.
 - e. Reference to a specific radiological work permit if the survey is performed to support the permit.
2. Records shall be maintained to document:
 - a. Results of monitoring and surveys for radiation and radioactive materials [see 10 CFR 835.703(a)].
 - b. Results of monitoring and calculations used to determine individual occupational doses [see 10 CFR 835.703(b)].
 - c. Results of surveys for release of materials from radiological areas [see 10 CFR 835.703(c)].
 - d. Results of sealed radioactive source leak tests and inventories [see 10 CFR 835.704(f)].
 - e. Results of surveys of radioactive material packages received from transportation [see 10 CFR 835.405 and 701(a)].
 - f. Changes in monitoring equipment, techniques, and procedures [see 10 CFR 835.704(e)].
3. Records for release of materials from radiological areas should describe the property, the date of the last survey, the identity of the individual who performed the survey, type and identification number of the survey instruments used, individual items released, and the survey results. For small items and packages of similar items such as boxes of tools or boxes of fasteners, creating a separate survey record is not necessary for each item. However, the survey record should provide traceability to the individual removing the item from the radiological area.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 7-10 of 7-14

Article 752, Radiation Monitoring

In addition to the elements provided in Article 751, records of radiation monitoring will include, at a minimum, the following information:

- a. Instrument model and serial number, (the Health Physics Instrument Laboratory bar code, when on an instrument, should be used as the serial number).
- b. Results of the measurements of area dose rates with a minimum reporting level of 10% of the lowest scale gradient or as specified on the calibration sticker.
- c. Locations of hot spots and other radiological hazards.
- d. Facility conditions existing during the survey that may have affected radiological conditions.

Article 753, Airborne Radioactivity Monitoring

In addition to the elements provided in Article 751, records of airborne radioactivity monitoring should include, at a minimum, the following information:

- a. Model and serial numbers of the sampler and laboratory counting instrument when available or unique identifier of each sampler and instrument and appropriate supporting parameters including counting efficiency, counting time, and correction factors.
- b. Locations of fixed air samplers.
- c. Locations of portable air samplers used for a survey.
- d. Air concentrations in general airborne areas and breathing zones.
- e. Supporting parameters including collection efficiency, flow rate, duration of sampling, correction factors, and filter medium.
- f. Identification (e.g., names or employee numbers) of individuals in the area for whom DAC-hour exposures are calculated.

Article 754, Contamination Monitoring

1. In addition to the elements provided in Article 751, records of contamination monitoring will include, at a minimum, the following information:

- a. Model and serial number of counting equipment.
- b. Contamination levels (using appropriate units) and appropriate supporting parameters including counting efficiency, counting time, correction factors, type of radiation, and whether the contamination was fixed or removable.
- c. Location of areas found to contain hot particles or high concentrations of localized contamination.
- d. Follow-up survey results for decontamination processes with cross-references to the original survey.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 7-11 of 7-14

Article 755, Sealed Radioactive Source Leak Tests and Inventories

1. In addition to the elements provided in Article 751, records of sealed radioactive source leak tests should include, at a minimum, the following information:
 - a. Model and serial number of counting equipment.
 - b. Contamination levels (using appropriate units) and appropriate supporting parameters including counting efficiency, counting time, correction factors, and type of radiation.
 - c. Corrective actions for leaking sources.
2. Records of accountable sealed radioactive source inventories shall include, at a minimum, the following information [see 10 CFR 835.704(f) and 10 CFR 835.1202(a)]:
 - a. Physical location of each accountable sealed radioactive source.
 - b. Verification of the presence and adequacy of associated postings and labels.
 - c. Verification of the adequacy of storage locations, containers, and devices.

Part 6, Instrumentation and Calibration Records**Article 761, Calibration and Operational Checks**

1. Calibration records for fixed, portable, and laboratory radiation measuring instruments and equipment and individual monitoring devices shall be maintained [see 10 CFR 835.703(d)]. These records should include frequencies, method, dates, personnel, training, and traceability of calibration sources conforming with National Institute of Standards and Technology or other acceptable standards.
2. Calibration and maintenance records shall be maintained for instruments and equipment used for monitoring [see 10 CFR 835.703d]. Calibration and maintenance records should be maintained for the following equipment:
 - a. Portable survey instruments.
 - b. Bioassay measurement equipment.
 - c. Laboratory, counting room, and fixed radiation measuring equipment.
 - d. Process and effluent monitors and sampling equipment.
 - e. Radiation area monitors.
 - f. Portal monitors and other personnel contamination monitors.
 - g. Pocket and electronic dosimeters.
 - h. Air sampling equipment.
 - i. Tool and waste monitoring equipment.
 - j. Protective clothing and equipment monitors.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 7-12 of 7-14

3. Documentation of instrument performance checks shall be maintained [see 10 CFR 835.701(a) and 10 CFR 835.401(b)(4)]. Such performance check records should be maintained for a period not shorter than the calibration period of the instrument.
4. Maintenance results for each instrument and device shall be created and retained [see 10 CFR 835.703(d)]. Maintenance histories for each instrument and device should be created and should include the nature of any defects and corrective actions taken.

Article 762, Special Calibration Records

Records of additional tests and checks of instrumentation used in conjunction with a suspected overexposure, questionable indication, or unusual occurrence will be retained. In addition, records of special instrument calibrations and modifications made in accordance with Article 562.6 shall be retained [see 10 CFR 835.703(d)].

Part 7, Records Management**Article 771, Media**

A combination of media may be used for a comprehensive records system. All records should be stored in a manner that ensures their integrity, retrievability, and security and, unless otherwise specified, shall be retained until the final disposition is authorized by DOE [see 10 CFR 835.701(b)].

Article 772, Microfilm

Records may be microfilmed provided that the resulting film copy is capable of producing a clear, legible copy after storage for the specified period. The following controls should be administered:

1. Verification that the resultant copy is legible.
2. Confirmation that printed sides are copied.
3. Periodic quality audits of the final filmed copy.

Article 773, Computerization of Records

1. Records may be transferred to magnetic or electronic storage media provided certain precautions are taken to ensure that the information is maintained in a retrievable configuration.
2. Controls for the use and handling of magnetic storage media should include the following:
 - a. A master index of documents on the magnetic storage medium.
 - b. A program to ensure backup and retrievability of information.
 - c. Quality control during data entry and analysis.
 - d. An index identifying software applications used in conjunction with the data.
 - e. Software validation and verification.
 - f. Periodic quality audits of software.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 7-13 of 7-14

- g. Prevention of unauthorized manipulation of data.
 - h. Assurance that previously stored information is retrievable and usable after system modifications.
3. Optical disks may be used to archive records if the optical disks satisfy the following:
 - a. A reliable system to prevent overwriting or erasure of records.
 - b. Software and user controls consistent with Article 773.2.
 - c. Manufacturer recommendations relating to software control, disk life expectancy, environmental storage conditions, and maintenance incorporated into policies and procedures.
 - d. Quality controls on the copying and imaging processes consistent with Article 772.

Article 774, Retention

1. Requirements for retaining records are established in 10 CFR 835. Upon cessation of activities that could result in the occupational exposure of individuals, all required records related to individual exposure monitoring shall be transferred to DOE [see 10 CFR 835.702(h)].
2. Once a record has been created, reviewed, and signed by appropriate supervision, the record is considered complete and is not to be modified. Subsequent errors identified in a completed record may be corrected by creating a supplemental record that includes traceability for the correction.

Article 775, Physical Protection of Records

1. Methods for protecting documents will include vaults, file rooms with fixed fire suppression, fire-rated cabinets, duplicate storage, or combinations of these as required by Site records procedures.
2. Storage arrangements should address physical damage that could be caused by temperature extremes, moisture, infestation, electromagnetic fields, excessive light, stacking, theft, and vandalism.
3. Records should, as a minimum, be protected from:
 - a. Exposure to fire, equivalent to an Underwriters Laboratories 1-hour, or greater, fire-resistance rating.
 - b. Exposure to water damage caused by a 100-year flood.
 - c. Exposure to windstorm velocities of 100-year recurrence.

Part 8, Radiological Reporting**Article 781, Reports to Individuals**

1. Individuals who are monitored in accordance with Article 511.1 or 521.1 shall be provided with an annual report of their dose [see 10 CFR 835.801(c)]. Electronic

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 7-14 of 7-14

- distribution may be used. Upon request, an individual shall be provided detailed information concerning his or her exposure, consistent with the Privacy Act [see 10 CFR 835.801(d)].
2. Upon request, terminating employees shall be provided a report, as soon as data are available but not later than 90 days following the last day of employment. A written estimate, based on available information, shall be provided upon termination, if requested [see 10 CFR 835.801(b)].
 - a. If an internal dose assessment is still in progress at the 90-day limit, the employee will be notified of its status, and provided with the interim, or final dose record, as soon as the assessment is complete.
 - b. If a terminated employee is provided a report at termination, he or she will not be provided an annual report.
 3. Reports of individual doses shall include the site or facility name, the individual's name and social security number, the employee number or other unique identification number, and all dose information required by Articles 722.4 through 722.9 [see 10 CFR 835.801(a)]. Reporting of lifetime occupational dose is suggested.
 4. Reports of individual exposure to radiation or radioactive material required under DOE O 231.1A or as a result of a planned special exposure, emergency exposure, or accident will be submitted to DOE in accordance with applicable occurrence reporting requirements. Copies of the individual dose information contained in these reports shall be provided to the affected individual at a time not later than transmittal of the report to DOE [see 10 CFR 835.801(e)].
 5. Monitoring results should be reported to each member of the public monitored in accordance with Article 511 or 521 within 30 days and no later than 90 days after the end of the visit. The report may serve as the annual report to these individuals. However, if an individual visits a site or facility more than once in a year, then an annual report should be sent which sums the doses from all of the visits.
 6. Upon request, Site Radiation Dosimetry Records will provide contractor employees traveling to noncontractor facilities an official letter indicating current exposure information and the amount of exposure the employee will be allowed at the noncontractor facility. The noncontractor facility will be requested to report doses, including zero doses, received at that facility to Site Radiation Dosimetry Records.

Article 782, Annual Radiation Report

Reporting requirements for the Annual Radiation Dose Summary report are provided in DOE O 231.1A. This report includes internal and external radiation dose results for monitored Site employees, and for monitored members of the public.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 8-1 of 8-9

8. REFERENCES (Bracketed text indicates the articles in which the references are cited.)

10 CFR 34, 2002, Title 10, "Energy," Part 34, "Licenses for Radiography and Radiation Safety Requirements for Radiographic Operations," Code of Federal Regulations [365.5 and 655]

10 CFR 71, 2003, Title 10, "Energy," Part 71, "Packaging and Transportation of Radioactive Material," Code of Federal Regulations [423.2]

10 CFR 71.4, 2003, Title 10, "Energy," Part 71, "Packaging and Transportation of Radioactive Material," Section .4, "Definitions," Code of Federal Regulations [423.13]

10 CFR 830.122, 2002, Title 10, "Energy," Part 830, "Nuclear Safety Management," Section .122, "Quality assurance criteria," Code of Federal Regulations [743]

10 CFR 835, Title 10, 2002, "Energy," Part 835, "Occupational Radiation Protection," Code of Federal Regulations [multiple citations]

21 CFR 1020.40, 2003, Title 21, "Food and Drugs," Part 1020, "Performance Standards for Ionizing Radiation Emitting Products, Section .40, "Cabinet x-ray systems," Code of Federal Regulations [365.3]

29 CFR 1910.134, Title 29, 2003, "Labor," Part 1910, "Occupational Safety and Health Standards," Section .134 "Respiratory protection," Code of Federal Regulations [531]

49 CFR, 2003, Title 49, "Transportation," Code of Federal Regulations [423.2]

49 CFR 171, 2003, Title 49, "Transportation," Part 171, "General Information, Regulations, and Definitions," Code of Federal Regulations [423.1]

49 CFR 172, 2003, Title 49, "Transportation," Part 172, "Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements," Code of Federal Regulations [423.1]

49 CFR 172.600, 2003, Title 49, "Transportation," Part 172, "Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements," Section .600, "Applicability and general requirements," Code of Federal Regulations [423.12]

49 CFR 173, 2003, Title 49, "Transportation," Part 173, "Shippers—General Requirements for Shipments and Packagings," Code of Federal Regulations [423.1]

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 8-2 of 8-9

49 CFR 173.443, 2002, Title 49, "Transportation," Part 173, "Shippers—General Requirements for Shipments and Packagings," Section .443 "Contamination control," Code of Federal Regulations [423.3]

49 CFR 175, 2003, Title 49, "Transportation," Part 175, "Carriage by Aircraft," Code of Federal Regulations [423.1]

49 CFR 176, 2003, Title 49, "Transportation," Part 176, "Carriage by Vessel," Code of Federal Regulations [423.1]

49 CFR 177, 2003, Title 49, "Transportation," Part 177, "Carriage by Public Highway," Code of Federal Regulations [423.1]

49 CFR 178, 2003, Title 49, "Transportation," Part 178, "Specifications for Packagings," Code of Federal Regulations [423.1]

52 FR 2822, 1987, "Radiation Protection Guidance to Federal Agencies for Occupational Exposure," January 27, 1987 [111]

5 USC § 552a, 1974, "Privacy Act of 1974, as amended," *United States Code* [712.3]

15 USC § 2601 et seq., 1976, "The Toxic Substances Control Act (TSCA) of 1976," *United States Code*, October 11, 1976 [443]

42 USC § 2160 et seq., 1954, "Atomic Energy Act of 1954, as amended," Public Law 83-703, *United States Code*, August 30, 1954 [112 and Glossary]

42 USC § 6901 et seq., 1976, "Resource Conservation and Recovery Act (Solid Waste Disposal Act)," *United States Code*, October 21, 1976 [443 and Glossary]

ANSI N43.2-2001, "Radiation Safety for X-ray Diffraction and Fluorescence Analysis Equipment," Health Physics Society [365.2]

ANSI N43.3-1993, "Installations Using Non-Medical X-Ray and Sealed Gamma-Ray Sources, Energies up to 10 MeV," American National Standards Institute [365.1 and 365.5]

ANSI N323-1978, "Radiation Protection Instrumentation Test and Calibration," Institute of Electrical and Electronics Engineers [562, 564]

ANSI Z88.2-1992, "For Respiratory Protection," American National Standards Institute [531.3, 532, and 533.5]

ANSI Z540.1-1994, "Calibration Laboratories and Measuring and Test Equipment General Requirements," National Conference of Standards Laboratories [562 and 564]

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 8-3 of 8-9

ASME AG-1-1997, "Code on Nuclear Air and Gas Treatment," American Society of Mechanical Engineers [464.2]

ASME N509-2002, "Nuclear Power Plant Air-Cleaning Units and Components," American Society of Mechanical Engineers [464.2]

ASME N510-1989, "Testing of Nuclear Air Treatment Systems," American Society of Mechanical Engineers [464.2]

Casey, W. R., A. J. Miller, J. B. McCaslin, and L. V. Coulson, 1988, *Health Physics Manual of Good Practices for Accelerator Facilities*, SLAC-327, Stanford Linear Accelerator Center, Stanford, California [364.1]

DOE, 1996, *Department of Energy Office of Worker Protection Programs and Hazards Management Radiological Control Technical Position (RCTP) 96-02, 10 Code of Federal Regulations Part 835 Appendix D – Surface Radioactivity Values* [223]

DOE G 435.1-1, 1999, "Crosswalk Tables DOE Order 5820.2A vs. DOE O 435.1/M 435.1-1" [441.1 and 451]

DOE G 441.1-1, 1999, "Management and Administration of Radiation Protection Programs Guide for Use with Title 10 Code of Federal Regulations, Part 835, Occupational Radiation Protection" [112 and 231.2]

DOE G 441.1-2, 1999, "Occupational ALARA Program Guide for Use with Title 10 Code of Federal Regulations, Part 835, Occupational Radiation Protection" [112 and 231.2]

DOE G 441.1-3, 1999, "Internal Dosimetry Program Guide for Use with Title 10 Code of Federal Regulations, Part 835, Occupational Radiation Protection" [112 and 231.2]

DOE G 441.1-4, 1999, "External Dosimetry Program Guide for Use with Title 10 Code of Federal Regulations, Part 835, Occupational Radiation Protection" [112 and 231.2]

DOE G 441.1-5, 1999, "Radiation-Generating Devices Guide for Use with Title 10 Code of Federal Regulations, Part 835, Occupational Radiation Protection" [112 and 231.2]

DOE G 441.1-6, 1999, "Evaluation and Control of Radiation Dose to the Embryo/Fetus Guide for Use with Title 10 Code of Federal Regulations, Part 835, Occupational Radiation Protection" [112 and 231.2]

DOE G 441.1-7, 1999, "Portable Monitoring Instrument Calibration Guide for Use with Title 10 Code of Federal Regulations, Part 835, Occupational Radiation Protection" [112 and 231.2]

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 8-4 of 8-9

DOE G 441.1-8, 1999, "Air Monitoring Guide for Use with Title 10 Code of Federal Regulations, Part 835, Occupational Radiation Protection" [112 and 231.2]

DOE G 441.1-9, 1999, "Radioactive Contamination Control Guide for Use with Title 10 Code of Federal Regulations, Part 835, Occupational Radiation Protection" [112 and 231.2]

DOE G 441.1-10, 1999, "Posting and Labeling for Radiological Control Guide for Use with Title 10 Code of Federal Regulations, Part 835, Occupational Radiation Protection" [112 and 231.2]

DOE G 441.1-11, 1999, "Occupational Radiation Protection Record-Keeping and Reporting Guide for Use with Title 10 Code of Federal Regulations, Part 835, Occupational Radiation Protection [112 and 231.2]

DOE G 441.1-12, 1999, "Radiation Safety Training Guide for Use with Title 10 Code of Federal Regulations, Part 835, Occupational Radiation Protection" [112 and 231.2]

DOE G 441.1-13, 1999, "Sealed Radioactive Source Accountability and Control Guide for Use with Title 10 Code of Federal Regulations, Part 835, Occupational Radiation Protection" [112 and 231.2]

DOE M 231.1-1, 2000, "Environment, Safety, and Health Reporting Manual," Chg 2, [112 and 231.2]

DOE M 435.1-1, 2001, "Radioactive Waste Management Manual" Chg 1 [441, 442, and 451]

DOE O 231.1A, 2003, "Environment, Safety, and Health Reporting" [127, 131, 721, 781.4, and 782]

DOE O 414.1A, 2001, "Quality Assurance," Chg 1 [743]

DOE O 420.2A, 2001, "Safety of Accelerator Facilities" [364.2]

DOE O 435.1, 2001, "Radioactive Waste Management," Chg 1 [441, 442, and 451]

DOE O 440.1A, 1998, "Worker Protection Management for DOE Federal and Contractor Employees" [312 and 345.1]

DOE O 460.1B, 2003, "Packaging and Transportation Safety" [423.2]

DOE G 460.1-1, 1997, "Packaging and Transportation Safety" [423.5]

DOE O 460.2, 1995, "Departmental Materials Transportation and Packaging Management," Chg 1 [423.2]

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 8-5 of 8-9

- DOE O 5400.5, 1993, "Radiation Protection of the Public and the Environment," Chg 2 [235, 312.4, 421.1, 422, 451, and Glossary]
- DOE O 5480.4, 1993, "Environmental Protection, Safety, and Health Protection Standards," Chg 4 [365.2]
- DOE O 5480.19, 2001, "Conduct of Operations Requirements for DOE Facilities," Chg 2 [125.1]
- DOE O 5480.20A, 2001, "Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities," Chg 1 [613.10]
- DOE-HDBK-1079-94, 1994, "Primer on Tritium Safe Handling Practices" [363]
- DOE-HDBK-1105-2002, 2002, "Radiological Training for Tritium Facilities" [663]
- DOE-HDBK-1108-2002, 2002, "Radiological Training for Accelerator Facilities" [664]
- DOE HDBK-1110-97, 2002, "ALARA Training for Technical Support Personnel" Chg 1 [652 and 653]
- DOE-HDBK-1113-98, 2002, "Radiological Safety Training for Uranium Facilities" Chg 1 [662]
- DOE-HDBK-1129-99, 1999, "Tritium Handling and Safe Storage" [363]
- DOE-HDBK-1145-2001, 2001, "Radiological Safety Training for Plutonium Facilities" [661]
- DOE O 420.1A, 2002, "Facility Safety" [128 and 381]
- DOE P 450.4, 1996, "Safety Management System Policy" [118]
- DOE-STD-1095-95, 1995, "Department of Energy Laboratory Accreditation Program for Personnel Dosimetry Systems" [512.1 and Glossary]
- DOE-STD-1098-99, 1999, "Radiological Control" [112]
- DOE-STD-1107-97, 1997, "Knowledge, Skills, and Abilities for Key Radiation Protection Positions at DOE Facilities" [142.3, 143.3, 646.1, 651.1, and 654.3]
- DOE-STD-1112-98, 1998, "The Department of Energy Laboratory Accreditation Program for Radiobioassay" [522.1]
- DOE-STD-1128-98, 2003, "Guide of Good Practices for Occupational Radiological Protection in Plutonium Facilities" [361.2]

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 8-6 of 8-9

DOE-STD-1136-2000, 2001, "Guide of Good Practices for Occupational Radiological Protection in Uranium Facilities," Chg 3 [362]

DOE-STD-3020-97, 1997, "Specification for HEPA Filters Used by DOE Contractors" [464.2]

DOE-STD-3022-98, 1998, "DOE HEPA Filter Test Program" [464.2]

DOE-STD-3025-99, 1999, "Quality Assurance Inspection and Testing of HEPA Filters" [464.2]

DOE-STD-3026-99, 1999, "Filter Test Facility Quality Program Plan" [464.2]

EPA, 1988, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion*, Federal Guidance Report No. 11, EPA 520188020, Environmental Protection Agency, available from the National Technical Information Service, Springfield, Virginia [Glossary]

HPS N 13.41-1997, "Criteria for Performing Multiple Dosimetry," Health Physics Society [512.4]

ICRP, 1975, *Reference Man Anatomical Physiological and Metabolic Characteristics*, Publication 23, International Commission on Radiological Protection [Glossary]

National Conference of Standards Laboratories Recommended Practice RP-1, 1996, "Establishment and Adjustment of Calibration Intervals" [562.3]

NCRP, 1980, *Management of Persons Accidentally Contaminated with Radionuclides*, Report Number 65, National Council on Radiation Protection [542.1]

NCRP, 1978, *Radiation Safety Training Criteria for Industrial Radiography*, Report Number 61, National Council on Radiation Protection [655.1]

PLN-260, "INEEL Radiation Protection Program," November 2003 [112, 114, 141, 613, 621, and 631]

ADDITIONAL REFERENCES

10 CFR 20, 2003, Title 10, "Energy," Part 20, "Standards for Protection Against Radiation," Code of Federal Regulations

21 CFR 1020.40, 2003, Title 21, "Food and Drug Administration," Part 1020, "Performance Standards for Ionizing Radiation Emitting Products," Section 40, "Cabinet x-ray systems," Code of Federal Regulations

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 8-7 of 8-9

ANSI/ANS-3.1-1993, "Selection, Qualification, and Training of Personnel for Nuclear Power Plants," American National Standards Institute/American Nuclear Society

ANSI/ANS-8.3-1997, "Criticality Accident Alarm System," American National Standards Institute/American Nuclear Society

ANSI N13.2-1969, "Guide for Administrative Practices in Radiation Monitoring," American National Standards Institute

ANSI N13.3-1969, "Dosimetry for Criticality Accidents," American National Standards Institute

ANSI N13.5-1972, "Performance Specifications for Direct Reading and Indirect Reading Pocket Dosimeters for X- and Gamma Radiation," American National Standards Institute

ANSI N13.15-1985, "For Radiation Detectors - Personnel Thermoluminescence Dosimetry Systems - Performance," American National Standards Institute

ANSI N42.17B-1989, "Performance Specifications for Health Physics Instrumentation - Occupational Airborne Radioactivity Monitoring Instrumentation," American National Standards Institute

ANSI N42.17C-1989, "For Radiation Instrumentation Performance Specifications for Health Physics Instrumentation - Portable Instrumentation for Use in Extreme Environmental Conditions," American National Standards Institute

ANSI N43.17-2002, "Radiation Safety for Personnel Security Screening Systems Using X-rays," American National Standards Institute

ANSI N317-1980, "Performance Criteria for Instrumentation Used for Inplant Plutonium Monitoring," American National Standards Institute

ANSI N320-1979, "Performance Specifications for Reactor Emergency Radiological Monitoring Instrumentation," American National Standards Institute

ANSI N322-1997, "Inspection, Test, Construction, and Performance Requirements for Direct Reading Electrostatic/Electroscope Type Dosimeters," American National Standards Institute

ANSI N323A-1997, "Radiation Protection Instrumentation Test and Calibration Portable Survey Instruments," Institute of Electrical and Electronics Engineers

ASTM E 1168-95 Reapproved 2001, "Standard Guide for Radiological Protection Training for Nuclear Facility Workers," American Society for Testing and Materials

DOE O 5400.5, 1993, "Radiation Protection of the Public and the Environment," Chg 2

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: 8-8 of 8-9

EPA Federal Guidance Report No. 12, 1993, *External Exposure to Radionuclides in Air, Water, and Soil*, Environmental Protection Agency

EPA 400-R-92-001, (1992) *Manual of Protective Action Guides and Protective Actions for Nuclear Incidents*, Environmental Protection Agency

HPS ASC N13.1-1999, "Guide to Sampling Airborne Radioactive Materials in Stacks and Ducts," Health Physics Society

HPS ANSI N13.6-1999, "Practice for Occupational Radiation Exposure Records Systems," Health Physics Society

ANSI N323D-2002, "Installed Radiation Protection Instrumentation," Institute of Electrical and Electronics Engineers

HPS ANSI N13.11-2001, "Personnel Dosimetry Performance - Criteria for Testing," Health Physics Society

ICRP, 1989, *Limits for Intake of Radionuclides by Workers*, Publication 30, Parts 1 through 4, International Commission on Radiological Protection

ICRP, 1991, *1990 Recommendations of the International Commission on Radiological Protection*, Publication 60, International Commission on Radiological Protection

NCRP, 1998, *Operational Radiation Safety Program*, Report Number 127, National Council on Radiation Protection

NCRP, 1991, *Calibration of Survey Instruments Used in Radiation Protection for the Assessment of Ionization Radiation Fields and Radioactive Surface Contamination*, Report No. 112, National Council on Radiation Protection

NCRP, 1987, *Use of Bioassay Procedures for Assessment of Internal Radionuclide Deposition*, Report Number 87, National Council on Radiation Protection

NCRP, 1985, *General Concepts for Dosimetry of Internally Deposited Radionuclides*, Report Number 84, National Council on Radiation Protection

NCRP Report No. 116, 1993, *Limitation of Exposure to Ionizing Radiation*, National Council on Radiation Protection

NIOSH Publication No. 85-115, 1985, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, National Institute for Occupational Safety and Health

NRC, 2000, *Qualification and Training of Personnel for Nuclear Power Plants*, Regulatory Guide 1.8, Rev. 3, Nuclear Regulatory Commission

RADIOLOGICAL CONTROL MANUAL	Identifier: PRD-183 Revision: 7 Page: 8-9 of 8-9
------------------------------------	---

NRC, 1992, *Instructions for Recording and Reporting Occupational Radiation Exposure Data*, Regulatory Guide 8.7, Rev. 1, Nuclear Regulatory Commission

PNL-6577, 1988, *Health Physics Manual of Good Practices to Reducing Radiation Exposure to Levels that are As Low As Reasonably Achievable (ALARA)*, Pacific Northwest National Laboratory, Richland, Washington

PNL-6612, 1988, *Health Physics Manual of Good Practices for the Prompt Detection of Airborne Plutonium in the Workplace*, Pacific Northwest National Laboratory, Richland, Washington

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: G-1 of G-12

GLOSSARY

NOTE: All underlined terms in the glossary were obtained from 10 Code of Federal Regulations (CFR) 835.2 "Definitions."

Abnormal situation: Unplanned event or condition that adversely affects, potentially affects, or indicates degradation in the safety, security, environmental or health-protection performance, or operation of a facility.

Absorbed dose (D) means 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)

Accountable sealed radioactive source means 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 of 10 CFR 835.

Activation: Process of producing a radioactive material by bombardment with neutrons, protons, or other nuclear particles.

Administrative control level: A numerical dose constraint established at a level below the regulatory limits to administratively control and help reduce individual and collective dose.

Airborne radioactive material or airborne radioactivity means radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases.

Airborne radioactivity area means 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 or Appendix C of 10 CFR 835

Or

2. An individual present in the area without respiratory protection could receive an intake exceeding 12 DAC-hours in a week.

ALARA means "as low as reasonably achievable," which is 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. ALARA is not a dose limit but a process that has the objective of attaining doses as far below the applicable limits as is reasonably achievable.

ALARA Committee: Multidisciplinary forum that reviews and advises management on improving progress toward minimizing radiation exposure and radiological releases.

Annual limit on intake (ALI) means 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 1975) that would result in a committed effective dose equivalent of 5 rem (0.05 sievert) or a committed dose equivalent of 50 rem (0.5 sievert) to any individual organ or tissue. ALI values for intake by

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: G-2 of G-12

ingestion and inhalation of selected radionuclides are based on Table 1 of the Environmental Protection Agency Federal Guidance Report No. 11. (EPA 1988).

Assessment: Evaluation or appraisal of a process, program, or activity to estimate its acceptability.

Background means radiation from:

1. Naturally occurring radioactive materials that have not been technologically enhanced
2. Cosmic sources
3. Global fallout as it exists in the environment (such as from the testing of nuclear explosive devices)
4. 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
5. Consumer products containing nominal amounts of radioactive material or producing nominal amounts of radiation.

Becquerel (bq): The International System of Units (SI) unit for activity of radioactive material. The quantity of radioactive material in which one atom is transformed per second or undergoes one disintegration per second is 1 becquerel.

Bioassay means the determination of the 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.

Calibration means to adjust and/or determine either:

1. 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
2. The strength of a radiation source relative to a standard (e.g., primary, secondary, or tertiary) or conventionally true value.

Challenge aerosol: A synthetic hydrocarbon used for in-place high efficiency particulate air (HEPA) -filter integrity testing because of its wide range of particulate sizes and preponderance of particulate 0.3 micron in diameter, the smallest particulate a HEPA filter is designed to filter.

Committed dose equivalent ($H_{T,50}$) means 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 ($H_{E,50}$) means 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)-that is, $H_{E,50} = \sum w_T H_{T,50}$. The committed effective dose equivalent is expressed in units of rem (or sievert).

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: G-3 of G-12

Company-issued clothing: Clothing provided by the Site contractor, such as work coveralls and shoes.

Containment device: A barrier such as a glove-bag, glovebox, or tent for inhibiting the release of radioactive material from a specific location.

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 10 CFR 835, but do not exceed 100 times those values.

Contamination reduction corridor: A defined pathway through a hazardous waste-site contamination reduction zone where decontamination occurs.

Continuing training: Training scheduled over a specified time such as over a 2-year period to maintain and improve technical knowledge and skills.

Continuous air monitor: An instrument that continuously samples and measures the levels of airborne radioactive materials providing real-time monitoring and has alarm capabilities at preset levels.

Contractor means any entity under contract with the Department of Energy (DOE) with the responsibility to perform activities at a DOE site or facility.

Contractor senior site executive: The person at a DOE contractor operated facility or site who has final onsite corporate authority and is often called the president, general manager, site manager, or director.

Controlled area means any area to which access is managed by or for DOE to protect individuals from exposure to radiation and/or radioactive material. [At the INEEL, individuals who enter only the controlled area without entering radiological areas are not expected to receive a total effective dose equivalent of more than 0.1 rem (0.001 sievert) in a year].

Conventionally true value of a quantity: The commonly accepted, best estimate of the true value of a quantity. The conventionally true value and the associated uncertainty will normally be determined by comparison with a national or transfer standard, using a reference instrument that has been calibrated against a national or transfer standard.

Counseling: Advice, information exchange, and guidance provided to employees on a radiologically related topic such as dose perspectives, potential health effects from radiation exposure, skin contaminations, contaminated wounds, internally deposited radioactivity, pregnancy, and radiation exposure. This advice and guidance normally is provided by knowledgeable, senior professionals from the Radiological Control organization and other organizations, such as Occupational Medical, as appropriate.

Critical mass: The smallest mass of fissionable material that will support a self-sustaining chain reaction under specified conditions.

Critique: Meetings of personnel involved in or knowledgeable about an event (either a successful or an abnormal event) to document a chronological listing of the facts.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: G-4 of G-12

Cumulative total effective dose equivalent means the sum of the total effective dose equivalents recorded for an individual, where available, for each year that occupational dose was received, beginning January 1, 1989.

Curie (Ci): A quantity of any radioactive material with a transformation rate of 3.7×10^{10} disintegrations per second.

Daily means anytime within a calendar day for the purposes of compliance with this manual.

Declared pregnant worker means a woman who has voluntarily declared to her employer, in writing, her pregnancy for the purpose of being subject to the occupational dose 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.

Decontamination: Process of removing radioactive contamination and materials from personnel, equipment, or areas.

Deep dose equivalent means the dose equivalent derived from external radiation at a depth of 1 cm in tissue.

Deposition, new confirmed: A deposition of radioactive material in the body or any organ or tissue of an individual identified during the current reporting period, confirmed through bioassay results to be greater than the Site-determined reportable level.

Derived air concentration (DAC) means, for the radionuclides listed in Appendix A of 10 CFR 835, the airborne concentration that equals the ALI divided by the volume of air breathed by an average worker for a working year of 2,000 hours (assuming a breathing volume of 2,400 m³). For the radionuclides listed in Appendix C of 10 CFR 835, the air immersion DACs were calculated for a continuous, nonshielded exposure via immersion in a semi-infinite atmospheric cloud. The value is based on the DAC found in Table 1 of the U.S. Environmental Protection Agency Federal Guidance Report No. 11 (EPA 1988).

Derived air concentration-hour (DAC-hour) means 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.

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 instrumentation.

DOE activity means 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 conducted according to the specifications in DOE-STD-1095-95, "Department of Energy Laboratory Accreditation Program for Personnel Dosimetry Systems."

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
 Revision: 7
 Page: G-5 of G-12

DOE Phantom Library: A program for lending in vivo calibration phantoms to DOE and other in vivo laboratories. The library is operated by Pacific Northwest National Laboratory in Richland, Washington, for the DOE Office of Worker Protection Programs and Management.

Dose is a general term for absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent.

Dose assessment: Process of determining radiation dose and the uncertainty included in the dose estimate, through the use of exposure scenarios, bioassay results, monitoring data, source term information, and pathway analysis.

Dose equivalent (H) means the product of the absorbed dose (D) in rad (or gray) in tissue, a quality factor (Q), and all other modifying factors (N). Dose equivalent is expressed in units of rem (or sievert) (1 rem = 0.01 sievert).

Effective dose equivalent (H_E) means the summation of the products of the dose equivalent received by specified tissues of the body (H_T) and the appropriate weighting factors (W_T)—that is, $H_E = \sum W_T H_T$. It includes the dose from radiation sources internal and/or external to the body. For the purposes of compliance with 10 CFR 835, 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).

Embryo/fetus: A developing human organism from conception until birth, synonymous with unborn child.

Engineering controls: Use of components and systems to reduce airborne radioactivity and the spread of contamination by using piping, containments, ventilation, filtration, or shielding.

Entrance or access point means any location through which an individual could gain access to areas controlled for the purposes of radiation protection. This includes entry or egress portals of sufficient size to permit human entry, irrespective of their intended use.

Extremity means the hands and arms below the elbow or feet and legs below the knee.

External dose or exposure means that portion of the dose equivalent received from radiation sources outside the body (i.e., “external sources”).

Facility: For the purposes of this manual, a facility includes systems, buildings, utilities, and related activities whose use is directed to a common purpose at a single location. Examples include accelerators, storage areas, test loops, nuclear reactors, radioactive waste disposal systems and burial grounds, testing laboratories, research laboratories transport activities, and accommodations for analytical examinations of components. Also includes the following: pipelines, ponds, impoundments, landfills, motor vehicles, rolling stock, and aircraft.

Filter integrity test or leak test: A test, normally accomplished using a high-quality challenge aerosol, performed on HEPA filters to identify any damage to the filter or leakage around the filter during in-place testing.

Frisk or frisking: Process of monitoring personnel for contamination. Frisking can be performed with hand-held survey instruments, automated monitoring devices, or by a radiological control technician.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: G-6 of G-12

General employee means 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 uses DOE facilities.

Gestational period: The time from conception to birth, approximately 9 months.

Gray (Gy): SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule per kilogram (100 rad).

High-efficiency particulate air (HEPA) filter: Normally considered to be a throwaway, extended-media dry type filter with a rigid casing enclosing the full depth of the pleats. The filter has a minimum efficiency rating of 99.97% for the removal of particles with a diameter of 0.3 micron.

High contamination area means any area, accessible to individuals, where removable surface contamination levels exceed or are likely to exceed 100 times the removable surface contamination levels specified in Appendix D of 10 CFR 835.

High radiation area means 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 Sv) in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

Hot particle: Fuel, activated corrosion product, or other particles of small size that have a high specific activity as a result of nuclear fission or neutron activation.

Hot spot: Localized source of radiation or radioactive material normally within facility piping or equipment. The radiation levels of hot spots exceed the general area radiation level by more than a factor of 5 and are greater than 100 mrem (1 mSv) per hour on contact.

Individual means any human being.

Internal dose or exposure means that portion of the dose equivalent received from radioactive material taken into the body (e.g., internal sources).

Infrequent or first-time activities: Radiological work activities or operations that require special management attention and consideration of new or novel radiological controls. The designation of infrequent or first-time activities is specifically applicable to facilities that conduct routine and recurring process operations, and is not applicable to facilities that routinely conduct first-time activities, such as experimental or research facilities.

Leak test: (see definition under filter integrity test)

Lens of the eye dose equivalent means the external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 cm.

Locked high radiation area (LHRA): A high radiation area that is locked in which radiation levels could result in an individual with access to the area receiving a deep-dose equivalent to the whole body in excess of 1 rem (0.01 Sv) in 1 hour at 30 cm from the radiation source or from any surface that radiation penetrates.

Low-level waste: Waste that contains radioactivity and is not classified as high-level waste, transuranic waste, spent nuclear fuel, or byproduct material as defined in Section 11e(2) of the

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: G-7 of G-12

Atomic Energy Act, as amended. Test specimens of fissionable material irradiated only for research and development and not for production of power or plutonium may be classified as low-level waste, provided the concentration of transuranic activity is less than 100 nCi/g.

Member of the public means 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 an occupational dose.

Minor means an individual less than 18 years of age.

Mixed waste: Waste containing both radioactive and hazardous components as defined by the Atomic Energy Act and the Resources Conservation and Recovery Act, respectively.

Monitoring means 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.

Monthly means every calendar month for the purposes of compliance with this manual.

Nonstochastic effects means 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).

Nuclear criticality: a self-sustaining chain reaction or the state in which the effective neutron multiplication constant of system of fissionable material equals or exceeds unity.

Occupational dose means 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.

Performance Check: Verification by a knowledgeable and trained individual that an instrument is properly operating by general instrument check and exposing the instrument to a known source to validate that the instrument response is within +/- 20% of response to same or similar source following calibration.

Person means 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.

Personnel dosimetry: Devices designed to be worn by a single person for the assessment of dose equivalent such as film badges, thermoluminescent dosimeters (TLDs), and pocket ionization chambers.

Personnel monitoring: Systematic and periodic estimate of radiation dose received by personnel during working hours. Also, the monitoring of personnel, their excretions, skin, or any part of their clothing to determine the amount of radioactivity present.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: G-8 of G-12

Personal protective equipment: Equipment such as respirators, face shields, and safety glasses used to protect workers from excessive exposure to radioactive or hazardous materials.

Phantom: A device, generally made of synthetic material to simulate human tissue, organs, or bone structure, that is used to calibrate radiation detection equipment. Examples include a realistic torso phantom and lung, thyroid, or liver calibration phantoms.

Planned special exposure: Preplanned, infrequent exposure to radiation, separate from and in addition to, the annual dose limits.

Prefilter: Filter that provides first-stage air filtration to remove larger particulates and prolong the efficient use of a HEPA filter.

Prenatal radiation exposure: The exposure of an embryo/fetus to radiation.

Primary dosimeter: A dosimeter worn on the body used to obtain the formal record of whole-body radiation dose.

Protective clothing: Clothing provided to personnel to minimize the potential for skin, personal, and company-issued clothing contamination. Also referred to as “anticontamination clothing,” “anti-Cs,” and “PCs.”

Qualification standard: The explicit performance requirements for minimum proficiency in technical, academic, and Site-specific knowledge and practical skills used in determining satisfactory completion of training programs.

Quality factor (Q) means 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. The quality factors are listed in 10 CFR 835.

Quarterly means every calendar quarter for the purposes of compliance with this manual.

Rad: Unit of radiation absorbed dose. One rad is equal to an absorbed dose of 100 ergs per gram or 0.01 joules per kilogram (0.01 gray).

Radiation means 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 nonionizing radiation such as radiowaves or microwaves or visible, infrared, or ultraviolet light.

Radiation area means 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 mSv) in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

Radioactive material: For the purposes of this manual, 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 radiation.

Radioactive material transportation means 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

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: G-9 of G-12

not include preparation of material or packaging for transportation, monitoring required by 10 CFR 835, storage of material awaiting transportation, or application of markings and labels required for transportation.

Radioactive material area means 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 of 10 CFR 835.

Radioactive waste: Solid, liquid, or gaseous material that contains radionuclides regulated under the Atomic Energy Act, as amended, and is of negligible economic value considering the cost of recovery.

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.

Radiography: Examination of the structure of materials by nondestructive methods using a radioactive source or a radiation-generating device.

Radiological area means any area within a controlled area defined in this section as a radiation area, high radiation area, very high radiation area, contamination area, high contamination area, or airborne radioactivity area. [At the INEEL, this includes radiological buffer area and locked high radiation area].

Radiological buffer area (RBA): An intermediate area established to prevent the spread of radioactive contamination and to protect personnel from radiation exposure.

Radiological control hold point: Cautionary step in a technical work document requiring the Radiological Control organization to perform some action or verification. The radiological control hold-point requirements will be satisfactorily completed before the work is continued.

Radiological label: Label on an item that indicates the presence of radiation or radioactive materials.

Radiological posting: Sign, marking, or label that indicates the presence or potential presence of radiation or radioactive materials.

Radiological work: Any work that requires the handling of radioactive material or that requires access to radiation areas, high radiation areas, very high radiation area, contamination areas, high contamination areas, or airborne radioactivity areas.

Radiological work permit (RWP): A written permit that identifies radiological conditions, establishes worker protection and monitoring requirements, and contains specific approvals for radiological work activities. Radiological work permits serve as an administrative process for planning and controlling radiological work and informing workers of radiological conditions.

Radiological worker mean a general employee whose job assignment involves operation of radiation producing 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. [At the INEEL, a radiological worker also may be referred to as a radiation worker or

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: G-10 of G-12

a “radworker.” Individuals who complete either Radiological Worker I or Radiological Worker II training are designated radiological workers].

Real-time air monitoring means measurement of the concentrations or quantities of airborne radioactive materials on a continuous basis.

Refresher or requalification training: Training scheduled to reacquaint one with material previously studied and applicable lessons learned.

Release to uncontrolled areas: Release of material from administrative control after confirming that the residual radioactive material meets the guidelines in DOE O 5400.5, “Radiation Protection of the Public and the Environment.”

Rem: A unit of dose equivalent that 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 nondestructive means such as casual contact, wiping, brushing, or washing.

Representative sample: A sample that closely approximates both the concentration of activity and the physical and chemical properties of material (e.g., particle size and solubility in case of air sampling of the aerosol to which workers may be exposed).

Respiratory protective device means an apparatus, such as a respirator, worn by an individual for the purpose of reducing the individual intake of airborne radioactive materials.

Response Check: Verification by a knowledgeable and trained individual that an instrument is properly operating by general instrument condition check and noting proper function in non-zero background area or near radioactive sources.

Sealed radioactive source means 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 nonradioactive 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.

Shallow dose equivalent means the dose equivalent deriving from external radiation at a depth of 0.007 cm in tissue.

Sievert (Sv): An SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv = 100 rem).

Site: An area managed by DOE where access can be limited for any reason. The Site boundary encompasses controlled areas.

Source leak test means a test to determine whether a sealed radioactive source is leaking radioactive material.

RADIOLOGICAL CONTROL MANUAL

Identifier: PRD-183
Revision: 7
Page: G-11 of G-12

Step-off pad: Transition area between contaminated and noncontaminated areas that is used to allow exit of personnel and removal of equipment.

Stochastic effects means 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.

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.

Technical work document: A term used to generically identify formally approved documents that direct work, such as procedures, work packages, or job or research plans.

Thermoluminescent dosimeter (TLD): Radiation monitoring device used to record the radiological exposure of personnel or areas to certain types of radiation.

Total effective dose equivalent (TEDE) means the sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures). [At the INEEL, deep-dose equivalent to the whole body may be used as effective dose equivalent for external exposures].

Transuranic waste: Without regard to source or form, waste that is contaminated with alpha-emitting transuranic radionuclides having half-lives greater than 20 years and concentrations greater than 100 nCi/g at the time of assay.

Unusual occurrence: Nonemergency occurrence that has significant impact or potential for impact on safety, the environment, health, security, or operations.

Very high radiation area means 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 m from a radiation source or from any surface that the radiation penetrates.

Week means a period of seven consecutive days.

Weekly means every calendar week for the purposes of compliance with this manual. When no work is in progress, response check from the previous workday may be used for operational and safety-related tours.

Weighting factor (w_T) means 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 listed in 10 CFR 835.

Whole body means, for the purposes of external exposure, head, trunk (including male gonads), arms above and including the elbow, or legs above and including the knee.

Whole-body dose means the sum of the annual deep-dose equivalent for external exposures and the committed effective dose equivalent for internal exposures.

RADIOLOGICAL CONTROL MANUAL	Identifier: PRD-183 Revision: 7 Page: G-12 of G-12
------------------------------------	---

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 10 CFR 835. The starting date 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.

Yearly means every 12 months \pm 3 months for the purposes of compliance with this manual.