Department of Energy

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RECEIVED
By Carolee.Thompson at 10:38 am, Mar 20, 2019

MAR 20 2019

Mr. Jeff Bradford, Program Manager
Four Rivers Nuclear Partnership, LLC
5511 Hobbs Road
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PPPO-02-5443901-19

Dear Mr. Bradford:

CONTRACT NO. DE-EM0004895: APPROVAL OF DELIVERABLE NO. 98, RADIATION PROTECTION PROGRAM, CP2-RP-0001/FR0A

Reference: Letter from J. Bradford to M. Fultz, "Four Rivers Nuclear Partnership, LLC, Deliverable No. 98—*Radiation Protection Program for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, CP2-RP-0001/FR0A," (FRNP-19-2085), dated February 20, 2019

The U.S. Department of Energy (DOE) has reviewed the revised Four Rivers Nuclear Partnership, LLC (FRNP) Deliverable No. 98, *Radiation Protection Program (RPP) for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, CP2-RP-0001/FR0A.

FRNP originally submitted the RPP to DOE on October 31, 2018, with administrative changes only. DOE requested that in addition to the administrative changes, FRNP should also incorporate DOE-STD-1098-2017 completely into the RPP as required by the FRNP Contract (Modification 0036).

There are several changes between DOE-STD-1098-2008 (current standard used in the submitted RPP) and DOE-STD-1098-2017. In order to ensure proper flow down from the RPP to FRNP procedures and documents, FRNP identified every implementing procedure and document needs to be reviewed and revised. This information was discussed with the DOE Portsmouth/Paducah Project Office Health Physicist during a comment resolution meeting that was held on January 24, 2019. In the meeting, FRNP proposed to complete incorporation of DOE-STD-1098-2017 into the RPP and submit to DOE for review and approval by January 6, 2020.

Based upon the agreed resolution of comments, DOE finds the document to be acceptable and hereby approves the RPP.

If you have any questions or require additional information, please contact Gil Whitehurst at (740) 897-2948.

Sincerely,

Robert E. Edwards, III
Manager
Portsmouth/Paducah Project Office

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CP2-RP-0001/FR0A

Radiation Protection Program for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

This document is approved for public release per review by:

W. K. Colvin 10-16-18

FRNP Classification Support Date

Radiation Protection Program for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—October 2018

U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

Prepared by
FOUR RIVERS NUCLEAR PARTNERSHIP, LLC,
managing the
Deactivation and Remediation Project
at the Paducah Gaseous Diffusion Plant
under Contract DE-EM0004895

Total Pages: 78

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APPROVALS

Radiation Protection Program for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

CP2-RP-0001/FR0A

October 2018

Approved: _____ Date: 10/29/18
Kevin Funke
Radiation Protection Manager

Approved: _____ Date: 10.29.18
Roland Chretien
Environmental, Safety, Health & Quality Director

DOE Approval Letter: PPPO-02-5443901-19 Date: 3-20-2019

Effective Date: ~~11-1-18~~ 10-29-18 4/1/2019

Required Review Date: 10/6/2020

Nuclear Safety Documentation: NA per CP3-NS-2001, Step 6.1.1

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REVISION LOG

REVISION NUMBER	DATE	DESCRIPTION OF CHANGES	PAGES AFFECTED
FR0	10/05/2017	Initial release by FRNP	All
FR0A		Administrative change to update reference identified in CAPA CA-1265. Also to update other references and editorial changes throughout document.	Applies to entire document.

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ACRONYMS

ACL	administrative control level
ALARA	as low as reasonably achievable
ARA	airborne radioactivity area
ARM	area radiation monitor
ASME	American Society of Mechanical Engineers
BZA	breathing zone air
CA	Contamination Area
CAM	continuous air monitor
CFR	*Code of Federal Regulations*
DAC	derived air concentration
DOE	U.S. Department of Energy
DOELAP	U.S. Department of Energy Laboratory Accreditation Program
DOT	U.S. Department of Transportation
ESH&Q	Environmental, Safety, Health, and Quality
FNAD	fixed nuclear accident dosimeter
FRNP	Four Rivers Nuclear Partnership, LLC
GERT	General Employee Radiological Training
HCA	High Contamination Area
HRA	High Radiation Area
ICRP	International Commission on Radiological Protection
NCS	nuclear criticality safety
NIST	National Institute of Standards and Technology
NRC	U.S. Nuclear Regulatory Commission
PGDP	Paducah Gaseous Diffusion Plant
PNAD	personal nuclear accident dosimeter
PPE	personal protective equipment
PPPO	Portsmouth/Paducah Project Office
RADCON	radiological control
RCT	radiological control technician
RCTS	radiological control technician supervisor
RP	radiation protection
RPM	radiation protection manager
RPP	Radiation Protection Program
RPPM	Radiation Protection Program Manager
RWP	radiological work permit
TED	total effective dose
TRU	transuranic
URMA	Underground Radioactive Materials Area
USEC	United States Enrichment Corporation
VHRA	Very High Radiation Area

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EXECUTIVE SUMMARY

The purpose of this Radiation Protection Program (RPP) document is to describe a program in which radiological work at the Paducah Gaseous Diffusion Plant (PGDP) can be performed safely and compliantly with applicable portions of the *Code of Federal Regulations* (*CFR*) and U.S. Department of Energy (DOE) guidance and directives documents.

This program document is fully integrated with the other Safety Management Plans prepared by PGDP. No exemptions from regulatory requirements or DOE directives are required or requested. Full programmatic compliance and operational implementation has been achieved prior to transition.

Four Rivers Nuclear Partnership, LLC, (FRNP) has developed, implemented, and is maintaining a DOE-approved radiological program, as described in Contract DE-EM0004895. As required by Contract DE-EM0004895 and as further described herein, FRNP's RPP includes all dosimetry, instrumentation, data, and records, with the exception of those elements provided as a government furnished service by the Infrastructure Contractor, necessary to demonstrate compliance with the required radiological monitoring and to verify the adequacy of site radiological control programs in protecting the health and safety of workers, the public, and the environment. Discrepancies in provided services are brought to the attention of DOE for resolution.

This RPP was put into place to meet the Price-Anderson Amendments Act requirements of 10 *CFR* § 835, *Occupational Radiation Protection*, for this contract. The purpose of the RPP is to accomplish the contracted work in a manner that minimizes exposure to ionizing radiation for employees, the public, and the environment to levels as low as reasonably achievable (ALARA). This RPP incorporates an ALARA policy using a graded approach to the application of pre-job ALARA reviews, workplace monitoring, job site inspections, and radiological performance indicators to assure accomplishment of annually established radiological performance goals.

This RPP is a management tool to enhance the ability to carry out tasks in a manner that will protect employees, the public, and the environment. Subcontractors are required to comply with this RPP; doing so removes the necessity of developing a FRNP-specific RPP. Subcontractors who possess DOE-approved RPP may use that program in support of FRNP activities only after it has been evaluated and approved by the FRNP Radiation Protection Manager. The RPP will be forwarded to DOE for approval. Subcontractor RPPs must contain scope-specific requirements equivalent to those in the FRNP RPP.

Together with the other safety-related programs, the RPP is an integral part of the site's *Integrated Safety Management System Description for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (CP2-HS-1000). Additionally, in accordance with 10 *CFR* § 830, *Nuclear Safety Management*, Subpart A, *Quality Assurance Requirements*; and DOE Order 414.1D, *Quality Assurance*, activities described in this RPP affect the quality of structures, systems, and components of nuclear facilities, whether the facility is under construction, operational, or in the decommission phase of its life. The activities addressed in the RPP are necessary to achieve safe, compliant, and operationally practical management of radioactive materials. As such, the RPP focuses on the achievement of results, emphasizes the role of the individual and line management in the achievement of quality, and fosters the application of these requirements in a manner consistent with the relative importance of the item or activity.

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1. PROGRAM MANAGEMENT AND ADMINISTRATION

1.1 INTRODUCTION

The Paducah Gaseous Diffusion Plant (PGDP) is a 3,556-acre tract in McCracken County, Kentucky. The site is in a generally rural area and was previously part of the Kentucky Ordnance Works. Approximately 1,986 acres of the site are leased to the Kentucky Department of Fish and Wildlife Resources. The largest cities within a 50-mile radius are Paducah, Kentucky, located approximately 12 air miles to the east, and Cape Girardeau, Missouri, located approximately 40 air miles to the west. Portions of 28 counties are located within a 50-mile radius of the plant; 11 of which are in Kentucky, 4 in Missouri, 10 in Illinois, and 3 in Tennessee.

PGDP occupies approximately 809 acres within the fenced limited security area. Highway U.S. 60 is the closest major highway and intersects the plant access road 3.5 miles south of the plant. Interstate Highway 24 is to the east of the plant and intersects U.S. 60 near the present city limits of Paducah.

The north, east, and west boundaries of the plant are defined by the West Kentucky Wildlife Management Area. Adjoining the wildlife area on the north is the Tennessee Valley Authority's Shawnee Fossil Plant, which is located on the Ohio River.

PGDP is a uranium enrichment plant that was constructed in the early-1950s and operated by the U.S. Department of Energy (DOE) and its predecessor agencies to supply low-enriched uranium for defense purposes and for commercial nuclear fuel sales. Enrichment operations at PGDP were discontinued by United States Enrichment Corporation (USEC) in 2013. PGDP underwent transfer of the facilities to DOE that were leased and operated by USEC in 2014.

The uranium enrichment program using the gaseous diffusion process resulted in the generation of significant quantities of radioactive, hazardous, and mixed waste. Activities at the site resulted in the contamination of equipment, facilities, soil, and groundwater with radioactive and hazardous contaminants. Waste and contaminants at the site include those regulated under the Resource Conservation and Recovery Act, the Toxic Substances Control Act, and the Atomic Energy Act, as amended, including construction debris, sanitary waste, hazardous waste, radioactive low-level waste, mixed low-level waste, transuranic (TRU) waste, and mixed TRU waste. Many of these wastes were stockpiled or disposed of on-site, resulting in the site being placed on the U.S. Environmental Protection Agency's National Priorities List in 1994.

Four Rivers Nuclear Partnership (FRNP), LLC, performs remediation, deactivation, and surveillance and maintenance in support of preparing the facilities for future demolition, in accordance with the terms and conditions of the Contract DE-EM0004895 with DOE. FRNP is responsible for ensuring compliance with all applicable laws, regulations, and contract requirements. FRNP also ensures compliance with safety basis documents and other regulatory agreements.

This Radiation Protection Program (RPP) document is applicable to all work activities that involve radioactive materials unless otherwise excluded from the requirements of 10 *CFR* § 835, *Occupational Radiation Protection.* The RPP addresses all of the requirements of 10 *CFR* § 835 that are applicable to PGDP. Appendix A of this document, Cross-Reference 10 *CFR* § 835 to FRNP RPP, provides a cross-reference between 10 *CFR* § 835 requirements and the provisions of this RPP, including the basis for any 10 *CFR* § 835 requirements that have been excluded from this RPP. It also shows the procedures into which the requirements have been incorporated.

This RPP applies all principles and functions of the Integrated Safety Management System process. Radiation protection is an integral component of the planning and execution of radiological work performed by FRNP.

1.2 PROJECT MANAGEMENT

Project execution is led by the program manager who is responsible and accountable for the execution of the work scope. The program manager is the senior line manager who is fully empowered to control project resources and has cradle-to-grave responsibility for project planning and execution. The program manager is supported by a team of Managers, to whom report various line managers who oversee specific projects as assigned. These line managers are responsible for all aspects of project execution, including implementation of radiation safety measures as required by this RPP, written radiation protection procedures, and written work authorizations. Work activities for the project include waste management, environmental restoration, facility deactivation, decontamination and demolition, facility upgrades, and material disposition.

1.3 RADIATION PROTECTION ORGANIZATION

The Radiation Protection (RP) organization, within the Environmental, Safety, Health, and Quality (ESH&Q), is responsible for developing and overseeing implementation of the RPP and for providing support to line management in complying with program requirements. The RP organization is managed by the radiation protection manager (RPM) who reports to the ESH&Q manager. The RPM is supported by a team of radiation protection project managers (RPPMs), radiological control technician supervisors (RCTS), lead techs, radiation protection technicians (RCTs), health physicists, and other personnel who are responsible for executing the programmatic and field operations aspects of the program. The RPM is responsible for ensuring implementation of the requirements of 10 *CFR* § 835 and its supporting guidance as it applies to the project.

To ensure that there are no conflicts between personnel, RP, and production goals, the ESH&Q organization, including RP, reports to the FRNP program manager and is independent of the execution organizations. Additionally, the RPM has the autonomy to interface directly with the FRNP program manager regarding urgent matters impacting radiological safety.

Support personnel who provide RP and radiological engineering, dosimetry, bioassay, independent oversight, and instrumentation and calibration functions are required to have technical qualifications commensurate with their assigned duties as specified in FRNP's training program description document, CP2-TR-0100, *Training Program for the Paducah Gaseous Diffusion Plant Paducah, Kentucky.* [DOE O 426.2]

RCTs and their supervisors perform the function of assisting and guiding workers in the radiological aspects of the job. RCTs and their supervisors are qualified and trained in accordance with an approved qualification and training program as outlined in CP2-TR-0100. [DOE O 426.2, DOE-STD-1098, DOE-HDBK-1122-2009] and RPP procedures. RCTs and their supervisors have the responsibility and authority to stop radiological work, take a "time out" to mitigate the effect of an activity if they suspect that the initiation or continued performance of a job, evolution, or test will result in the violation of approved radiological protection requirements.

This RPP and its requirements are not applicable to the activities excluded in 10 *CFR* § 835, Subpart A. Additionally, this RPP does not govern independent activities performed by other site prime contractors who have their own 10 *CFR* § 835-compliant RPP activities (i.e., Swift & Staley Inc. and Mid-America Conversion Services). If other site prime contractors perform radiological work as a subcontractor to FRNP, the FRNP RPM may allow the work to be performed in accordance with the prime contractor's RPP after a thorough review has been performed to ensure the other prime contractor's RPP provides an equivalent level of protectiveness for the scope being performed. The RPP will be submitted to site DOE for approval. To avoid interface conflicts, the respective RPMs will concur on delegation of program roles, responsibilities, accountabilities, and authorities prior to work start.

With regard to surveys or processes in support of U.S. Department of Transportation (DOT) activities or unrestricted release under DOE Order 458.1, programs established under this RPP may be utilized in order to ensure consistency across the organization. However, this RPP is not applicable when conditions stated in a DOE-approved Authorized Limit are met.

1.4 RADIATION PROTECTION PROGRAM

1.4.1 Purpose and Scope

This RPP description document provides an overview of the measures implemented by FRNP to ensure compliance with the requirements of 10 *CFR* § 835 for the PGDP Deactivation Project. FRNP is responsible for ensuring compliance with 10 *CFR* § 835 and implements the appropriate management and administrative measures necessary to ensure that authorized activities are conducted in accordance with this RPP. [10 *CFR* § 835.101(a) (e)]

This RPP is consistent with the requirements of 10 *CFR* § 835.101, *Radiation Protection Programs* and DOE Order (O) 458.1, *Radiation Protection of the Public and Environment.* This RPP describes the general requirements for ensuring that employees, members of the public, and the environment are protected from the effects of ionizing radiation during the execution of PGDP Deactivation, Remediation project activities within the scope of DOE Contract DE-EM0004895. It applies to work activities that involve radioactive materials, unless otherwise excluded from the requirements of 10 *CFR* § 835. This RPP is applicable at any location, on and off the Paducah Reservation, where FRNP may perform work for DOE under Number DE-EM0004895. DOE approval is required for any radiological activities performed beyond the DOE Reservation. The DOE Reservation includes property owned by DOE, property leased to DOE Prime Contractors in support of DOE scope, and DOE-owned property licensed to the Commonwealth of Kentucky, which makes up portions of the West Kentucky Wildlife Management Area. This work scope includes the following: [10 *CFR* § 835.101(c) (d)]

- Environmental restoration and remediation
- Environmental monitoring
- Facility deactivation
- Building decommissioning, decontamination, and demolition
- Facility upgrades
- Waste management

- Material disposition
- Other activities in support of DOE's environmental management mission, as described in Contract DE-EM0004895

Radiological support for off-site agencies and hospitals during plant emergencies and radiological incidents will be provided as described in CP2-EP-1000, *Paducah Site Emergency Plan for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, which has been approved by DOE.

The upper level requirements described in this RPP are implemented through a variety of mechanisms, including written administrative and technical procedures and instructions, work authorizations, and employee training and qualifications.

This RPP is intended to address all the requirements of 10 *CFR* § 835 that are applicable to the site. Appendix A, "Cross-Reference 10 *CFR* § 835 to PGDP Radiation Protection Program," provides a crosswalk that links the 10 *CFR* § 835 section with its respective implementing RPP section. In the third column of this appendix is the implementing procedure title that flows down the corresponding requirement from the RPP. While this RPP is not intended specifically to address activities associated with radioactive material transportation, programs and techniques within this document may be used in support of transportation activities in order to promote consistency across the organization. Those programs and techniques are also subject to requirements published in DOT regulations and applicable DOE Orders. If activities licensed by the U.S. Nuclear Regulatory Commission (NRC) or by the Commonwealth of Kentucky are performed in areas controlled by FRNP, such as radiography or well logging, RP may impose additional requirements to ensure the radiological safety of FRNP employees, subcontractors, and staff augmentation personnel.

No actions will be taken that are inconsistent with the requirements of this RPP or any other program, plan, schedule, or process that implements the requirements of 10 *CFR* § 835. FRNP management is responsible for compliance with this RPP. Nothing in this RPP is to be construed as limiting actions that may be necessary to preserve health and safety. [10 *CFR* § 835.3(a) (b) (d)]

Requirements are implemented by Environmental Radiological Protection Program (ERPP) procedure, CP2-ES-0103, as required by DOE Order (O) 458.1. The elements of the RP program that are applicable to the execution of the ERPP will be integrated in order to promote consistency throughout the organization. Integration of Integrated Safety Management System core functions and principles with regard to the RPP and ERPP also is required.

FRNP will obtain several RP programmatic elements from the DOE's Infrastructure Contractor as a government furnished service. These services include radiological monitoring instrument maintenance, instrument calibration, and DOE Laboratory Accreditation Program (DOELAP) accredited dosimetry services to include external dosimeters, external dosimetry processing, analysis, and dosimetric information databases. FRNP will request that joint assessments with DOE of these key programmatic elements be conducted to ensure the services provided meet the requirements of 10 *CFR* § 835 and FRNP expectations for service. Any discrepancy or noncompliance will be brought to the attention of the Infrastructure Contractor and DOE for timely resolution.

1.4.2 Plans, Schedules, and Other Measures for Achieving Full Implementation

All programmatic elements of this RPP have been established by FRNP or through government-furnished services provided by the Infrastructure Contractor. This RPP, in conjunction with other FRNP program documents such as CP2-QA-1000, *Quality Assurance Program Description for the Paducah Gaseous*

Diffusion Plant, Paducah, Kentucky, and CP2-HS-2000, *Worker Safety and Health Program for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, governs authorized radiological activities that are regulated by DOE. Appendix B, "Radiological Assessment Functional Elements," cross-references functional elements to the corresponding 10 *CFR* § 835 requirement.

1.4.3 RPP Approval and Changes

This RPP revision has been approved by cognizant FRNP management and submitted to DOE for approval by the Portsmouth/Paducah Project Office (PPPO) Field Element Manager or other properly designated DOE authority.

Revisions to this RPP may be instituted as necessary to reflect changes in the scope of the covered activities, changes in the radiological controls instituted for those activities, or changes to 10 *CFR* § 835. Any change that does not reduce the effectiveness of the RPP and that continues to meet the requirements of 10 *CFR* § 835 will become effective upon FRNP management approval without prior DOE approval. Any proposed change that may reduce the effectiveness of the RPP will be submitted to and be approved by DOE prior to implementation. In any case, further changes will be submitted to DOE for information or review and approval, as necessary. RPP updates required due to 10 *CFR* § 835 amendments will be submitted to DOE within 180 days of the effective date of the regulatory amendment. [10 *CFR* § 835.101(b)(g)–(i)]

1.4.4 Exemptions

FRNP does not foresee a condition whereupon a 10 *CFR* § 835 exemption request is warranted or justified, at this time.

1.5 INTEGRATED SAFETY MANAGEMENT

An RPP is an element of safety that integrates safety management into work practices as established in CP2-HS-1000, *Integrated Safety Management System Description for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*. This program document flows down requirements from DOE Policy 450.4, *Integrated Safety Management Policy*. This RPP is intended to be consistent and complement with safety implementation. This RPP supports safety by providing a system of radiological controls that can be implemented and tailored to meet hazard-specific needs. In addition, this RPP provides guidance and integration of controls for increasing worker involvement in identification and implementation of appropriate controls [e.g., in as low as reasonably achievable (ALARA) work planning].

1.6 INTERNAL ASSESSMENTS

FRNP has implemented an independent internal radiological assessment program that examines the content and implementation of all functional elements of the RPP at least once every 36 months. [10 *CFR* § 835.102] The functional elements of the program and assessment criteria are established in the assessment program, procedures, or other documents. Management and self-assessments are conducted by FRNP and/or external personnel in accordance with CP2-QA-1000, *Quality Assurance Program Description for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*. Appendix B, Radiological Assessment Functional Elements" shows the functional elements, regulatory provision, and associated guidance documents. Internal audits should be conducted by individuals who are organizationally independent from organizations responsible for developing the RPP. An independent triennial assessment should be performed to ensure the radiological assessment program is compliant.

1.7 EDUCATION, TRAINING, AND SKILLS

FRNP has implemented processes to ensure that all individuals who bear responsibility for developing and implementing measures necessary for ensuring compliance with 10 *CFR* § 835 have the appropriate education, training, and skills to discharge those responsibilities. [10 *CFR* § 835.103] Processes and requirements are identified in CP2-TR-0100. Affected personnel include members of the RP organization and specified managers and supervisors who oversee personnel that work in controlled areas. CP2-TR-0100 implements requirements from DOE Order 426.2, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*. [DOE-STD-1098, DOE-HDBK-1122-2009]

1.8 WRITTEN PROCEDURES AND OTHER DOCUMENTATION

The RPP description document is not intended to be a working-level document. The provisions of the RPP are implemented through lower level administrative controls, including written procedures (see cross-reference in Appendix A, Cross-Reference 10 *CFR* § 835 to FRNP Radiation Protection Program) and work authorizations. FRNP develops and implements written procedures, work authorizations, and other documents as needed to ensure compliance with the requirements of 10 *CFR* § 835. Procedure processes are identified in CP3-OP-0002, *Developing and Maintaining Performance Documents*. All employees, subcontractors, and staff augmentation personnel are obligated to comply with the applicable procedures and other documents that implement this RPP.

Written authorizations are developed and implemented to control entry into and work within all radiological areas. The work authorizations may be in the form of written procedures, radiological work permit (RWP) or technical work document authorized by the RPM or designee. The need for written procedures for any specified activity is based on an assessment of various factors including the following: [10 *CFR* § 835.501 d]

- Level and extent of radiological hazards;
- Complexity of the measures required to achieve compliance; and
- Education, training, and skills of affected individuals.

The work authorizations, whether in the form of a written procedure, an RWP, or other properly authorized document, specify radiation protection measures commensurate with the existing and potential radiological hazards associated with the work to be performed. Methods for assessing radiological hazards and specifying appropriate controls are established in RP procedures.

1.9 PRIORITIZATION PROCESS

Primary goals include dispositioning radioactive and hazardous wastes, managing the radioactive materials under FRNP control, remediation and monitoring of the environment, and providing for deactivation of facilities. FRNP recognizes that higher priority items may arise and take precedence over the current schedule and maintains flexibility to expedite completion of those higher priority items when needed. For radiological areas, FRNP is working to complete activities safely that present radiological risks to personnel and the environment. The radiological risks associated with these activities include internal and external exposure to ionizing radiation and the spread of radioactive contamination. To help reduce exposures, FRNP actively addresses risks in its work processes through the use of job hazard analysis and ALARA reviews. A graded approach that ensures regulatory requirements are met will be used when determining personal protective equipment (PPE) for radiological activities.

1.10 RADIOLOGICAL HAZARD ASSESSMENT

Radiological hazards to employees found at PGDP are related to the generic categories of direct gamma and beta radiation exposure; inhalation or ingestion of airborne radioactivity; ingestion of loose surface contamination, contaminated soil, and other contaminated environmental media; and direct transfer of radioactivity into the blood stream through wounds. The level of hazard varies from location to location and is attributed to chemically processed uranium (including enriched, natural, and depleted) and associated daughter products.

Due to the historic processing of reprocessed uranium from the Hanford and Savannah River sites, fission products and TRU elements, notably neptunium, plutonium, and americium are found at the Paducah site. The best available data indicates that the primary mode of radionuclide exposure will be from the activities of individuals working in the vicinity of, or working with, uranium-contaminated surfaces and, occasionally, bulk quantities of various uranium compounds and mixtures. TRU radionuclides are found in varying concentrations at several locations within the DOE Reservation. TRU concentrations may vary from a small fraction of uranium quantities to in some cases concentrations exceeding 100 nanocuries per gram. Certain historic processes acted to concentrate TRU analytes, such as cold traps used to remove contaminants from the product. These areas are controlled specifically for TRU materials.

Fission products, including cesium-137 and most notably technetium-99 (Tc-99), are found at various levels throughout the facility. Similar to TRU radionuclides, concentrations of Tc-99 vary greatly depending on historic processes. Tc-99 is often found at high concentrations within uranium process gas impurity traps and at the higher enrichment portions of the cascade.

Thorium, primarily thorium-230 (Th-230) is found at several locations in the plant, in varying concentrations, due to historic operations which caused daughter products to become separated from their uranium-parent. Materials and locations historically involving fluorination of uranium oxides, isotope recovery, and cylinder wash have the highest likelihood of encountering Th-230 at concentrations greater than its uranium parent.

Efforts are made during pre-job planning to assess the radiological hazards associated with non-uranium contaminants and to ensure appropriate controls are used to mitigate the exposure risks associated with TRU, Th-230, and fission product radionuclides.

Administrative limits have been derived in order for total and removable alpha contamination to demonstrate compliance with isotope specific release criteria found in 10 *CFR* § 835 Appendix D. Administrative limits are based on historical sampling data from multiple area and facilities. The use of these limits provides an operationally practical method of demonstrating compliance with isotope specific limits. Administrative limits may be modified as additional characterization data become available. Should characterization data indicate that the limits are not protective, alternate limits will be applied to ensure compliance with Appendix D is maintained.

1.11 ALARA POLICY AND PROGRAM

FRNP is firmly committed to having a Radiological Control Program of the highest quality. This program applies to activities conducted by FRNP that manage radiation and radioactive materials, and that may result in radiation exposure to workers, the public, and the environment. The fundamental principle underlying this RPP is the following statement from the Radiation Protection Guidance to Federal Agencies for Occupational Exposure (1987): "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."

The FRNP ALARA Policy is as follows:

> It is the policy of FRNP to conduct its operations in a manner that ensures the health and safety of all its employees, subcontractors, and the general public. FRNP shall ensure that radiation exposures to its workers and the public, and releases of radioactivity to the environment are maintained below regulatory limits. Deliberate efforts are taken to further reduce exposures and releases to as low as reasonably achievable (ALARA).

The FRNP RPP consistently reflects this policy. The program also defines the operational planning process whereby specific tasks are evaluated to ensure worker exposures are minimized during the work evolutions.

The occupational ALARA Program has been developed and implemented using a combination of physical design features and administrative controls. FRNP shall conduct radiological operations in a manner that promotes the health and safety of all employees, subcontractors, and the public. In achieving this objective, management shall minimize the radiation exposure to employees, subcontractors, the public, and the environment. Deliberate efforts will be taken to further reduce exposures and releases in accordance with a process to make any such exposures or releases ALARA.

The ALARA Program incorporates a multi-tiered, graded approach, commensurate with the nature of the activities performed similar to that outlined in DOE Guide 441.1-1C Chg 1. The method of implementing the ALARA program depends on the complexity and magnitude of potential radiological hazards. Complex activities with greater potential for exposure are expected to involve more engineering and administrative control measures to control worker exposures. When occupational exposures are shown to be less than established dose and contamination-based thresholds, routine hazard controls are deemed effective, and a documented ALARA analysis is not required.

Due to the complex nature of many FRNP activities, a combination of radiological and nonradiological hazards may be encountered. Identification of nonradiological hazards is critical to the ALARA process, because efforts to apply the ALARA process may inadvertently increase risks from nonradiological hazards. An integrated safety management approach that optimizes worker protection from all hazards is considered in the ALARA process for a given FRNP activity.

Line management, in consort with RP, is responsible for implementing the radiological protection requirements necessary to maintain radiation exposures ALARA during work activities, including major maintenance, deactivation, and environmental remediation. The degree of formality and the level of detail contained in work documents are commensurate with the magnitude of the radiological hazards. Work documents for activities with higher collective dose and/or potential for significant individual dose have more detailed references to ALARA considerations than work documents developed for lower risk activities, thereby implementing a graded approach.

1.12 ALARA PROGRAM

The ALARA Program is defined in FRNP procedure CP3-RP-1114, *ALARA Program*. When initiated by the RPM, the FRNP senior leadership will meet, as needed, to review and monitor selected: operational RP issues, proposed designs, work practices, and projects with regard to radiation exposure, contamination control, and/or ALARA. If needed, FRNP senior leadership can assign an ad hoc committee to review specific issues or concerns.

1.13 RESPONSIBILITIES

The ESH&Q manager ensures that the ALARA functions and the assigned tasks of the senior leadership team are executed properly. Special reports are prepared for management upon request or when senior leadership determines issues warrant attention. The RPM assists the ESH&Q manager in the execution of ALARA responsibilities.

The FRNP senior leadership team may review matters that have or may have an impact on radiation exposure, contamination control, and/or ALARA. These include, but are not limited to, the following:

1. Technologies for selected buildings and/or job tasks;
2. Current work practices and completed tasks that have/had radiation exposure, contamination control, or ALARA concerns;
3. RP violations;
4. Operating Experience;
5. Trends and resulting impacts on radiation exposure, contamination control, and/or ALARA;
6. Annual radiation exposure, contamination control, and exposure goals; and
7. Other performance metrics, criteria, and objectives.

1.14 PLANNING

Radiological operations and activities shall be appropriately planned to allow for the effective implementation of dose and contamination reduction, and control measures. Planning of radiological operations and activities is performed using an integrated and graded approach, and will include reasonable controls directed toward reducing exposure, preventing the spread of radiological contamination, and minimizing the generation of contaminated wastes and the release of effluents. Personnel are trained per DOE O 426.2.

The incorporation of dose reduction, contamination reduction, and waste minimization controls into work control documents is implemented in the earliest planning stages whenever applicable or feasible. Radiation Protection personnel are integrated with the work planning process to ensure controls are accurately specified in the command media. Whenever possible, these controls are directed to maintaining contamination at the source, eliminating airborne radioactivity, maintaining personnel exposure below regulatory limits, and using a process that assures ALARA exposure levels.

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2. RADIATION DOSE LIMITS AND EXPOSURE CONTROL

2.1 RADIATION DOSE LIMITS

Individual doses resulting from radiation exposures associated with the project are controlled within the following limits [10 *CFR* § 835.202(a), § 206(a), § 207, and § 208]; see also the administrative limits in Section 9.2:

Category	Type of Dose	Dose Limit[1]
Radiological worker[2]	Total effective dose	5 rem per year
	Total organ equivalent dose[3]	50 rem per year
	Equivalent dose to the lens of the eye	15 rem per year
	Equivalent dose to the skin or extremity[4]	50 rem per year
Declared pregnant worker	Embryo/fetus	0.5 rem during gestation period
Occupationally exposed minors	Total effective dose	0.1 rem per year
	All other doses	10 percent of limits for general employees
Member of the public in controlled area	Total effective dose	0.1 rem per year

[1] Occupational dose limits do not include doses from background, therapeutic, and diagnostic medical radiation or radiation doses resulting from voluntary participation in medical research programs. [10 *CFR* § 835.202(c)]
[2] Does not include doses resulting from planned special exposures or authorized emergency exposures.
[3] Equals the sum of the equivalent dose to the whole body for external exposure and the committed equivalent dose to any organ or tissue other than the skin or the lens of the eye.
[4] Equals the sum of the equivalent dose to the skin or to any extremity for external exposures and the committed equivalent dose to the skin or any extremity.

Several dosimetry program elements will be provided by the Infrastructure Contractor. FRNP will coordinate with the Infrastructure Contractor to ensure the recording each individual's total effective dose (TED) as the sum of the effective dose from external exposures and the committed effective dose from intakes during the year. [10 *CFR* § 835.203(a)] The equivalent dose to the whole body may be used as effective dose for external exposure, expressed in units of rem. FRNP determines the equivalent dose using the radiation and tissue weighting factors provided in 10 *CFR* § 835.2, *Definitions*. The equivalent dose to tissue is multiplied by the appropriate tissue weighting factor in 10 *CFR* § 835.2, *Definitions,* to obtain the effective dose contribution from that tissue. [10 *CFR* § 835.203(b)] For nonuniform exposures to the skin which require multiple dosimeters, FRNP will coordinate with the Infrastructure Contractor who determines and records the equivalent dose using the procedures provided in 10 *CFR* § 835.205, *Determination of Compliance for Non-Uniform Exposure of the Skin*. Assessment of skin dose received as a result of personnel contamination events is the responsibility of FRNP. Doses calculated by FRNP will be provided to the Infrastructure Contractor to be included in the individual's dose record. FRNP will be responsible for dose assessment following a lost dosimeter.

In demonstrating compliance with the occupational dose limits, FRNP will coordinate with the Infrastructure Contractor records all occupational doses received during the year and that attempts to obtain documentation of all occupational doses received by the individual during the current year are made. When notified by the Infrastructure Contractor that dose records cannot be obtained, FRNP will prepare and submit a written estimate to the Infrastructure Contractor that is signed by the affected individual and FRNP. [10 *CFR* § 835.202(b)]

2.2 PLANNED SPECIAL EXPOSURES

FRNP does not intend to use planned special exposures during the course of the project. [10 *CFR* § 835.204]

2.3 LIMITS FOR THE EMBRYO/FETUS

FRNP's programmatic requirements for protection of the embryo/fetus is compliant with 10 *CFR* § 835.206 and should be consistent with DOE guidance [e.g., DOE Guide (G) 441.1-1C, Chg 1, Section 8, *Evaluation and Control of Radiation Dose to the Embryo/Fetus*]. Radiation protection for the embryo/fetus must be a joint effort between the affected radiological worker and FRNP. FRNP will provide estimated exposure to Infrastructure Contractor. The Infrastructure Contractor will maintain the record.

Embryo/fetus protection provisions are designed for individuals, who are trained radiological workers and who currently are involved (or plan to be) in work in radiological areas. After a female radiological worker voluntarily notifies her immediate supervisor in writing that she is pregnant, her supervisor then must notify (in writing) the RPM or designee. Upon written notification, she is considered a declared pregnant worker. A worker may elect to revoke her status, in writing, at any time.

For a declared pregnant worker who chooses to continue working as a radiological worker, the dose limit to the embryo/fetus from conception to birth (entire gestation period) is 0.5 rem. In addition, measures are taken to avoid substantial variation above the uniform exposure rate necessary to meet the 0.5 rem limit for the gestation period. Typically, this involves implementation of measures to avoid substantial monthly variation in the exposure received by the declared pregnant worker. If the dose to the unborn child is determined already to have exceeded 0.5 rem by the time a worker notifies her supervisor in writing of her pregnancy, the worker will not be allowed to perform work where additional occupational radiation exposure is likely during the remainder of the gestation period. In any event, a reassignment of work tasks must be mutually agreeable and must not involve a loss of pay or promotional opportunity. [10 *CFR* § 835.206(b)–(c)] The declared pregnant radiological worker will be included in the site dosimetry program during the gestation period.

2.4 OCCUPATIONAL DOSE LIMITS FOR MINORS

In addition to the dose limit in Section 2.1, minors are also limited to 10% of the limits specified for the lens of the eye, skin, and extremities of general employees. [10 *CFR* § 835.207] Per PPPO direction, visiting minors will be given access to radiologically controlled areas after approval has been granted by the PPPO Health Physicist, the appropriate DOE Site Lead, and the PPPO Manager, Deputy Manager, or Designee.

2.5 CONCENTRATIONS OF RADIOACTIVE MATERIAL IN AIR

In establishing controls on occupational exposures to airborne radioactive material, FRNP uses the derived air concentration values provided in 10 *CFR* § 835 Appendix A, Derived Air Concentrations (DAC) for Controlling Radiation Exposure to Workers at DOE Facilities, of 10 *CFR* § 835. [10 *CFR* § 835.209(a)]

Derived DAC values may be calculated using the sum of ratios based on radionuclide isotopic data for a facility.

For purposes of estimating individual internal doses, radiobioassay data are generally preferable to air monitoring data. FRNP will estimate each individual's internal dose based on radiobioassay data, rather than air monitoring data, unless the radiobioassay data are unavailable or inadequate, or estimates based on air monitoring data can be demonstrated to be as or more accurate. [10 *CFR* § 835.209(b)] Internal dose estimates, regardless of methodology, will be performed by FRNP and provided to the Infrastructure Contractor for recording.

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3. RADIOLOGICAL MONITORING

3.1 GENERAL REQUIREMENTS

RP procedures implement the requirements of 10 *CFR* § 835 for monitoring of work areas and individuals, including external and internal exposures, contamination control, and radiological accident monitoring. RP is responsible for providing the radiological monitoring necessary to comply with 10 *CFR* § 835 in accordance with this RPP. Monitoring results are documented on radiological survey forms. They are available to the managers, line managers, and subcontractors to assist in activity hazard analysis and job planning. Information only copies may be obtained by requesting it through the RPPM.

Workplace monitoring provides a control mechanism to detect and quantify external radiation and radioactive contamination levels, enables measures to be taken to prevent unanticipated and unplanned exposures, and contributes to maintaining actual exposures ALARA.

3.2 EXTERNAL DOSIMETRY

FRNP's External Dosimetry Program, in conjunction with the External Dosimetry Program provided by the Infrastructure Contractor, will be compliant with 10 *CFR* § 835, Subpart C, and implemented in a manner consistent with the guidance provided in DOE G 441.1-1C, Chg 1, Section 6, *External Dosimetry Program*. Radiological workers who are likely to receive an effective dose of 100 mrem or more in a year require monitoring for external radiation exposure and will be enrolled into the Infrastructure Contractor External Dosimetry Program. Monitoring of personnel for external radiation exposure will be performed using DOELAP accredited personal dosimetry devices or other devices having similar sensitivity and accuracy. [10 *CFR* § 835.402(b)] It is the individual's responsibility to wear dosimeters in accordance with requirements established by the RP Program. The Infrastructure Contractor External Dosimetry Program is accredited in accordance with DOELAP for personnel dosimetry. FRNP will implement the provided Infrastructure Contractor External Dosimetry Program.

Monitoring of personnel for external radiation exposure under 10 *CFR* § 835.402 is performed using DOELAP accredited monitoring devices. It is the individual's responsibility to wear dosimeters in accordance with requirements established by RP. The external dosimetry program will utilize DOELAP accredited services. [10 *CFR* § 835.402(a) (1) (ii)-(5)] FRNP will request from DOE the results of any independent assessments of the Infrastructure Contractor External Dosimetry Program conducted by DOE and/or DOELAP.

Persons entering work areas are also required to be monitored for external radiation exposure if they meet one of the following criteria:

- Individuals who are likely to receive an equivalent dose to the skin or to any extremity of 5 rem or more in a year;
- Individuals who are likely to receive an equivalent dose to the lens of the eye of 1.5 rem or more in a year;
- Declared pregnant workers who are likely to receive from external sources an equivalent dose in excess of 50 mrem to the embryo/fetus;

- Occupationally exposed minors likely to receive an equivalent dose to the whole body of 50 mrem or more in a year, a lens of the eye equivalent dose of 750 mrem or more in a year, or an equivalent dose to the skin or to any extremity of 2,500 mrem or more in a year;

- Members of the public entering a controlled area who are likely to receive a dose in excess of 50 mrem in a year from external sources;

- Any individual entering a high or very high radiation area; and

- As directed by the RPM or RWP.

3.3 INTERNAL DOSIMETRY

FRNP's Internal Dosimetry Program, in conjunction with the Internal Dosimetry Program provided by the Infrastructure Contractor, will be developed according to 10 *CFR* § 835, Subpart C, and should be implemented in a manner consistent with DOE G 441.1-1C, Chg 1, Section 5, *Internal Dosimetry Program.* Radiological workers who are likely to receive intakes that could result in a committed effective dose of 100 mrem or more, or who are at risk for such intakes, are evaluated for participation in a routine individual monitoring program that includes bioassay and/or personal air sampling. [10 *CFR* § 835.402(c)(1)] This evaluation is done when work authorizations are prepared for the specific work to be performed. Bioassay requirements are stated on the RWP or other work authorization. Worker bioassay samples may be collected based on either a routine schedule or work authorization log-in entries. For purposes of practicality, the Internal Dosimetry Program may include all individuals who work in areas where exposure to removable surface contamination or airborne radioactive material is likely; however, exceptions may be made in situations in which it can be demonstrated that the individual's radiation dose will be <10mrem, and confirmatory monitoring performed as determined by the RPM. FRNP will evaluate hazards and specify the appropriate bioassay regimen consistent with the Infrastructure Contractor's Internal Dosimetry Program document. If FRNP requires a bioassay regimen that is inconsistent with the established regimens, FRNP will notify the Infrastructure Contractor and DOE. FRNP will implement the bioassay selection and schedule sample collection among its workforce.

The Infrastructure Contractor Internal Dosimetry Program is accredited in accordance with DOELAP for radiobioassay and shall remain so unless specifically excepted from this accreditation. [10 *CFR* § 835.402(d)] FRNP will implement the provided Infrastructure Contractor Internal Dosimetry Program. FRNP shall request from DOE the results of any independent assessments of the Infrastructure Contractor internal dosimetry program conducted by DOE and/or DOELAP. In some cases, such as during a radiological incident when employees suspected of receiving intakes is necessary, FRNP may perform bioassay sampling for purposes of screening. Screening samples are provided to the Infrastructure Contractor and collected under the provisions of 10 *CFR* § 835.401 and do not require DOELAP accreditation. Screening samples typically are analyzed rapidly and may be used to determine those individuals who are likely to have received an intake that could result in a committed effective dose of 100 mrem or greater. Screening samples are not utilized to determine the dose of record under 10 *CFR* § 835.402 (c); therefore, follow-up DOELAP-accredited sampling is required for confirmation and dose assessment for those individuals who are suspected of having received an intake with a resultant committed effective dose in excess of the 100 mrem threshold.

The committed effective dose per unit of intake by inhalation from International Commission on Radiological Protection (ICRP) Publication 68, *Dose Coefficients for Intakes of Radionuclides by Workers* (Reference 3), is used to calculate internal dose. *In vivo* lung counting also may be employed for off-normal exposures as determined by the RPM. The Infrastructure Contractor will provide a mechanism to conduct

DOELAP-accredited in vivo monitoring. The routine bioassay program considers the exposure potential to personnel by work location and work activity. The Infrastructure Contractor internal dosimetry technical basis documents provides the technical and philosophical bases of the bioassay monitoring and internal dose assessment aspects of the internal dosimetry programs at PGDP that are applicable to the FRNP scope of work. The Infrastructure Contractor is responsible for ensuring the provided internal dosimetry program and associated technical documents consider all the hazards and exposure conditions anticipated by the FRNP.

Personnel entering work areas also are required to be monitored for internal radiation exposure if they meet one of the following criteria: [10 *CFR* § 835.402(c) (2)–(4)]

- Declared pregnant workers who are likely to receive an intake or intakes resulting in an equivalent dose to the embryo/fetus in excess of 50 mrem;
- Occupationally exposed minors who are likely to receive a dose in excess of 50 mrem from all radionuclide intakes in a year;
- Members of the public entering a controlled area likely to receive a dose in excess of 50 mrem from all radionuclide intakes in a year; and
- As directed by the RPM or RWP.

3.4 WORKPLACE RADIOLOGICAL MONITORING

3.4.1 Introduction

Workplace radiation, contamination, and air monitoring programs are used to verify the integrity of radioactive material containment and to detect inadvertent releases of those materials into the workplace. Radiological instruments are measuring and test equipment (M&TE) and must be quality assured prior to use. Workplace monitoring provides a control mechanism to detect and quantify external radiation and radioactive contamination levels, enables measures to be taken to prevent unanticipated and unplanned exposures, and contributes to maintaining actual exposures ALARA. Procedures require that radiological monitoring be performed where an individual is likely to receive an exposure of 40 or more DAC-hours in a year (i.e., 100 mrem), or as necessary to characterize the airborne radioactivity hazard where respiratory protective devices for protection against airborne radionuclides have been prescribed. Real-time air monitoring is performed as necessary to detect and provide warning of airborne radioactivity concentrations that warrant immediate action to terminate inhalation of airborne radioactive material. [10 *CFR* § 835.403]

3.4.2 General Monitoring

Monitoring involves radiation surveys as well as monitoring for surface and airborne contamination. Contamination surveys are conducted both on a routine and special basis. More effort is required for monitoring transferable radioactive contamination since internal deposition is most likely the greatest

contributor to individual dose. This is because radiation levels in excess of 5 mrem/hour are measured only in a small portion of the site [e.g., near recently emptied uranium hexafluoride (UF_6) cylinders involved in transfer operations]. Potentially contaminated materials in radiological areas are surveyed prior to release. Contamination surveys on materials, equipment, and portable facilities for release of material from radiological areas are conducted as specified in procedures. Monitoring of individuals and areas is

performed to: [10 *CFR* § 835.401(a)]

- Demonstrate compliance with 10 *CFR* § 835;
- Document and detect changes in radiological conditions;
- Detect the gradual buildup of radioactive material;
- Verify the effectiveness of engineered and administrative controls in containing radioactive material and reducing radiation exposure; and
- Identify and control potential sources of individual exposure to radiation and/or radioactive material.

3.4.3 Work Area Surveys

The radiological survey program consists of routine surveys, work support surveys, and material release activities. Surveys are conducted to support facility activities in a manner that ensures that radiological hazards associated with each activity are properly identified and that relative radiation levels and concentrations of radioactive material are determined. Radiological surveys are conducted for the purposes of establishing PPE or for posting requirements and are performed by qualified RP personnel.

Routine survey frequencies are established based on occupancy factors and the stability of operation as demonstrated by the consistency of survey results. The routine survey program is described in site procedures and involves surveys of the facility to determine workplace radiological conditions, effectiveness of contamination control measures, and proper identification of radiological hazards. Areas within the facility are categorized and scheduled for survey commensurate with their relative radiological hazard and contamination potential. Survey frequencies are based on area occupancy, potential for spread of contamination, and process knowledge.

Due to the large physical size of each process building and facilities and the facility design (control rooms and locker rooms are located inside the controlled area), the primary focus of the routine survey program is to identify quickly any breakdown in contamination control. Areas having the highest survey frequency are those that serve as the access, egress, or boundaries between areas of different radiological conditions where the spread of radioactive material is most likely to occur. Survey frequencies are established by the RP organization and approved by the RPM. Frequencies are evaluated routinely and adjusted accordingly to ensure contamination control is maintained while maximizing survey efficiency.

Work support surveys are a fundamental element of the RWP process. In-process surveys are conducted as necessary to verify radiological conditions at various points in the work activity and to ensure that exposure potentials are maintained in accordance with the ALARA principle. When required by work activities, surveys are conducted to support decontamination efforts and the release of tools, equipment, and waste material from the work area. Requirements from NUREG-1575, *Multi-Agency Radiation Survey and Site Investigation Manual*, and NUREG-1575, Supplement 1, *Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual*, have been incorporated in the technical basis that governs the performance of radiological surveys.

In the event that radiological surveys indicate radiation or radioactive contamination levels above the limits for the area, work is paused, the area is reposted, workers are re-briefed (as necessary), and the cause of the increased radiation or radioactive contamination is investigated. The Facility Manager will be assigned an action in Issues Management to evaluate the area to determine if it can be deconned. The action will include the proposed time frame to complete the process.

Area radiation monitors (ARMs) may be installed in frequently occupied locations with the potential for unexpected increases in dose rates and in remote locations where there is a need for local indication of dose rates prior to personnel entering these areas. RP and/or nuclear criticality safety (NCS) determine the need for and placement of ARMs.

3.4.4 Radiological Protection Instrumentation

Properly selected, operated, maintained, and calibrated radiological instruments are employed to implement an effective radiological control program. Radiological instruments are divided into several broad categories, such as portable radiation dose rate survey instrumentation, contamination monitoring instrumentation, air monitoring instrumentation, and non-portable instrumentation. The Infrastructure Contractor calibrates all instrumentation with the exception of the Tennelec.

The standards used for calibrating instrument functions are directly or indirectly traceable to a National Institute of Standards and Technology (NIST) standard. Portable instruments are calibrated before initial use, after maintenance or adjustment that may affect the calibration, following any modification or alteration that may affect instrument response, and at intervals not to exceed one year. [10 *CFR* § 835.401(b) (1)] The instrument to be used for any particular application is selected by RP personnel based on the type(s), levels, and energies of the radiation field and the environmental conditions in the affected area. Functionality checks are performed to verify that the instruments respond properly to radiation. Instruments suspected of providing incorrect in-service measurements are tagged out of service, removed from service pending a satisfactory source check or calibration. Radiological survey data collected with a suspect instrument are evaluated prior to final written acceptance of the data. [10 *CFR* § 835.401(b) (2)-(4)].

FRNP will obtain instrument calibration services from the DOE Infrastructure Contractor as a government furnished service. The Infrastructure Contractor will administer the calibration program in accordance with a Quality Assurance program based on 10 *CFR* § 830, DOE Order 414.1D, *Quality Assurance,* EM-QA-001, and American Society of Mechanical Engineers (ASME) NQA-1, *Nuclear Quality Assurance*, Part 1 Requirement 12, "Control of Measuring and Test Equipment." FRNP shall request from DOE the results of any independent assessments of the Infrastructure Contractor instrumentation program conducted by DOE. Noncompliances and performance issues noted during the performance of the work scope will be brought to the attention of the Infrastructure Contractor and DOE for resolution.

3.4.5 Work Area Air Sampling

Airborne radioactivity monitoring is conducted in areas where an individual is likely to receive an exposure of 40 or more DAC-hours in a year, [10 *CFR* § 835.403(a)] and in other areas where it is necessary to characterize the airborne radioactivity hazard where respirators are worn. These areas are identified by RP based on evaluations of workplace conditions and planned activities. The airborne radioactivity monitoring activities include stationary and portable air sampling equipment.

To the extent practicable, radioactive materials are contained and/or confined during processing, transfer, and storage as necessary to minimize intakes of such materials by personnel in accordance with the ALARA principle. As appropriate, operations involving readily dispersible forms of radioactive materials are accomplished within enclosures (e.g., process equipment, glove boxes, glove-port hoods, laboratory-type hoods). Negative air machines are used as an engineering control to prevent/reduce airborne radioactivity in work areas where large portions of process system surfaces are exposed for maintenance.

Air samples will be collected, as specified in procedures and other work control documents, in the breathing zones of workers, within the work area, and downwind from the work area. RWPs will establish requirements for use of breathing zone air (BZA) monitoring devices designed to measure radioactive material in the breathing zone. These samples will be collected to assess airborne radioactive material concentrations and determine the adequacy of respiratory protection requirements. Samples will be tracked, handled, and controlled.

Assessment of worker committed dose is supported by radiobioassay sampling. However, personal BZA sampling may also be used as a backup method to estimate dose equivalents to workers resulting from inhalation of airborne radioactive material and to identify the need for initiation of special bioassay sampling. Air sampling will be conducted to ensure that airborne contaminants in the general work area are maintained ALARA and to establish boundaries of airborne radioactivity areas (ARAs). Monitoring frequency is at the discretion of RP. Samples will be tracked, handled, and controlled.

The air-monitoring program has been established in facilities or areas where process, maintenance, and support activities involve radioactive materials, process equipment, or hook-ups and disconnects of UF_6 handling equipment. The program may include fixed and portable air-sampling equipment such as permanently installed sampling heads, continuous air monitors (CAMs), portable low and high-volume air samplers, and battery-powered lapel samplers.

A series of fixed or portable general area air samplers typically are installed in process and support facilities where airborne radioactive materials may be encountered. A combination of breathing zone, low volume, and high-volume air samplers are used for job coverage air sampling.

Real-time monitoring will be performed in the work areas, as necessary to detect and provide warning of airborne radioactivity concentrations that warrant immediate action to terminate inhalation of airborne radioactive material. [10 *CFR* § 835.403(b)] The application of real-time air samplers will be determined by RP. CAMs are real-time monitors that provide an early warning of elevated levels of airborne radioactivity. CAMs are configured with an alarm feature that alerts nearby workers that airborne radioactivity was measured in excess of a predetermined level. Alarm set points for CAMs, used for routine monitoring, are based on the radioisotope(s) involved and solubility. Set points will be established as determined by RP and set by the Infrastructure Contractor (during calibration) so as to indicate loss of containment or the need for corrective action without causing a significant number of false alarms.

CAMs also may be installed to verify the adequacy of engineering controls, such as glove boxes or ventilation hoods, or in work areas where power failures could result in the release of airborne radioactivity due to an abrupt interruption of negative ventilation.

Flow rates through low volume and high-volume air samplers, as measured by in-line flow rate instrumentation, are recorded at the beginning and end of each sampling period. Air sample flow measurement devices are calibrated under standard laboratory conditions at least annually. Samplers are calibrated as specified in the Infrastructure Contractor's procedure(s).

ARAs are posted when general area air concentrations exceed 30% of the applicable DAC. A derived DAC may be calculated for mixtures of radionuclides as specified in 10 *CFR* § 835. Special bioassay sampling is required when air samples indicate an intake of 10 DAC-hours or greater. Adjustment for respirator protection factors is considered in determining special bioassay monitoring. Notifications of special bioassay sampling will be forwarded to the Infrastructure Contractor. Sampling will be conducted in accordance with the Infrastructure Contractor Internal Dosimetry Program.

Filter media samples have appropriate correction factors applied for alpha and beta particles based on the duration of the sampling period and environmental conditions of the area being sampled. Air sampling program specifications are found in RP program technical basis documents.

3.5 MONITORING OF PACKAGES RECEIVED FROM TRANSPORTATION

Due to the potential for damage during transport and exposure of individuals who routinely do not work with radioactive materials, special precautions are warranted for handling arriving packages of radioactive material.

Arriving shipments of radioactive material, including exclusive use shipments, are surveyed in accordance with procedures. The required monitoring is performed as soon as is practicable following receipt of the package, but not later than eight hours following the start of the working day following receipt of the package. [10 *CFR* § 835.405(d)] Monitoring activities in support of DOT-regulated activities is integrated with the Transportation organization. Additional monitoring requirements in support of DOT requirements may be specified by the Transportation organization.

3.5.1 Type A Quantities

If packages containing quantities of radioactive material in excess of a Type A quantity, as defined at 10 *CFR* § 71.4, *Packaging and Transportation of Radioactive Material, General Provisions, Definitions,* are expected to be received from radioactive material transportation, arrangements are made to either: [10 *CFR* § 835.405(a)]

- 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.

3.5.2 Radioactive White and Yellow Label Material

Upon receipt from radioactive material transportation, external surfaces of packages known to contain radioactive material are monitored if the package: [10 *CFR* § 835.405(b)]

- Is labeled with a Radioactive White I, Yellow II, or Yellow III label, as specified at 49 *CFR* § 172.403, *Class 7 (Radioactive) Material,* and 49 *CFR* § 172.436–440, *Radioactive White-I Label, Radioactive Yellow-II Label,* and *Radioactive Yellow-III Label*;
- Has been transported as Low Specific Activity material (as defined at 10 *CFR* § 71.4) on an exclusive use vehicle (as defined at 10 *CFR* § 71.4); or
- Has evidence of degradation, such as packages that are crushed, wet, or damaged.

This monitoring is not required for packages transported on-site that remain under the continuous observation and control of a qualified radiological worker who is knowledgeable of and implements required exposure control measures. [10 *CFR* § 835.405(e)]

3.5.3 Monitoring Criteria

The specific monitoring requirements for DOT-regulated packages are specified in FRNP procedures. These also address differences in DOT and DOE monitoring requirements. In general, the monitoring described in Section 3.5.2 includes the following: [10 *CFR* § 835.405(c)]

- Measurements of removable contamination levels, unless the package contains only special form (as defined at 10 *CFR* § 71.4) or gaseous radioactive material; and

- Measurements of the radiation levels, if the package contains a Type B quantity (as defined at 10 *CFR* §71.4) of radioactive material.

4. RADIOLOGICAL AREA ENTRY CONTROL

4.1 CONTROLS FOR ALL RADIOLOGICAL AREAS

FRNP implements measures to maintain personnel entry control for each radiological area, commensurate with existing and potential radiological hazards within the area. [10 *CFR* § 835.501(a)–(b)] There may be site-specific situations where the use of boundary identifiers (ropes, chains, fence, etc.) may not be appropriate. These might include large areas with minimal radiological hazards such as fixed contamination areas or underground radioactive material areas. Site-specific controls, such as a gate and posting on an access road, supplemented by postings at suitable intervals around the area, may be adequate to provide appropriate warning and minimize inadvertent intrusions. These instances will be communicated to DOE. Stenciling of surfaces having fixed contamination is also another approved administrative control.

One or more of the following methods is used, depending on the hazards in the area and the planned activities. [10 *CFR* § 835.501(c)]

- Signs and barricades
- Control devices on entrances
- Conspicuous visual and/or audible alarms
- Locked entrance ways
- Administrative controls

FRNP implements written authorizations that are approved by the RPM or designee to control entry into and work within radiological areas. The written authorization specifies radiation protection measures commensurate with the existing and potential hazards. The RWP (or other work authorization) is the primary administrative mechanism used to establish radiological entry controls and protective measures for intended work activities. The RWP informs workers of area radiological conditions and entry requirements, limiting conditions, and provides a mechanism to relate worker exposure to specific work activities. Written RWPs (either general or job-specific) are used to control entry into radiological areas. All individuals must comply with controls prescribed in the controlling work authorization. [10 *CFR* § 835.501(d)] Individuals who fail to comply with prescribed controls may be subject to disciplinary action in accordance with Human Resources processes. Infrastructure Contractor should be notified of any Radiological Work Permit (RWP) changes.

An RWP to cover planned work may require the development of a pre-job ALARA review. RP develops the pre-job ALARA review based on project team input and supporting work control documents.

RP establishes and maintains radiological barriers, barricades, warning devices, or locks as needed to safely control the work site in accordance with the determinations made regarding radiological entry control, posting, and labeling requirements. Permanent barricades are used to augment administrative controls whenever necessary.

No control(s) are installed at any radiological area exit that would prevent rapid evacuation of personnel. [10 *CFR* § 835.501(e)]

Per PPPO direction, visiting minors will be given access to radiologically controlled areas after approval has been granted by the PPPO Health Physicist, the appropriate DOE Site Lead, and the PPPO Manager, Deputy Manager, or Designee.

4.2 HIGH RADIATION AREA ENTRY CONTROL

For entry into High Radiation Areas (HRAs), RP provides additional monitoring as needed to determine the exposure rates to which individuals are exposed. This may include monitoring before the entry (such that RP personnel can be assured of the actual radiation levels in the area) or intermittent or continuous monitoring during the entry. In addition, RP provides supplemental dosimeters such as pocket or electronic dosimeters that are capable of providing an immediate indication of the individual's integrated effective dose to the whole body during the entry. RWP stay-time controls are implemented, as appropriate. [10 *CFR* § 835.502(a)]

RP provides physical controls to control access to an HRA where radiation levels exist such that an individual could exceed an effective dose to the whole body of 1 rem in any one hour at 30 cm from the source or from any surface that the radiation penetrates. The controls for HRAs include one or more of the following: [10 *CFR* § 835.502(b)]

- 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 that level defining an HRA.
- A device that functions automatically to prevent use or operation of the radiation source or field while individuals are in the area.
- A control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the HRA and the supervisor of the activity are made aware of the entry.
- Continuous direct or electronic surveillance that is capable of preventing unauthorized entry.
- A control device that automatically will generate audible and visual alarm signals to alert personnel in the area before use or operation of the radiation source and in sufficient time to permit evacuation of the area or activation of a secondary control device that will prevent use or operation of the source.
- Entryways that are locked. During periods when access to the area is required, positive control over each entry is maintained.

4.3 VERY HIGH RADIATION AREA CONTROL

Very High Radiation Areas (VHRAs) are areas where radiation levels exceed 500 rads/hr at one meter from the radiation source or 1 meter from any surface that the radiation penetrates. There are no VHRAs at PGDP, and none are anticipated.

5. RADIOLOGICAL HAZARD POSTING AND LABELING

5.1 GENERAL POSTING AND LABELING REQUIREMENTS

Except for radioactive material labels applied to sealed radioactive sources [10 *CFR* § 835.606(b)], all radiological hazard postings and labels, unless otherwise excepted, bear the standard radiation warning trefoil in black or magenta on a yellow background. [10 *CFR* §835.601(a)] All signs and labels are clearly and conspicuously posted. [10 *CFR* §835.601(b)] Additional, radiological protection instructions beyond those required by 10 *CFR* § 835, such as protective clothing, dosimetry requirements, and transuranic (unoccupied, abandoned facilities) may be included on the signs and labels, as directed by RP procedures or personnel. If more than one radiological condition exists in an area and requires posting, each condition is identified by posting radiological conditions on one or more signs (user-changeable signs using inserts, for example).

Other areas not designated in 10 *CFR* § 835 as a "radiological area" may be posted based on RP procedures or instructions from RP supervision. These areas may be posted as needed to establish buffer areas around the designated areas or to identify other conditions, such as underground hazards, internal contamination, soil contamination, or areas requiring special controls.

The boundaries of posted areas are established based on the results of area monitoring activities. Any contamination beyond the posted boundary will require the notification to DOE and deconning of the affected area. The posted boundaries may be expanded beyond the physical limits indicated by monitoring activities to provide a buffer area and as necessary to facilitate area access and control. Appropriate postings and labels are established as soon as practicable following identification of the radiological conditions requiring posting and/or labeling.

5.2 POSTINGS

Each access point to radiological areas and radioactive material areas are posted with conspicuous signs bearing the wording provided in Sections 5.2.2 through 5.2.8. [10 *CFR* § 835.603]. All areas six feet above the floor are considered to be contaminated unless characterized by RP. RP should be contacted prior to performing any work above six feet.

5.2.1 Controlled Areas

Each access point to a Controlled Area is posted "Caution Controlled Area" whenever radiological areas or radioactive material areas exist in the area. Individuals who enter a Radiation Area (5 mrem hr) will be issued an optically stimulated luminescence dosimeter. [10 *CFR* § 835.602(a)] Signs used for this purpose are selected to avoid conflict with security requirements. [10 *CFR* §835.602(b) DOE-G 441.1-1C]

5.2.2 Radiation Areas

The words "Caution, Radiation Area" are posted at any area accessible to individuals in which radiation levels could result in an individual receiving an equivalent dose in excess of 5 mrem in one hour at 30 cm from the radiation source or from any surface that the radiation penetrates. [10 *CFR* § 835.603(a)]

5.2.3 High Radiation Areas

The words "Caution, High Radiation Area" are posted at any area accessible to individuals in which radiation levels could result in an individual receiving an equivalent dose in excess of 100 mrem in one hour at 30 cm from the radiation source or from any surface that the radiation penetrates. [10 *CFR* § 835.603(b)]

5.2.4 Very High Radiation Areas

There are no VHRAs at PGDP and none are anticipated

5.2.5 Airborne Radioactivity Area

The words "Caution, Airborne Radioactivity Area" are posted for the following:

- Any area accessible to individuals in which airborne radioactivity levels exceed, or are likely to exceed, the DAC values listed in 10 *CFR* § Appendix A, Derived Air Concentrations (DAC) for Controlling Radiation Exposure to Workers at DOE Facilities; or

- Any area where an individual present in the area without respiratory protection could exceed an intake exceeding 12 DAC-hours in a week. [10 *CFR* § 835.603(d)]

- ARAs are posted and controlled when general area air samples exceed 30% of the applicable DAC. A derived DAC may be established for radioisotope mixtures as specified in 10 *CFR* § 835. FRNP may implement a conservative, administrative control level for ARA posting in areas with the potential for non-static radiological conditions.

5.2.6 Contamination Area

The words "Caution, Contamination Area" are posted in areas accessible to individuals where removable surface contamination levels exceed values listed in Appendix D, Surface Contamination Values, of 10 *CFR* § 835, but are less than or equal to 100 times those values. [10 *CFR* § 835.603(e)]

5.2.6.1 Contamination Area Designated Inactive

The words "Caution, Contamination Area, RWP required for entry, Inactive" are posted in areas accessible to individuals where removable surface contamination levels exceed values listed in Appendix D, Surface Contamination Values, of 10 *CFR* § 835, but are less than or equal to 100 times those values. Contamination Areas (CAs) designated as inactive are not surveyed on any frequency. The area has been determined to be abandoned or infrequently entered. The area designated inactive SHALL be surveyed and inactive label SHALL be removed prior to performing walkdowns, tours, or work. The boundary of contamination areas posted "Inactive" are documented in the radiological routine program and surveyed once a year. [10 *CFR* § 835.603(e)]

5.2.7 High Contamination Area

The words "Caution, High Contamination Area" are posted in areas accessible to individuals where removable surface contamination levels are greater than 100 times the values listed in Appendix D of 10 *CFR* § 835. High Contamination Areas (HCAs) designated as inactive are not surveyed on any frequency. The area has been determined to be abandoned or infrequently entered. The area designated inactive SHALL be surveyed and inactive label SHALL be removed prior to performing walkdowns,

tours, or work. The boundary of HCAs posted "Inactive" are documented in the radiological routine program and surveyed once a year. [10 *CFR* § 835.603(f)]

5.2.8 Radioactive Material Area

The words "Caution, Radioactive Material" are posted at any area accessible to individuals in which items or containers of radioactive material exist and the total activity of the radioactive material exceeds the applicable values in Appendix E, Values for Establishing Sealed Radioactive Source Accountability and Radioactive Material Posting and Labeling Requirements, of 10 *CFR* § 835. [10 *CFR* § 835.603(g)]

5.2.9 Other Postings

In addition to the postings listed in 10 *CFR* § 835, additional radiological designations also will be utilized.

5.2.9.1 Radiological Buffer Areas

Radiological Buffer Areas provide secondary boundaries within the Controlled Area to minimize the spread of radiological contamination and to limit doses to general employees who have not been trained as radiological workers. A Radiological Buffer Area should be established for exposure control adjacent to CAs and HCAs. The boundary for the radiological buffer area shall be established to minimize the spread of contamination and limit radiation doses to general employees to less than 100 mrem per year or as low as reasonably achievable.

5.2.9.2 Fixed Contamination Area

Fixed Contamination Areas are areas where the removable contamination levels are less than the applicable limits of 10 *CFR* § 835, Appendix D, but the total contamination levels are greater than the applicable total contamination limits. Each access point to a Fixed Contamination Area will be posted conspicuously, "Caution, Fixed Contamination Area." The entrance to the controlled area has been posted as a Fixed Contamination Area. A list of known fixed contamination areas has been compiled and is maintained in the RP office for reference. Fixed Contamination Areas are documented in the radiological routine program and surveyed once a year.

5.2.9.3 Underground Radioactive Material Area

Underground Radioactive Material Areas (URMAs) may be established at the discretion of RP 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, covered, unplanned releases (spills). URMAs 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. URMAs may be posted "CAUTION, UNDERGROUND RADIOACTIVE MATERIAL." Posting should include instructions or special warnings to workers, such as "CONTACT RADCON PRIOR TO DISTURBING SURFACES" or "SUBSURFACE CONTAMINATION EXISTS." URMAs may be located outside controlled areas unless access is likely to result in individual doses (TED) greater than 100 millirem in a year from underground radioactive material. Newly identified URMAs must be reported to Environmental Group and screened for possible identification as an area of concern or solid waste management unit.

5.2.10 Exceptions to Posting Requirements

In lieu of radiological hazard postings, radiological areas and radioactive material areas may be placed under the continuous observation and control of an individual who is knowledgeable of and empowered to implement the required access and exposure control measures [e.g., radiological control technician (RCT) or RCT supervisor (RCTS)]. These provisions may be used for no more than eight continuous hours; after eight hours, appropriate radiological hazard postings will be established. [10 *CFR* § 835.604(a)]

The following areas need not be posted as radioactive material areas: [10 *CFR* § 835.604(b)]

- Areas that are posted as radiological areas;
- Areas in which each item or container of radioactive material is labeled in accordance with 10 *CFR* § 835, Subpart G, Posting and Labeling, such that individuals entering the area are made aware of the hazard; or
- Areas in which the radioactive material of concern consists solely of structures or installed components that have been activated (i.e., such as by being exposed to neutron radiation or particles produced by an accelerator).

It is preferable that radioactive material packages in transport be delivered directly into a properly posted area. However, an area that contains only packages received from radioactive material transportation, properly labeled, and in a nondegraded condition is excepted from the radiological area and radioactive material area posting requirements until completion of the package receipt monitoring required by Section 3.5 above. Radioactive material, excluding shipping papers, will be transported inside the controlled area using the DOT shipping standards as a guideline. [10 *CFR* § 835.604(c)]

5.3 RADIOACTIVE MATERIAL LABELING

Except as provided below, each item or container of radioactive material bears a durable, clearly visible label bearing the standard radiation warning trefoil and the words "Caution, Radioactive Material." The label provides sufficient information to permit individuals handling, using, or working in the vicinity of the items or containers to take precautions to avoid or control exposures. RP procedures establish specific requirements for the information to be included on radioactive material labels. The design of acceptable radioactive material labels is authorized by the RPM consistent with the requirements of 10 *CFR* § 835. [10 *CFR* § 835.605]

Items and containers may be excepted from the radioactive material labeling requirements of this Section (5.3) when [10 *CFR* § 835.606(a)]

- Used, handled, or stored in areas posted and controlled as specified in this RPP, and sufficient information is provided to permit individuals to take precautions to avoid or control exposures;
- The quantity of radioactive material is less than one tenth of the values specified in Appendix E of 10 *CFR* § 835 and less than 0.1 Ci;
- Packaged, labeled, and marked in accordance with the regulations of DOT or DOE orders governing radioactive material transportation;

- Inaccessible, or accessible only to individuals authorized to handle or use them, or to work in the vicinity;
- Installed in manufacturing, process, or other equipment, such as reactor components, piping, and tanks;
- The radioactive material consists solely of nuclear weapons or their components.

Piles of rubble, soil, or similar materials normally are not considered to be "items or containers"; therefore, the labeling requirements are not applicable.

Manufacturers of sealed radioactive sources often imprint permanent label information upon the source or its container. Such labels are exempt from the radioactive material label color requirements (i.e., black or magenta trefoil on a yellow background). [DOE G 441.1-1C Section 15.4]

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6. RADIATION PROTECTION RECORDKEEPING

6.1 CONTENT OF RPP RECORDS

The records of RPP-related activities are prepared, maintained, and dispositioned in accordance with contract requirements and applicable procedures. Records are maintained sufficient to document and evaluate compliance with 10 *CFR* § 835 and with this RPP. [10 *CFR* § 835.701(a)] FRNP programmatic requirements for records management are identified in FRNP-TRANS-0013, *Records Management Plan at the Paducah Gaseous Diffusion Plant*. Requirements specific to RP records are contained in specific RP procedures and record maintenance plans. The records that are identified with a specific individual are readily available to that individual. All records required by this section will be retained until final disposition is authorized by DOE, or transferred to DOE upon cessation of activities at the site that could cause exposure to individuals. [10 *CFR* § 835.701(b)] FRNP receives dosimetry and calibration/maintenance program elements as a government furnished service from the Infrastructure Contractor. Many of these record requirements pertain to records held in their possession.

The Infrastructure Contractor will ensure records are sufficient to provide dose information necessary to complete the reports required by Section 3 of this RPP as required by their contract. FRNP will maintain records for programmatic areas not associated with dosimetry and instrument calibration/maintenance. Records maintained in accordance with this RPP include, at a minimum, the following: [10 *CFR* § 835.701, § 702(c) (1)–(2), § 702(f), § 702(h)]

- *(Infrastructure Contractor)* Records of doses received by all individuals for whom monitoring is conducted and doses received during planned special exposures, unplanned doses exceeding the monitoring thresholds of 10 *CFR* § 835.402, *Individual Monitoring* and authorized emergency exposures. [10 *CFR* § 835.702(a)–(b)]
  - Recording of the non-uniform equivalent dose to the skin is not required if the dose is less than one rem.
  - Recording of internal dose (committed effective dose) is not required for any monitoring result estimated to correspond to an individual receiving less than 10 mrem committed effective dose provided that the bioassay or air monitoring result used to make the estimate is documented and maintained and that the unrecorded internal dose estimated for any individual in a year does not exceed the applicable internal dosimetry monitoring thresholds of 10 *CFR* § 835.402(c). FRNP will provide all dose estimates to the Infrastructure Contractor.
- *(Infrastructure Contractor)* Results of monitoring used to assess the following quantities for external dose received during the year: [10 *CFR* § 835.702(c)(3)]
  - The effective dose from external sources of radiation (equivalent dose to the whole body may be used as effective dose for external exposure),
  - The equivalent dose to the lens of the eye,
  - The equivalent dose to the skin, and
  - The equivalent dose to the extremities.
- *(Infrastructure Contractor)* The following information for internal dose resulting from intakes received during the year: [10 *CFR* § 835.702(c)(4)]

— Committed effective dose,
— Committed equivalent dose to any organ or tissue of concern, and
— Identity of radionuclides.

- *(Infrastructure Contractor)* The following quantities for the summation of the external and internal dose: [10 *CFR* § 835.702(c)(5)]

  — Total effective dose in a year;

  — For any organ or tissue assigned an internal dose during the year, the sum of the equivalent dose to the whole body from external exposures and the committed equivalent dose to that organ or tissue; AND

  — Cumulative TED.

- *(Infrastructure Contractor)* The equivalent dose to the embryo/fetus of a declared pregnant worker. [10 *CFR* § 835.702(c)(6)]

- *(Infrastructure Contractor)* Documentation of all occupational doses received during the current year, to demonstrate compliance with the limits for general employees in Section 2.1. If complete records documenting previous occupational dose during the year cannot be obtained, a written estimate signed by the individual may be accepted to demonstrate compliance. If a dose estimate is estimated, the results will be forwarded to the Infrastructure Contractor. [10 *CFR* § 835.702(d)]

- *(Infrastructure Contractor)* For radiological workers whose occupational dose is monitored in accordance with 10 *CFR* § 835.402, *Individual Monitoring*, reasonable efforts are made to obtain complete records of prior years' occupational internal and external doses. [10 *CFR* § 835.702(e)]

- *(Infrastructure Contractor and FRNP)* Data necessary to allow future verification or reassessment of the recorded doses. [10 *CFR* § 835.702(g)]

- *(FRNP)* Results of individual, area, and contamination control monitoring for radiation and radioactive material, except for surface contamination monitoring of individuals exiting contamination, high contamination, or airborne radioactivity areas. [10 *CFR* § 835.703(a)]

- *(FRNP)* Results of monitoring used to determine individual occupational dose from external and internal sources. [10 *CFR* § 835.703(b)]

- *(FRNP)* Results of monitoring for the release and control of material and equipment. [10 *CFR* § 835.703(c)]

- *(Infrastructure Contractor)* Results of maintenance and calibration performed on personnel contamination monitors and portable instruments/equipment. [10 *CFR* § 835.703(d)]

- *(FRNP)* Results of maintenance and calibration performed on fixed laboratory instruments and equipment. [10 *CFR* § 835.703(d)]

- *(FRNP)* Results of daily calibration and performance checks performed on instruments and equipment. [10 *CFR* § 835.703(d)]

- *(FRNP)* Training records to demonstrate compliance with 10 *CFR* § 835.103 and 10 *CFR* § 835.901, *Radiation Safety Training*. [10 *CFR* § 835.704(a)]

- *(FRNP)* Documentation of actions taken to maintain occupational exposures ALARA, including the formal plans and measures for applying the ALARA process to occupational exposure, as well as facility design and control actions. [10 *CFR* § 835.704(b)]

- *(FRNP)* The results of internal audits and other reviews of FRNP-performed program content and implementation. [10 *CFR* § 835.704(c)]

- *(Infrastructure Contractor and FRNP)* Written declarations of pregnancy, including the estimated date of conception, and revocations of declarations of pregnancy. [10 *CFR* § 835.704(d)]

- *(FRNP)* Documentation of changes in equipment, techniques, and procedures used for monitoring. [10 *CFR* § 835.704(e)]

- *(FRNP)* Records of sealed radioactive source control, inventory, and leak tests. [10 *CFR* § 835.704(f)]

6.2 RADIOLOGICAL UNITS

Unless otherwise specified, the required records will use the special radiological units, including curies, rads, roentgen, and rem, and multiples and subdivisions of these units. Other radiological units that have been specified and are allowable for RPP records include the following:

- Units of dpm/100 cm^2 for measurements of radioactive surface contamination; and

- Multiples and subdivisions of DACs and DAC-hours for measurements of airborne radioactivity and individual exposure to airborne radioactivity.

The International System radiological units (e.g., becquerel, gray, and sievert) may be used for purposes of calculations and may be provided parenthetically in required records as an aid to unit conversion. [10 *CFR* § 835.4]

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7. REPORTS

Radiation exposures received at the facilities are reported to each individual annually and upon request by the affected individual, consistent with the provisions of the Privacy Act (5 U.S.C. 552a). Upon request, the Infrastructure Contractor will provide a dose report to any individual terminating employment with the project. Termination dose reports are provided as soon as the required data are available but not later than 90 days following termination. If requested, the Infrastructure Contractor provides a written dose estimate at the time of termination based on available information. FRNP will provide additional information as required to generate dose estimate. All reports are made in writing and include the name of the site or facility, the name of the individual, and the individual's social security number, employee number, or other unique identification number. All individual dose reports include the applicable exposure information specified in Section 6.1. [10 *CFR* § 835.801(a)–(d)]

In addition, on any occasion in which FRNP is required to report an individual's exposure as a result of a reportable occurrence to DOE, the Infrastructure Contractor will provide to the affected individual a report of his or her exposure associated with the reportable occurrence after it is reviewed by FRNP RPM. Such reports will be transmitted to the affected individual on or before the date of the submittal of the report to DOE. [10 *CFR* § 835.801(e)]

The Infrastructure Contractor also submits an annual report of personnel monitoring information to the DOE Radiological Exposure Monitoring System. The Infrastructure Contractor will provide the employee with their annual dose report once reviewed by DOE and FRNP.

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8. TRAINING PROGRAM

8.1 RADIATION SAFETY TRAINING PROGRAM CONTENT

FRNP's and the Infrastructure Contractor's program for providing radiation safety training has been developed to be consistent with the guidance in DOE G 441.1-1C, *Radiation Protection Programs Guide for Use with Title 10, Code of Federal Regulations, § 835, Occupational Radiation Protection* (Reference 6), and DOE Order 426.2, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities.* Radiation safety training consists of General Employee Radiological Training (GERT) and Radiation Worker (RW) Training (RW-1 and RW-2). The training materials provided by FRNP and the Infrastructure Contractor are based on the DOE core module concepts and guidance in DOE- HDBK-1131-2007, *General Employee Radiological Training* (Reference 4) and DOE-HDBK-1130-2007, *Radiological Worker Training* (Reference 8). The appropriate level of radiation safety training for each individual is based on potential job assignments, activities, and work locations.

Review of radiation safety training content for RW-1, RW-2, and Visitor training provided by the Infrastructure Contractor is the responsibility of the RP organization. RP is responsible for development and administration of RCT training. Radiation safety training is developed to promote the technical competency of the workforce and is a critical component of achieving ALARA goals.

To meet the requirements of 10 *CFR* § 835.901 and DOE O 426.2, the requirements for the RPP are documented and implemented through CP2-TR-0100.

As specified by contract, FRNP is provided radiation safety training from the Paducah Infrastructure Contractor as a government furnished service. This includes Visitor, GERT, RW-I, and RW-2 training. FRNP continues to self-perform radiation safety training for RCTs. FRNP also will perform radiation safety orientation training for visitors.

FRNP will assist the Infrastructure Contractor with maintenance of the Radiological Worker Training Program by timely submission of program changes to the Infrastructure Contractor and DOE.

Radiation safety training is required for unescorted access to controlled areas and before receiving occupational dose during access to controlled areas. The training includes the following topics to the extent appropriate to an individual's prior training, work assignments, and degree of exposure to potential radiological hazards, and commensurate with the hazards in the area and the required controls: [10 *CFR* § 835.901(a)–(c)]

- Risks of exposure to radiation and radioactive materials, including prenatal radiation exposure;
- Basic radiological fundamentals and radiation protection concepts;
- Physical design features, administrative controls, limits, policies, procedures, alarms, and other measures implemented to manage doses and maintain doses ALARA, including both routine and emergency actions;
- Individual rights and responsibilities as related to the radiation protection program;

- Individual responsibilities for implementing ALARA measures; and
- Individual exposure reports that may be requested.

Each individual must demonstrate knowledge of the radiation safety topics above, commensurate with the hazards in the area and required controls, by successful completion of an examination and performance demonstrations before being permitted unescorted access to radiological areas and before performing unescorted assignments as a radiological worker.

RW-1 and RW-2 is administered in three parts: Core, Site Specific, and Practical Factors. Training may grant equivalence to individuals with previous RW or those who possess certification by the American Board of Health Physics or those registered in the National Registry of Radiation Protection Technologists. Documentation of equivalency per CP3-TR-0102, *Conduct of Training,* is provided to the Training organization for inclusion in the training records.

Visitors shall **not** be given unescorted access to radiologically controlled areas. Visiting minors shall **not** be given access to radiologically controlled areas per direction from PPPO.

8.2 RADIATION WORKER TRAINING DESCRIPTIONS

8.2.1 General Employee Radiological Training

GERT is provided to all site employees who receive occupational exposure during access to radiologically controlled areas at PGDP or who are permitted unescorted access to radiologically controlled areas. These individuals may not enter radiological areas (e.g., radiation areas and CAs) unescorted nor may they perform unescorted duties as a radiological worker.

8.2.2 Radiation Worker 1 Training

RW-1 training provides the appropriate level of training for individuals who meet these criteria:

- Enter noncontaminated radiation areas (but not high or very high radiation areas) or areas in which they are likely to receive doses exceeding 0.1 rem (0.0001 Sv) in a year (e.g., certain radioactive material areas and areas surrounding radiological areas);
- Work with sealed or fixed radioactive material that does not produce high radiation fields (i.e., fields exceeding 0.1 rem (0.001 Sv) in an hour); or
- Work with radiation producing devices that do not produce high radiation fields (i.e., fields exceeding 0.1 rem (0.001 Sv) in an hour).

RW-1 trained individuals shall not enter CAs, HCAs, HRAs, VHRAs, or ARAs.

8.2.3 Radiation Worker 2 Training

RW-2 is intended for workers whose job assignments involve unescorted entry to ARAs, RAs, and CAs. Further, workers who have potential use of gloveboxes with high contamination levels should complete RW-2. [DOE G 441.1-1C]

8.3 USE OF ESCORTS IN LIEU OF TRAINING

Under certain circumstances, it may be expedient to provide an escort to some individuals instead of granting unescorted access. Such circumstances are established in RP procedures. When an escort is provided in lieu of radiation safety training, the escort must have current radiation safety training, examinations, and performance demonstrations required for entry into the affected area and performance of the work. The escort must also ensure that the escorted individuals comply with the requirements of the RPP. [10 *CFR* § 835.901(d)]

8.4 RETRAINING

Retraining is provided when there is a significant change to radiation protection policies and procedures that may affect the individual and at intervals not to exceed 24 months, and includes successful completion of an examination. [10 *CFR* § 835.901(e)] This time interval may be extended by a period not to exceed 30 days to accommodate scheduling needs. [10 *CFR* § 835.3(e)] FRNP may self-perform retraining of personnel following a significant, time-critical program change, when necessary to address corrective actions, or when necessary to remediate radiation worker practices. Self-performance of training will be at the discretion of the RPM and communicated with DOE. Routine retraining of individuals at the 24-month intervals will be provided by the Infrastructure Contractor.

8.5 RADIOLOGICAL CONTROL TECHNICIANS AND SUPERVISORS

FRNP will self-perform RCT training. Individuals responsible for developing and implementing measures necessary for ensuring compliance with this RPP will have education, training, and skills necessary to discharge these responsibilities and documented as approved training developer as required by training program. [10 *CFR* § 835.103] These individuals who exercise discretionary authority and/or make independent judgments and decisions concerning radiation protection have additional selection and training requirements. These individuals include RCTs, RCTSs, and radiation protection managers.

RCT and RCTS selection complies with DOE Order 426.2, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*. Training provisions and concepts from DOE-STD-1107-97, *Knowledge, Skills, and Abilities for Key Radiation Protection Positions at DOE Facilities*, DOE-STD-1098-2008, *Radiological Control*, were incorporated into training and selection program requirements.

Similar to RW-1 and RW-2, RCT and RCTS training consists of core, site specific, and practical factors. Oral boards should be utilized for Supervisor qualification and to support promotion of Junior RCTs to Senior RCT status. As suggested by DOE in DOE-STD-1098-2008, *Radiological Control*, the RPM may grant equivalence of core training requirements to individuals with previous RCT qualifications from other DOE or NRC-licensed sites or those who possess certification by the American Board of Health Physics or those registered in the National Registry of Radiation Protection Technologists. An evaluation of training content will be performed to validate equivalency determinations and documented per CP3-TR-0102, *Conduct of Training*. RCTs who have not completed all of the applicable practical factors modules may perform limited support activities, including only those tasks in which they have successfully demonstrated competence and are considered qualified.

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9. DESIGN AND CONTROL

9.1 PHYSICAL DESIGN FEATURES/ENGINEERED CONTROLS

In addition to meeting the radiation dose limits established in Section 2, FRNP has instituted measures to control individual and collective radiation doses in controlled areas at levels that are ALARA through engineered and administrative controls. The ALARA process is implemented through the use of physical design features, including material confinement, ventilation, remote handling, and shielding. Administrative controls are employed only as supplemental methods to control radiation exposure. [10 *CFR* § 835.1001(a)]

Because the scope of the project includes the deactivation of previously used facilities, including their confinement and ventilation systems, many of the design features used during the project will include short-term engineered controls, such as temporary shielding, confinement, and ventilation systems. The application of the specific engineered controls to be used is determined by RP personnel working in consort with project planning personnel and project management.

The scope of project work primarily involves remediation and deactivation of existing facilities; however, if new or modified facilities are to be constructed, the following objectives apply to the design of new facilities or modification of existing facilities: [10 *CFR* § 835.1002]

- Optimization methods will be used to assure that occupational exposure is maintained ALARA in developing and justifying facility design and physical controls.

- The design objective for controlling personnel exposure from external sources of radiation in areas of continuous occupational occupancy (2,000 hours per year) is to maintain exposure levels below an average of 0.5 mrem/hour and as far below this average as is reasonably achievable. The design objectives for exposure rates for potential exposure to a radiological worker where occupancy differs from the above are ALARA and will not exceed 20% of the applicable standards in 10 *CFR* § 835.202.

- Regarding the control of airborne radioactive material, the design objective is, under normal conditions, to avoid releases to the workplace atmosphere and in any situation, to control the inhalation of such material by workers to levels that are ALARA; confinement and ventilation will normally be used.

- The design or modification of a facility and the selection of materials will include features that facilitate operations, maintenance, decontamination, and decommissioning.

9.2 ADMINISTRATIVE CONTROLS

Administrative controls are used to supplement the prescribed physical design features where physical design features are demonstrated to be impractical. [10 *CFR* § 835.1001(b)]

Administrative controls used to implement the ALARA process shall be included, as appropriate for the planned activities, administrative control levels (ACLs), performance goals, written procedures, and work authorizations.

FRNP has established a complex-wide administrative control level of 2 rem TED per year. If determined to be effective in controlling individual or collective doses, FRNP may establish subproject- or work group-specific ACLs. The subproject-specific ACLs will be established by FRNP management. Any

instances in which planned work will result in an individual exceeding the ACL will require management approval.

FRNP also will establish annual ALARA performance goals for the project. Performance tracking mechanisms will be used to track progress toward achievement of the goals and corrective action implemented as appropriate to correct adverse trends and control individual and collective doses. The ALARA performance goals may be revised as necessary to accommodate changes in the scope, unanticipated tasks, or radiological conditions.

The ALARA process inherently includes formal or informal cost/benefit analyses. The level of formality associated with these analyses depends on a number of factors, including the expected radiation doses, the complexity of the hazards and controls, and the types of work to be performed. As the project progresses, the types of physical design controls and administrative controls used to implement the ALARA process, and the balance between design features and administrative controls, may change due to changes in the types of work being performed and the radiological hazards associated with that work. In all cases, the combination of physical design features and administrative controls will be adequate to ensure that

individual radiation doses are within the occupational dose limits established in Section 2 above and that exposure levels are ALARA. [10 *CFR* § 835.1003(a)(b)]

10. CONTAMINATION CONTROL

Personnel performing radiological work take precautions and measures to control the spread of contamination from radiological areas into unaffected areas. This is accomplished by implementing engineered and administrative controls, compliance with RP personnel direction, and compliance with RWP or work authorization requirements for the area. Additional measures that are implemented, as appropriate, during site activities in a radiological area to prevent the spread of contamination include the following:

- Surveys of equipment and personnel;
- Decontamination of equipment and personnel, if needed;
- Covering controls and equipment (to the extent practicable) with a barrier to protect from potentially contaminated media at the site;
- Provision of clean work surfaces (i.e., gravel or mats);
- Use of rubber tired equipment instead of tracked equipment, as applicable;
- Selection of equipment with low ground pressures to help prevent marring;
- Implementation of good housekeeping practices during all activities;
- Ensuring that all personnel have the proper training to don, wear, and doff PPE;
- Assisting personnel to inspect their PPE for rips, tears, holes, etc.;
- Notification of an RCT if PPE becomes ripped or torn while in a radiological area;
- Use of dust suppression and fixatives;
- Use of air monitoring equipment; and
- Use of respiratory protection, as required.

Protective clothing is required for entry into areas in which removable contamination exists at levels exceeding the values in 10 *CFR* § 835, Appendix D, *Surface Contamination Values*, applicable administrative limits, or DOE-approved Authorized Limits. The type of clothing required is dependent upon the type and level of contamination anticipated and the individual's work assignment. The protective clothing requirements for radiological control are specified in the applicable written work authorization or RWP.

Except for personal items, which may be surveyed by the individual carrying them, only RP personnel are authorized to perform free-release surveys and make release decisions.

A whole-body frisk will be performed by personnel after removing protective clothing upon exit from contaminated areas. RP personnel are notified if monitoring results exceed alarm thresholds. The requirement to remove PPE and frisk prior to exiting the step-off area may be preempted during emergency

situations when personnel are to report to the designated assembly points and monitoring systems. Removal of protective clothing and monitoring then is accomplished at the monitoring point. If individuals are contaminated above the applicable surface contamination values in 10 *CFR* § 835 Appendix D, (see Table 1) or applicable administrative limits, personnel decontamination is performed. If contamination is not readily removable in the field, contaminated personnel are transported to a dedicated facility and decontamination efforts are continued by RP and/or medical personnel. Emergency medical treatment will take precedence over radiological considerations.

Table 1. 10 *CFR* § 835 Appendix D, Surface Contamination Values[1]

Radionuclide	Removable[2,4]	Total (Fixed + Removable)[2,3]
U-nat, U-235, U-238, and associated decay products	1,000[7]	5,000[7]
TRUs, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	20	500
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	200	1,000
Beta-gamma emitters (nuclides with decay modes other thanalpha emission or spontaneous fission) except Sr-90 and others noted above[5]	1,000	5,000
Tritium and special tritium compounds[6]	10,000	See Footnote 6
Administrative limit for mixed alpha contamination (assumes 8% TRU by alpha activity)	200	1,000

[1] The values in this appendix, with the exception noted in Footnote 6 below, apply to radioactive contamination deposited on, but not incorporated into the interior or matrix if, the contaminated item. Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides apply independently.

[2] 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.

[3] The levels may be averaged over one square meter provided the maximum surface activity in any area of 100 cm^2 is less than three times the value specified. For purposes of averaging, any square meter of surface shall be considered to be above the surface contamination value if (1) from measurements of a representative number of sections it is determined that the average contamination level exceeds the applicable value; or (2) it is determined that the sum of the activity of all isolated spots or particles in any 100 cm^2 area exceeds three times the applicable value.

[4] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by swiping the area with dry filter or soft absorbent paper, applying moderate pressure, and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. (Note: The use of dry material may not be appropriate for tritium.) When removable contamination on objects or surface area less than 100 cm^2 is determined, the activity per unit shall be based on the actual area and the entire surface shall be wiped. It is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that he total residual surface contamination levels are within the limits for removable contamination.

[5] This category of radionuclides includes mixed fission products, including the Sr-90 that is present in them. It does not apply to Sr-90 that has been separated from the other fission products or mixtures where the Sr-90 has been enriched.

[6] Tritium contamination may diffuse into the volume or matrix of materials. Evaluation of surface contamination shall consider the extent to which such contamination may migrate to the surface in order to ensure the surface contamination value provided in this appendix is not exceeded. Once this contamination migrates to the surface, it may be removable, not fixed; therefore, a 'Total' value does not apply. In certain cases, a 'Total' value of 10,000 dpm/100 cm^2 may be applicable either to metals, of the types which from insoluble special tritium compounds that have been exposed to tritium; or to bulk materials to which particles of insoluble special tritium compound are fixed to a surface.

[7] These limits only apply to the alpha emitters within the respective decay series and for soils located outside the process buildings within the Limited Area unless TRU posts exist.

NOTE: For off-site releases, see Environmental Radiation Protection Program (ERPP).

When engineered and administrative controls, including access restrictions and the use of specific work practices designed to minimize airborne contamination or loss of contamination control, are insufficient to ensure that ARA posting limits will not be exceeded, respiratory protection is prescribed. Ventilation systems are used as described below.

In addition to general building ventilation systems, portable ventilation units may be employed for short duration jobs. These local ventilation units are equipped with high-efficiency particulate air (HEPA) filters

and are designed to recirculate and discharge room air at low velocities. Activities where these units may be employed are also approved and controlled by safety analysis and NCS as necessary.

All personnel who use respiratory equipment are formally trained and qualified in accordance with 29 *CFR* § 1910.134. Respirators for radiological exposure control are controlled, issued, and inspected according to applicable procedures.

10.1 RELEASE OF MATERIALS, EQUIPMENT, AND FACILITIES

NOTE: See RPM for applicable Authorized Limits

Materials and equipment in CAs, HCAs, and airborne radioactivity areas are not released if the removable surface contamination on accessible surfaces exceed the values in 10 *CFR* § 835 Appendix D, applicable administrative limits, or applicable DOE-approved Authorized Limits, or if prior use suggests that the removable surface contamination levels on inaccessible surfaces are likely to exceed the removable surface values in 10 *CFR* § 835 Appendix D, applicable administrative limits, or applicable DOE-approved Authorized Limits. [10 *CFR* § 835.1101(a)]

Material and equipment exceeding the removable surface contamination values specified in 10 *CFR* § 835, Appendix D, applicable administrative limits, or applicable DOE-approved Authorized Limits, may be released conditionally for movement on-site from one radiological area for immediate placement in another radiological area only if appropriate monitoring is performed and appropriate controls for the movement are established and exercised. [10 *CFR* § 835.1101(b)]

Material and equipment with fixed contamination levels that exceed the total contamination values specified in 10 *CFR* § 835, Appendix D. applicable administrative limits, or applicable DOE-approved Authorized Limits may be released for use in controlled areas outside of radiological areas under the following conditions: [10 *CFR* § 835.1101(c)]

- Removable surface contamination levels are below the removable surface contamination values specified in 10 *CFR* § 835, Appendix D, applicable administrative limits, or applicable DOE-approved Authorized Limits; and

- The material or equipment is monitored routinely and clearly marked or labeled to alert personnel of the contaminated status.

10.2 CONTROL OF AREAS

Appropriate controls are maintained and verified that prevent the inadvertent transfer of removable contamination to locations outside of radiological areas under normal operating conditions. Any area in which contamination levels exceed the values specified in 10 *CFR* § 835, Appendix D applicable administrative limits, or applicable DOE-approved Authorized Limits, is controlled in a manner commensurate with the physical and chemical characteristics of the contaminant, the radionuclides present, and the fixed and removable surface contamination levels. [10 *CFR* § 835.1102(a)–(b)]

Areas accessible to individuals where the measured total surface contamination levels exceed, but the removable surface contamination levels are less than, corresponding surface contamination values specified in 10 *CFR* § 835, Appendix D, applicable administrative limits, or applicable DOE-approved Authorized Limits,) are controlled as follows when located outside of radiological areas: [10 *CFR* § 835.1102(c)]

- The area is routinely monitored to ensure that the removable surface contamination level remains below the removable surface contamination values specified in 10 *CFR* § 835, Appendix D applicable administrative limits, or applicable DOE-approved Authorized Limits, and

- The area is marked conspicuously to warn individuals of the contaminated status.

Protective clothing is required for entry to areas in which removable contamination exists at levels exceeding the removable surface contamination values specified in 10 *CFR* § 835, Appendix D applicable administrative limits, or applicable DOE-approved Authorized Limits. Individuals exiting contamination, high contamination, or airborne radioactivity areas are monitored, as appropriate, for the presence of surface contamination. [10 *CFR* § 835.1102(d)-(e)]

11. SEALED RADIOACTIVE SOURCE CONTROL

Sealed radioactive sources, including sources authorized for use in industrial radiography devices, moisture density devices, and instrument calibration sources, are subject to specific requirements and are procured, used, handled, and stored in accordance with RP procedures in a manner commensurate with the hazards associated with the operations associated with the source. [10 *CFR* § 835.1201]

Any sealed radioactive source with an activity exceeding the applicable value specified in 10 *CFR* § 835, Appendix E, Values for Establishing Sealed Radioactive Source Accountability and Radioactive Material Posting and Labeling Requirements, is considered to be an accountable sealed radioactive source. Each accountable sealed radioactive source is inventoried at intervals not to exceed 6 months. This time interval may be extended by a period not to exceed 30 days to accommodate scheduling needs [10 *CFR* § 835.3(e)]. The inventory is sufficient to establish the physical location of each accountable sealed radioactive source, verify the presence and adequacy of the associated postings and labels, and establish the adequacy of storage locations, containers, and devices. 10 *CFR* § 835.1202(a)]

Except for sealed radioactive sources consisting solely of gaseous radioactive material or tritium, each accountable sealed radioactive source is subject to a source leak test upon receipt, when damage is suspected, and at intervals not to exceed 6 months. This time interval may be extended by a period not to exceed 30 days to accommodate scheduling needs. [10 *CFR* § 835.3(e)] The leak test is performed using methods and equipment capable of detecting radioactive material leakage equal to or exceeding 0.005 μCi. If any source is found to be leaking, it will be controlled in a manner that minimizes the spread of radioactive contamination (e.g., disposal, repair, or containment). [10 *CFR* § 835.1202(b), (e)]

The requirements for leak testing of accountable sealed radioactive sources do not apply to sources that have been removed from service. Such sources are stored in a controlled location, subject to periodic inventory as above, and are subject to source leak testing prior to being returned to service, transferred to another site, or disposed of as radioactive waste. [10 *CFR* § 835.1202(c)]

The requirements for accountable sealed radioactive source inventory and leak testing are not applicable if the source is located in an area that is unsafe for human entry or otherwise inaccessible. [10 *CFR* § 835.1202(d)] No known areas exist or are anticipated where this may be applicable.

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12. RADIATION EXPOSURE CONTROL UNDER EMERGENCY CONDITIONS

Under certain emergency conditions, it may be necessary to authorize individuals to receive radiation doses in excess of the routine dose limits established in 10 *CFR* § 835.202, *Occupational Dose Limits for General Employees*. Such doses must be authorized by FRNP Program Manager and RPM after receiving approval from the PPPO Manager (or designee) under the following conditions: [10 *CFR* § 835.1302]

Measures will be implemented to minimize the risk of injury to those individuals involved in rescue and recovery operations. [10 *CFR* § 835.1302(a)] FRNP management will weigh actual and potential risks against the benefits to be gained. [10 *CFR* § 835.1302(b)] No individual will be required to perform a rescue action that might involve substantial personal risk. [10 *CFR* § 835.1302(c)]

For each individual authorized to perform emergency actions likely to result in occupational doses exceeding the regulatory limits, FRNP will provide radiation safety training in accordance with 10 *CFR* § 835.901(b) and a briefing (before the exposure) on the known or anticipated hazards associated with the operation. [10 *CFR* § 835.1302(d)]

12.1 GENERAL PROVISIONS

Upon completion of the emergency exposure and restoration of routine operating conditions, it may be desirable to allow the individuals who received authorized emergency exposures to return to their routine duties involving occupational radiation exposure.

FRNP may permit a general employee who received authorized emergency exposures exceeding the regulatory dose limits to return to work in radiological areas during the current year under the following conditions: [10 *CFR* § 835.1301(a)]

- Approval is first obtained from FRNP management and the PPPO Manager.
- The individual receives counseling from RP and medical personnel regarding the consequences of receiving additional occupational exposure during the year.
- The affected employee agrees to return to radiological work.

All doses exceeding the limits in 10 *CFR* § 835.202, *Occupational Dose Limits for General Employees,* will be recorded in the affected individual's occupational dose record by the Infrastructure Contractor. [10 *CFR* § 835.1301(b)]

When the conditions under which a dose was received in excess of the regulatory limits have been eliminated, FRNP management will notify the PPPO Manager. [10 *CFR* § 835.1301(c)]

Operations that were suspended as a result of a dose in excess of the regulatory limits, except those received as part of a planned special exposure, will only be resumed with the approval of the PPPO Manager. [10 *CFR* § 835.1301(d)]

12.2 NUCLEAR ACCIDENT DOSIMETRY

Nuclear accident dosimetry is required where sufficient quantities of fissile material exist to potentially constitute a critical mass and where significant exposure of personnel to radiation from a nuclear accident is possible. [10 *CFR* § 835.1304(a)] Nuclear accident dosimetry, includes fixed nuclear accident dosimeters (FNADs) and personal nuclear accident dosimeters (PNADs), whole body DOELAP accredited beta-gamma dosimeters and screening techniques and analysis methods using activation products in the blood, hair, and other biological materials. [10 *CFR* § 835.1304(b)]

Fixed nuclear accident dosimeter locations are selected on the basis of shielding, potential use of data for dose reconstruction efforts, and the ease of recovery in the event of a nuclear accident. A network of FNADs is situated around the site facilities. In the event of a criticality, the FNADs are processed. FRNP will deploy FNADs in areas determined jointly by Radiation Protection and NCS.

DOE Guide 441.1-1C, *Radiation Protection Programs Guide for Use with Title 10, Code of Federal Regulations, § 835, Occupational Radiation Protection*, provides acceptable methods and specifications for nuclear accident dosimetry programs.

Personnel who are monitored routinely for external exposure while wearing an issued whole-body dosimeter will use their whole-body dosimeter as a nuclear accident dosimeter. Personnel, including visitors, who are not monitored routinely or do not have a whole-body dosimeter but enter areas that are posted or otherwise require personnel nuclear accident dosimetry, must wear a PNAD.

In the event of a criticality, Infrastructure Contractor will ship PNADs to their contracted laboratory for processing.

13. REFERENCES

10 *Code of Federal Regulations* (*CFR*) § 71, *Packaging and Transportation of Radioactive Material*

10 *CFR* § 830, *Nuclear Safety Management, Subpart A, Quality Assurance Requirements*

10 *CFR* § 835, *Occupational Radiation Protection*

10 *CFR* § 1910, *Occupational Safety and Health Standards*

40 *CFR* § 172.403, *Class 7 (Radioactive) Material*

49 *CFR* § 172, 436-440, *Radioactive White-I Label, Radioactive Yellow-II Label, and Radioactive Yellow-III Label*

American Society of Mechanical Engineers (ASME) NQA-1, *Quality Assurance Requirements for Nuclear Facility Applications*

CP2-EP-1000, *Emergency Management Plan for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*

CP2-ES-0103, *Environmental Radiological Protection Program*

CP2-HS-1000, *Integrated Safety Management System Description for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*

CP2-HS-2000, *Worker Safety and Health Program for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*

CP2-QA-1000, *Quality Assurance Program Description for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*

CP2-TR-0100, *Training Program for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*

CP3-OP-0002, *Developing and Maintaining Performance Documents*

CP3-RP-1114, *ALARA Program*

CP3-TR-0102, *Conduct of Training*

DOE G 441.1-1C Chg 1, *Radiation Protection Programs Guide for Use with Title 10, Code of Federal Regulations, Part 835, Occupational Radiation Protection*

DOE-HDBK-1122-2009, Change Notice No. 2, *Radiological Control Technician Training*

DOE-HDBK-1130-2008, Change Notice 2, *Radiological Worker Training*

DOE-HDBK-1131-2007, Change Notice 1, *General Employee Radiological Training*

DOE Order (O) 414.1D Chg 1, *Quality Assurance*

DOE O 426.2 Chg 1, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*

DOE O 458.1 Admin Chg 3, *Radiation Protection of the Public and the Environment*

DOE Policy (P) 450.4A Chg 1 (Min Chg), *Integrated Safety Management Policy*

DOE-STD-1098-2008, Change Notice 1, *Radiological Control*

DOE-STD-1107-97, Change Notice No. 1, *Knowledge, Skills, and Abilities for Key Radiation Protection Positions at DOE Facilities*

EM-QA-0001 Rev. 1, *Environmental Management Quality Assurance Program*

FRNP-TRANS-0013, *Records Management Plan at the Paducah Gaseous Diffusion Plant.*

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

ICRP Publication 68, *Dose Coefficients for Intakes of Radionuclides by Workers*

APPENDIX A

CROSS-REFERENCE 10 *CFR* § 835 TO FRNP RADIATION PROTECTION PROGRAM

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Cross-Reference 10 CFR § 835 to FRNP Radiation Protection Program

10 *CFR* § 835 Section	RPP Section	Implementing Procedure Title
835.3(a)–(b)	1.4.1	No implementing procedure needed
835.3(c)	N/A	FRNP is the designated contractor
835.3(d)	1.4.1	CP3-RP-1101, *Radiation Exposure Limits*
835.3(e)	8.4, 11	CP3-RP-1601, *Radiation Safety Training*
835.4	6.2	CP3-RP-1401, *Radiation Protection Program Records*, and equivalent Infrastructure Contractor procedure
835.101(a)	1.4.1	No implementing procedure needed
835.101(b)	1.4.3	No implementing procedure needed
835.101(c)	1.4.1 1.11.1	CP3-RP-1114, *ALARA Program*
835.101(d)	1.4.1	No implementing procedure needed
835.101(e)	1.4.1	No implementing procedure needed
835.101(f)	N/A	No implementing procedure needed
835.101(g)-(i)	1.4.3	No implementing procedure needed
835.102	1.6	CP4-RP-1502, *Radiation Protection Internal Assessment Program* CP3-QA-1004, *Independent Assessment Program* CP2-QA-1000, *Quality Assurance Program Description for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*
835.103	1.7, 6.1, 8.5	CP3-RP-1601, *Radiation Safety Training* CP2-TR-0100, *Training Program for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*
835.104	1.8	No implementing procedure needed
835.202	9.1, 12.0, 12.1	CP3-RP-1101, *Radiation Exposure Limits*
835.202(a)	2.1	CP3-RP-1101, *Radiation Exposure Limits*
835.202(b)	2.1	CP3-RP-1101, *Radiation Exposure Limits*
835.202(c)	2.1	CP3-RP-1101, *Radiation Exposure Limits*
835.203(a)	2.1	CP3-RP-1101, *Radiation Exposure Limits*
835.203(b)	2.1	CP3-RP-1101, *Radiation Exposure Limits*
835.204	2.2	No implementing procedure needed; FRNP does not intend to use planned special exposures during the course of the project
835.205	2.1	Provided by Infrastructure Contractor
835.206(a)	2.1	CP3-RP-1203, *Embryo/Fetus Protection*
835.206(b)–(c)	2.3	CP3-RP-1203, *Embryo/Fetus Protection*
835.207	2.1 & 2.4	CP3-RP-1101, *Radiation Exposure Limits*
835.208	2.1	CP3-RP-1101, *Radiation Exposure Limits*
835.209(a)	2.5	CP4-RP-1107, *Workplace Air Monitoring for Radioactivity*
835.209(b)	2.5	Provided by Infrastructure Contractor
835.401	3.3	Provided by Infrastructure Contractor
835.401(a)	3.4.2	Provided by Infrastructure Contractor
835.401(b)	3.4.4	Provided by Infrastructure Contractor
835.402	3.2, 6.1	Provided by Infrastructure Contractor
835.402(a)	3.2	Provided by Infrastructure Contractor
835.402(b)	3.2	Provided by Infrastructure Contractor
835.402(c)	3.3, 6.1	Provided by Infrastructure Contractor
835.402(d)	3.3	Provided by Infrastructure Contractor
835.403	3.4.1	CP4-RP-1107, *Workplace Air Monitoring for Radioactivity*
835.403(a)	3.4.5	CP4-RP-1107, *Workplace Air Monitoring for Radioactivity*
835.403(b)	3.4.5, 3.4.1	CP4-RP-1107, *Workplace Air Monitoring for Radioactivity*
835.405(a)	3.5.1	CP3-RP-1105, *Receipt, Transport, and Movement of Radioactive Materials*
835.405(b)	3.5.2	CP3-RP-1105, *Receipt, Transport, and Movement of Radioactive Materials*

Cross-Reference 10 CFR § 835 to FRNP Radiation Protection Program (Continued)

10 *CFR* § 835 Section	RPP Section	Implementing Procedure Title
835.405(c)	3.5.3	CP3-RP-1105, *Receipt, Transport, and Movement of Radioactive Materials*
835.405(d)	3.5	CP3-RP-1105, *Receipt, Transport, and Movement of Radioactive Materials*
835.405(e)	3.5.2	CP3-RP-1105, *Receipt, Transport, and Movement of Radioactive Materials*
835.501(a)	4.1	CP3-RP-1104, *Radiological Area Entry Control*
835.501(b)	4.1	CP3-RP-1104, *Radiological Area Entry Control*
835.501(c)	4.1	CP3-RP-1104, *Radiological Area Entry Control*
835.501(d)	4.1	CP3-RP-1104, *Radiological Area Entry Control*
835.501(e)	4.1	CP3-RP-1104, *Radiological Area Entry Control*
835.502(a)-(b)	4.2	CP3-RP-1104, *Radiological Area Entry Control*
835.502(c)	N/A	CP3-RP-1104, *Radiological Area Entry Control*
835.502(d)	N/A	CP3-RP-1104, *Radiological Area Entry Control*
835.601(a)	5.1	CP3-RP-1108, *Posting and Labeling*
835.601(b)	5.1	CP3-RP-1108, *Posting and Labeling*
835.601(c)	N/A	There are no private residences or businesses associated with the project.
835.602(a)	5.2.1	CP3-RP-1108, *Posting and Labeling*
835.602(b)	5.2.1	CP3-RP-1108, *Posting and Labeling*
835.603(a)	5.2.2	CP3-RP-1108, *Posting and Labeling*
835.603(b)	N/A	CP3-RP-1108, *Posting and Labeling*
835.603(c)	5.2.4	CP3-RP-1108, *Posting and Labeling*
835.603(d)	5.2.5	CP3-RP-1108, *Posting and Labeling*
835.603(e)	5.2.6	CP3-RP-1108, *Posting and Labeling*
835.603(f)	5.2.7	CP3-RP-1108, *Posting and Labeling*
835.603(g)	5.2.8	CP3-RP-1108, *Posting and Labeling*
835.604(a)–(c)	5.2.10	CP3-RP-1108, *Posting and Labeling*
835.605	5.3	CP3-RP-1108, *Posting and Labeling*
835.606(a)	5.3	CP3-RP-1108, *Posting and Labeling*
835.606(b)	5.1	CP3-RP-1108, *Posting and Labeling*
835.701(a)–(b)	6.1	CP3-RP-1401, *Radiation Protection Program Records and equivalent Infrastructure Contractor procedure*
835.702(a)–(h)	6.1	Provided by Infrastructure Contractor
835.703(a)	6.1	CP4-RP-1110, *Radiation Surveys* CP3-RP-1109, *Radioactive Contamination Control and Monitoring* CP4-RP-1111, *Workplace Monitoring* Infrastructure Contractor Calibration Procedures
835.703(b)	6.1	CP3-RP-1401, *Radiation Protection Program Records*, and equivalent Infrastructure Contractor procedure
835.703(c)	6.1	CP3-RP-1104, *Radiological Area Entry Control*
835.703(d)	6.1	CP3-RP-1401, *Radiation Protection Program Records*, and equivalent Infrastructure Contractor procedure
835.704(a)-(b)	6.1	CP3-RP-1401, *Radiation Protection Program Records*, and equivalent Infrastructure Contractor procedure
835.704(c)–(d)	6.1	CP3-RP-1401, *Radiation Protection Program Records*, and equivalent Infrastructure Contractor procedure
835.704(e)	6.1	Provided by Infrastructure Contractor
835.704(f)	6.1	CP3-RP-1302, *Radioactive Source Control*
835.801(a)–(e)	7	Provided by Infrastructure Contractor
835.901(a)–(c)	8.1	Provided by Infrastructure Contractor
835.901(d)	8.3	Provided by Infrastructure Contractor

Cross-Reference 10 CFR § 835 to FRNP Radiation Protection Program (Continued)

10 *CFR* § 835 Section	RPP Section	Implementing Procedure Title
835.901(e)	8.4	Provided by Infrastructure Contractor
835.1001(a)	9.1	CP3-RP-1102, *Design and Control*
835.1001(b)	9.2	CP3-RP-1102, *Design and Control*
835.1002	9.1	CP3-RP-1102, *Design and Control*
835.1003(a)–(b)	9.2	CP3-RP-1114, *ALARA Program* CP3-RP-1102, *Design and Control*
835.1101(a)–(c)	10.1	CP3-RP-1104, *Radiological Area Entry Control*
835.1102(a)–(c)	10.2	CP3-RP-1104, *Radiological Area Entry Control*
835.1102(d)	10.2	CP3-RP-1104, *Radiological Area Entry Control*
835.1102(e)	10.2	CP3-RP-1106, *Selection and Use of Anti-Contamination Clothing*
835.1201	11	CP3-RP-1302, *Radioactive Source Control*
835.1202(a)	11	CP3-RP-1302, *Radioactive Source Control*
835.1301(a)-(d)	12.1	CP3-RP-1101, *Radiation Exposure Limits*
835.1302(a)–(d)	12	CP3-RP-1101, *Radiation Exposure Limits*
835.1304(a)–(b)	12.2	CP3-RP-1117, *Accidents and Emergencies* CP3-RP-1202, *External Dosimetry*
Appendix A	5.2.5	CP4-RP-1107, *Workplace Air Monitoring for Radioactivity* CP3-RP-1108, *Posting and Labeling*
Appendix C	N/A	Not applicable to PGDP
Appendix D	5.2.6, 5.2.7, 10, 10.1, 10.2	CP3-RP-1108, *Posting and Labeling for 835.603(e)–(f), 835.1101, & 835.1102*
Appendix E	5.2.8, 11	CP3-RP-1108, *Posting and Labeling for 835.603(g) & 835.605*

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APPENDIX B

RADIOLOGICAL ASSESSMENT FUNCTIONAL ELEMENTS

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Radiological Assessment Functional Elements

Functional Element	Regulatory Provision	Guidance Document
1. Organization and Administration	10 *CFR* § 835, Subpart B	DOE G 441.1-1C Chg 1 Chapter 3.0
2. ALARA Program	10 *CFR* § 835.101(c), Subpart K	DOE G 441.1-1C Chg 1 Chapter 4.0
3. External Dosimetry Program	10 *CFR*§ 835.401(a), 402(a), (b)	DOE G 441.1-1C Chg 1 Chapter 6.0
4. Internal Dosimetry Program	10 *CFR* § 835.401(a), 402(c), (d)	DOE G 441.1-1C Chg 1 Chapter 5.0
5. Area Monitoring & Control a. Area Radiation Monitoring	10 *CFR* § 835.401(a)	DOE G 441.1-1C Chg 1 Chapter 6.0
b. Airborne Radioactivity Monitoring	10 *CFR* § 835.209, 401(a), 403	DOE G 441.1-1C Chg 1 Chapter 10.0
c. Contamination Monitoring & Control	10 *CFR* § 835.401(a), Subpart L	DOE G 441.1-1C Chg 1 Chapter 11.0 DOE O 458.1, Admin. Chg 3
d. Instrument Calibration & Maintenance	10 *CFR* § 835.401(b)	DOE G 441.1-1C Chg 1 Chapter 9.0
6. Radiological Controls a. Radiological Work Planning	10 *CFR* § 835.501(d), 1001(b), 1003	DOE-STD-1098-2008
b. Entry & Exit Controls	10 *CFR* § 835, Subpart F	DOE G 441.1-1C Chg 1 Chapter 7.0
c. Radiological Work Controls	10 *CFR* § 835, Subpart F, 1003	DOE G 441.1-1C Chg 1 Chapter 7.0
d. Posting and Labeling	10 *CFR* § 835, Subpart G	DOE G 441.1-1C Chg 1 Chapter 12.0
e. Release of Materials & Equipment	10 *CFR* § 835.1101	DOE G 441.1-1C Chg 1 Chapter 11.0
f. Sealed Radioactive Source Accountability & Control	10 *CFR* § 835, Subpart M	DOE G 441.1-1C Chg 1 Chapter 15.0
g. Receipt of Packages Containing Radioactive Material	10 *CFR* § 835.405	DOE O 460.1D
7. Emergency Exposure Situations	10 *CFR* § 835.1301, 1302	DOE O 151.1-1C
8. Nuclear Accident Dosimetry	10 *CFR* § 835.1304	DOE G 441.1-1C Chg 1 Chapter 6.0
9. Records	10 *CFR* § 835, Subpart H	DOE G 441.1-1C Chg 1 Chapter §13.0
10. Reports to Individuals	10 *CFR* § 835, Subpart I	DOE G 441.1-1C Chg 1 Chapter 13.0
11. Radiation Safety Training	10 *CFR* § 835, Subpart J	DOE G 441.1-1C Chg 1 Chapter 14.0 DOE O 426.2, Chg 1 DOE-STD-1107, Change Notice No. 1 DOE-STD-1098-2008
12. Radiation Exposure Limits	10 *CFR* § 835, Subpart C	DOE G 441.1-1C Chg 1 Chapter 5.0, 6.0, 8.0
13. Radiation Generating Devices	10 *CFR* § 835.1001(a), 1003	DOE G 441.1-1C Chg 1 Chapter 7.0
14. Respiratory Protection	10 *CFR* § 835.403, 1001, 1003, Appendix A	DOE G 441.1-1C Chg 1 Chapter 10.0
15. Radioactive Waste Management	10 *CFR* § 835.401(a), Subpart L	DOE O 435.1, Chg 1

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