CP2-ES-0103/FR2

Environmental Radiation Protection Program

This document is approved for public release per review by:

David Hayden — 1-28-2020

FRNP Classification Support — Date

Environmental Radiation Protection Program

Date Issued—January 2020

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 Task Order DE-EM-0004895

THIS PAGE INTENTIONALLY LEFT BLANK

APPROVALS

Environmental Radiation Protection Program

CP2-ES-0103/FR2

LeAnne Garner
Environmental Radiation Protection Manager — 1/27/2020 Date

Environmental Stewardship Program Manager — 1-27-2020 Date

Environmental Services Director — 1-27-2020 Date

Program Manager — 1/30/2020 Date

THIS PAGE INTENTIONALLY LEFT BLANK

CONTENTS

ACRONYMS

ACL	administrative control level
AEA	Atomic Energy Act
ALARA	as low as reasonably achievable
ASER	Annual Site Environmental Report
BAT	best available technology
BCG	biota concentration guide
CAP-88 PC	Clean Air Act Assessment Package-1988 personal computer version
CFR	*Code of Federal Regulations*
DAC	derived air concentration
DCS	Derived Concentration Standard
DOE	U.S. Department of Energy
dpm	disintegrations per minute
EMP	Environmental Monitoring Plan
EMS	Environmental Management System
ERPP	Environmental Radiation Protection Program
ES	Environmental Services
GPP	Groundwater Protection Plan
KPDES	Kentucky Pollutant Discharge Elimination System
NESHAP	National Emissions Standards for Hazardous Air Pollutants
PGDP	Paducah Gaseous Diffusion Plant
RCRA	Resource Conservation and Recovery Act
TED	total effective dose
TENORM	Technologically Enhanced Naturally Occurring Radioactive Material

THIS PAGE INTENTIONALLY LEFT BLANK

DEFINITIONS

Terminology used in this Environmental Radiation Protection Program is consistent with the definitions provided in U.S. Department of Energy (DOE) Order (O) 458.1, *Radiation Protection of the Public and the Environment*.

Absorbed Dose—The average energy imparted by ionizing radiation to the matter in a volume element per unit mass of irradiated material. The absorbed dose is expressed in units of rad (or gray) (1 rad = 0.01 gray).

Actual or Likely Use Scenarios—The current uses and reasonably anticipated uses in the foreseeable future of real and personal property considering the history of use; use restrictions, designations, or controls; affected populations; or ecosystems, or natural resources; and the property's historic or cultural significance. For real property considerations also include Federal and State use designations; local zoning and future land use plans; and proximity to residences, commercial or industrial areas, or areas of cultural or historic significance.

Airborne Discharges—Material released to the atmosphere in the form of dusts, fumes, particulates, mists, vapors, or gases.

ALARA (As Low As Reasonably Achievable)—An approach to radiation protection to manage and control releases of radioactive material to the environment, and exposure to the work force and to members of the public so that the levels are ALARA, taking into account societal, environmental, technical, economic, and public policy considerations. As used in DOE O 458.1, ALARA is not a specific release or dose limit, but a process that has the goal of optimizing control and management of releases of radioactive material to the environment and doses so that they are as far below the applicable limits of DOE O 458.1 as reasonably achievable.

ALARA Process—A graded process for evaluating alternative operations, processes, and other measures for optimizing releases of radioactive material to the environment and exposure to the workforce and to members of the public taking into account societal, environmental, technical, economic, and public policy considerations to make a decision concerning the optimum level of public health and environmental protection. A graded approach provides the flexibility to perform qualitative or quantitative ALARA analyses. For low doses, qualitative evaluations normally will suffice.

Authorized Limit—A limit on the concentration or quantity of residual radioactive material on the surfaces or within property that has been derived consistent with DOE directives, including the ALARA process requirements. An authorized limit also may include conditions or measures that limit or control the disposition of property.

Background Radiation—Radiation from (1) naturally occurring radioactive materials that have not been technologically enhanced (e.g., background radiation does not include TENORM); (2) cosmic sources; (3) global fallout as it exists in the environment (such as from the testing of nuclear explosive devices); (4) radon and its decay products in concentrations or levels existing in buildings or the environment that have not been elevated as a result of current or prior activities; and (5) consumer products containing nominal amounts of radioactive material or producing nominal amounts of radiation.

Best Available Technology (BAT)—The preferred technology for a particular activity, selected from among others after taking into account factors related to technology, economics, public policy, and other

parameters. As used in DOE O 458.1, the BAT is not a specific level of treatment, but is the conclusion of a selection process in which several alternatives are evaluated.

BAT Selection Process—The evaluation of candidate alternative technologies in order to select the BAT after considering; technology; economics; the age of equipment and facilities involved; the process employed; the engineering aspects of applying various types of control techniques; process changes; other environmental impacts (including energy requirements); safety considerations; and policy considerations.

Clearance of Property—The removal of property that contains or may contain residual radioactive material from DOE radiological control under 10 *CFR* Part 835 and DOE O 458.1.

Collective Dose—The sum of the total effective dose to all persons in a specified population received in a specified period of time. For clearance of property the collective dose refers to the population potentially exposed to the cleared property. Collective dose is expressed in units of person-roentgen equivalent man (rem) (or person-sievert).

Committed Effective Dose (E_{50})—The sum of the committed equivalent doses to various tissues or organs in the body ($H_{T,50}$), each multiplied by the appropriate tissue weighting factor (w_T)—that is, $E_{50} = \Sigma_{wT}H_{T,50} + w_{Remainder}H_{Remainder,50}$, where $w_{Remainder}$ is the tissue weighting factor assigned to the remainder organs and tissues and $H_{Remainder,50}$ is the committed equivalent dose to the remainder organs and tissues. Committed effective dose is expressed in units of rems (or sieverts).

Committed Equivalent Dose ($H_{T,50}$)—The equivalent dose calculated to be received by a tissue or organ over a 50-year period after the intake of a radionuclide into the body. It does not include contributions from radiation sources external to the body. Committed equivalent dose is expressed in units of rems (or sieverts).

Controlled Area—Any area to which access is managed by or for DOE to protect individuals from exposure to radiation and/or radioactive material as defined by 10 *CFR* Part 835.

Derived Concentration Standard (DCS)—A derived concentration value for a radionuclide in water that would result in a dose of 100 mrem in a year to a gender- and age-weighted reference person using DOE approved dose coefficients and assuming continuous exposure.

Dose—A general term for absorbed dose, equivalent dose, effective dose, committed equivalent dose, committed effective dose, or total effective dose (TED), as defined in DOE O 458.1.

Effective Dose (E)—The summation of the products of the equivalent dose received by specified tissues or organs of the body (H_T) and the appropriate tissue weighting factor (w_T)—that is, $E = \Sigma_{wT}H_T$. It includes the dose from radiation sources internal and/or external to the body. For purposes of compliance with DOE O 458.1, equivalent dose to the whole body may be used as effective dose for external exposures. The effective dose is expressed in units of rems (or sieverts).

Effluent Monitoring—The collection and analysis of samples of liquid and gaseous effluents or measurements of liquid and gaseous effluents performed to characterize and quantify radiological contaminants and process stream characteristics, assess radiation exposures of members of the public, and demonstrate compliance with applicable standards.

Environmental Surveillance—The collection and analysis of samples of air, water, soil, foodstuffs, biota, and other media at the DOE Site and surrounding environs and the measurement of external

radiation to demonstrate compliance with applicable standards, assess radiation exposure of members of the public, and assess effects, if any, on the environment.

Equivalent Dose (H_T)—The product of average absorbed dose ($D_{T,R}$) in rad (or gray) in a tissue or organ (T) and a radiation (R) weighting factor (w_R). For external dose, the equivalent dose to the whole body is assessed at a depth of 1 cm in tissue; the equivalent dose to the lens of the eye is assessed at a depth of 0.3 cm in tissue, and the equivalent dose to the extremity and skin is assessed at a depth of 0.007 cm in tissue. Equivalent dose is expressed in units of rems (or sieverts).

External Dose or Exposure—That portion of the dose received from radiation sources outside the body (e.g., external sources).

Facility—Something that is built, installed, or established to serve a particular DOE radiological activity.

General Employee—An individual who is either a DOE or DOE contractor employee, an employee of a subcontractor, or an individual who performs work for or in conjunction with DOE or utilizes DOE facilities.

Internal Dose or Exposure—That portion of the dose received from radioactive material taken into the body (e.g., internal sources).

Liquid Discharge—The release to the environment of radioactive material in a liquid medium. The discharge generally occurs at a point, such as the end of a pipe, where it is released to any of several receptors in the environment, such as a waterway, land, sewer system, etc.

Maximally Exposed Individual—A hypothetical individual who—because of realistically assumed proximity, activities, and living habits—would receive the highest radiation dose, taking into account all pathways, from a given event, process, or facility.

Measurement Quality Objectives—A statement of a performance objective or requirement for a particular method performance characteristic.

Member of the Public—An individual who is not a general employee. An individual is not a member of the public during any period in which the individual receives an occupational dose.

Monitoring—The measurement of radiation levels, discharges or environmental releases, residual radioactive levels, quantities of radioactive material, or exposure to members of the public and the use of the results of these measurements to evaluate radiological discharges or releases or potential and actual dose resulting from exposures to radioactive material or radiation.

Personal Property—Property of any kind, except for real property.

Potential Dose—A calculated dose based on a postulated set of exposure conditions that have a reasonable probability of occurrence.

Public Dose—The dose received by members of the public from exposure to radiation and to radioactive material released by a DOE radiological activity whether the exposure is within a DOE site boundary or off-site.

Radiation—Ionizing radiation: alpha particles, beta particles, gamma rays, X-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation, as used in DOE O 458.1, does not include nonionizing radiation, such as radio waves or microwaves, or visible, infrared, or ultraviolet light.

Radiation Weighting Factor (w_R)—The modifying factor used to calculate the equivalent dose from the average tissue or organ absorbed dose; the absorbed dose (expressed in rad or gray) is multiplied by the appropriate radiation weighting factor.

Radioactivity—The property or characteristic of radioactive material to undergo spontaneous transformations (disintegrations or decay) with the emission of energy in the form of radiation. It is measured by the rate of spontaneous transformations of a radionuclide. The unit of radioactivity is the curie, Ci (or becquerel, Bq) (1 Ci = 3.7×10^{10} Bq).

Radiological Activity—Any activity taken for or by DOE that has the potential to result in releases of radioactive material to the environment or exposures of members of the public, to include all doses both present and future, from clearance activities and radiation generating devices. The activity may involve a single DOE facility, or combination of facilities and operations, possibly including an entire site or no fixed site at all.

Real Property—Land and anything permanently affixed to the land such as buildings, fences, and those things attached to the buildings, such as light fixtures, plumbing and heating fixtures, or other such items, that would be personal property if not attached.

Reference Person—A hypothetical aggregation of human (male and female) physical and physiological characteristics arrived at by international consensus for the purpose of standardizing radiation dose calculations.

Remedial Actions—Those actions, consistent with permanent remedy, taken to control or remove radiological contaminants to prevent or to minimize doses to members of the public.

Representativeness—The extent to which a set of measurements taken in a space-time domain reflects the actual conditions in the same or different space-time domain taken on a scale appropriate for a specific application.

Residual Radioactive Material—Any radioactive material that is in or on soil, air, water, equipment, or structures as a consequence of past operations or activities of the Department or its predecessors.

Sanitary Sewerage—A system of public sewers for carrying off waste water and refuse, but excluding sewage treatment facilities, septic tanks, and leach fields owned or operated by or for DOE.

Settleable Solids—(i) that matter in waste water which will not stay in suspension during a preselected settling period, such as one hour, but settles to the bottom; (ii) in the Imhoff cone test, the volume of matter that settles to the bottom of the cone in one hour; or (iii) suspended solids that can be removed by conventional sedimentation processes.

Sewer—An artificial conduit, usually underground, for carrying off waste water and refuse.

Site—Land or property upon which DOE facilities or activities are located and access to which is subject to DOE or DOE contractor control.

Site Boundary—The perimeter of a DOE Site, within which DOE or a DOE contractor normally can control access or restrict activities.

Soil Column—An *in situ* volume of soil through which liquid waste streams percolate from ponds, cribs, trenches, drain fields, or other areas or facilities used for the primary purpose of removing or retaining the suspended or dissolved radionuclides contained within the liquid process waste stream.

Technologically Enhanced Naturally Occurring Radioactive Material (TENORM)—Any naturally occurring radioactive materials whose radionuclide concentrations or potential for human exposure have been increased above levels encountered in the natural state by human activities.

Tissue Weighting Factor (w_T)—The fraction of the overall health risk, resulting from uniform, whole body irradiation, attributable to specific tissue (T). The equivalent dose to tissue, (H_T), is multiplied by the appropriate tissue weighting factor to obtain the effective dose (E) contribution from that tissue.

Total Effective Dose—Sum of the effective dose (for external exposures) and the committed effective dose.

Whole Body—For the purposes of external exposure, head, trunk (including male gonads), arms above and including the elbow, or legs above and including the knee.

Working Level—The potential alpha energy concentration of radon decay products in 1 liter of air, without regard to the degree of equilibrium, that will result in the emission of 1.3×10^5 MeV of alpha particle energy.

THIS PAGE INTENTIONALLY LEFT BLANK

CONVERSION TABLES

Prefix	Symbol	Exponential Value	E Notation	Numeric Value
pico	p	10^{-12}	1E-12	0.000000000001
nano	n	10^{-9}	1E-9	0.000000001
micro	µ	10^{-6}	1E-6	0.000001
milli	m	10^{-3}	1E-3	0.001
kilo	k	10^{3}	1E3	1,000
mega	M	10^{6}	1E6	1,000,000
giga	G	10^{9}	1E9	1,000,000,000
tera	T	10^{12}	1E12	1,000,000,000,000

Examples of use:	
pCi =	picocurie
mrem =	millirem

THIS PAGE INTENTIONALLY LEFT BLANK

1. PROGRAM ORGANIZATION AND ADMINISTRATION

1.1 ENVIRONMENTAL RADIATION PROTECTION PROGRAM

1.1.1 Purpose and Scope

The Deactivation and Remediation Contractor is under contract with the U.S. Department of Energy (DOE) to perform facility modification, stabilization, and deactivation; decontamination and demolition; and environmental services at the Paducah Gaseous Diffusion Plant (PGDP). The purpose of this Environmental Radiation Protection Program (ERPP) is to set forth the approach for the deactivation work scope in a manner that meets the requirements of DOE Order (O) 458.1 Chg 3, *Radiation Protection of the Public and the Environment*.[1] This ERPP provides an overview of the measures implemented by the Deactivation and Remediation Contractor to ensure compliance with the requirements of DOE O 458.1 for PGDP. The Deactivation and Remediation Contractor has implemented an appropriate structure of management and administrative measures, as necessary, to ensure the authorized activities are conducted in accordance with this ERPP.

The goals of this ERPP are as follows:

1. To conduct radiological activities so that exposure to members of the public is maintained within the dose limits established by the Order;

2. To control the radiological clearance of real and personal property;

3. To ensure that potential radiation exposures to members of the public are as low as reasonably achievable (ALARA);

4. To monitor routine and nonroutine radiological releases and to assess the radiation dose to members of the public; and

5. To provide protection of the environment from the effects of radiation and radioactive material.

This ERPP incorporates ALARA policies in *ALARA Program*, CP3-RP-1114, and DOE-HDBK-1215-2014, *Optimizing Radiation Protection of the Public and the Environment for Use with DOE O 458.1, ALARA Requirements,* (DOE 2014a) using a graded approach to the application of environmental ALARA reviews, environmental monitoring, and environmental radiological performance metrics to assure accomplishment of annually established environmental performance goals and objectives.

This ERPP has been prepared consistent with the requirements of DOE O 458.1, Attachment 1, "Contractor Requirements Document." This ERPP describes the general requirements for ensuring that members of the public and the environment are protected from the effects of radiation and radioactive material during the execution of remediation and decommissioning activities within the scope of the DOE contract.

This ERPP applies to all work activities associated with the completion of the scope of work defined under the contract and conducted on behalf of DOE by Deactivation and Remediation Contractor and all

[1] All references to DOE O 458.1 within this document are to DOE O 458.1 Chg 3.

respective subcontractors and suppliers that involve radioactive materials. The upper level requirements described in this ERPP are implemented through a variety of mechanisms, including written procedures, plans, instructions, and employee training and qualifications. Additionally, the scope of the ERPP applies to all operations at locations, facilities, activities, and sites that are within the contract scope of work where the Deactivation and Remediation Contractor performs work for DOE. These locations, facilities, and sites may extend beyond the boundaries of the DOE Reservation in some instances. Consequently, the Deactivation and Remediation Contractor employees, subcontractors, and subtier subcontractor personnel are obligated to comply with the applicable environmental radiation protection procedures that implement this ERPP. Implementing guidance and requirements contained in this ERPP are intended to help itemize and clarify environmental radiation protection responsibilities and performance expectations.

This ERPP is intended to address all of the requirements of paragraph 2 of Attachment 1 to DOE O 458.1 that are applicable to the Deactivation and Remediation Contractor. The responsible DOE Field Element Manager performs oversight of the Deactivation and Remediation Contractor ERPP Program. The responsible DOE Field Element Manager for DOE activities at PGDP currently is the Portsmouth/Paducah Project Office Manager (or designee).

The Depleted Uranium Hexafluoride (DUF_6) Contractor and the Infrastructure Contractor share the Paducah Site (see also Section 1.1.5). Detectable results are shared promptly with other site contractors and DOE to ensure actions to achieve ALARA are implemented in a timely manner to minimize potential exposure.

1.1.2 Plans, Schedules, and Other Measures for Achieving Compliance

Should any conditions constituting noncompliance be discovered during the course of program implementation, the Deactivation and Remediation Contractor will take prompt action to assess the condition, ensure the safety of the public and the environment, and restore the conditions to be in compliance with the Order. If the condition is caused by another contractor, that contractor is responsible for corrective actions, and the Deactivation and Remediation Contractor will continue monitoring.

1.1.3 ERPP Approval and Changes

DOE line management must approve this ERPP in accordance with paragraph 1.d of Attachment 1 to DOE O 458.1. Changes to this ERPP will be instituted, as necessary, to reflect changes in the scope of the covered activities, changes in the environmental radiological controls instituted for those activities, or changes to DOE O 458.1. Any change that does not reduce the effectiveness of the ERPP and that continues to meet the requirements of DOE O 458.1 will be made, as necessary, without prior DOE approval. Any proposed change that may reduce the effectiveness of the ERPP will be approved by DOE prior to implementation.

1.1.4 Performance Documents and Other Administrative Controls

The ERPP is not intended to be a working-level document. The provisions of the ERPP are implemented through lower level administrative controls, including performance documents and other guidance documents. The Deactivation and Remediation Contractor develops and implements performance documents and other administrative controls, as needed, to ensure compliance with the requirements of DOE O 458.1. Consequently, employees and subcontractor personnel are obligated to comply with the performance documents and other administrative controls that implement this ERPP.

1.1.5 Other Site Tenants

Tenants at the Paducah Site complete work according to their respective contracts. Coordination among the tenants is meant to ensure efforts are not duplicated.

DUF_6 Activities. The DOE DUF_6 Contractor operates a conversion facility (DUF_6 Project) to convert UF_6 stored in cylinders, which were depleted of uranium-235 (U-235) in the enrichment process, to hydrogen fluoride and triuranium octoxide to render the material in a form safer for storage, transportation, and disposal. Activities performed by the DUF_6 contractor specific to their work are not addressed specifically under this ERPP.

Infrastructure Activities. The DOE Infrastructure Contractor is responsible for facility surveillance and maintenance of roads and grounds. The Infrastructure Contractor also provides mowing, janitorial services, records management, site security programs, site dosimetry, site radiological instrumentation maintenance/calibration, computing and telecommunications, and fleet management. Activities performed by the Infrastructure Contractor specific to their work are not addressed specifically under this ERPP.

1.2 ENVIRONMENTAL RADIOLOGICAL HAZARD ASSESSMENT

The potential environmental radiological hazards found at PGDP are related to the following categories:

- Direct gamma and beta radiation exposure from controlled and inadvertent releases of radioactive material;
- Inhalation or ingestion of controlled and inadvertent releases of airborne radioactivity; and
- Ingestion of loose surface contamination, contaminated liquids, contaminated soil, and other environmental media contaminated as the result of a controlled and inadvertent release of radioactive material.

The level of radiological hazard on-site varies by location and is attributed to chemically processed uranium (including enriched, natural, and depleted) and associated daughter products; consequently, the level of environmental hazard and the potential exposure to the public varies, as well. Due to the legacy processing of reprocessed uranium from the Hanford and Savannah River sites, mixed fission products such as technetium-99 and, to a lesser degree, transuranic elements—notably plutonium, americium, and neptunium—also are found at the Paducah Site.

2. ORGANIZATIONAL ROLES AND RESPONSIBILITIES

Organizational roles and responsibilities within the Deactivation and Remediation Contract for environmental radiation protection are discussed in the following sections. This organization is shown in Figure 1.

2.1 ENVIRONMENTAL RADIATION PROTECTION

Environmental Radiation Protection is managed within the Environmental Services (ES) organization. The ES Director is responsible for all aspects of project execution, including implementation of environmental protection measures, as required by this ERPP, written environmental procedures, and other documents. The Environmental Stewardship Manager is a senior line manager who is fully empowered to control project resources and has cradle-to-grave responsibility for project planning and execution. The Environmental Radiation Protection organization is supported by the Environmental Monitoring organization and is part of the Environmental Stewardship organization, including the Field Compliance organization, the Water Policy organization, and other personnel.

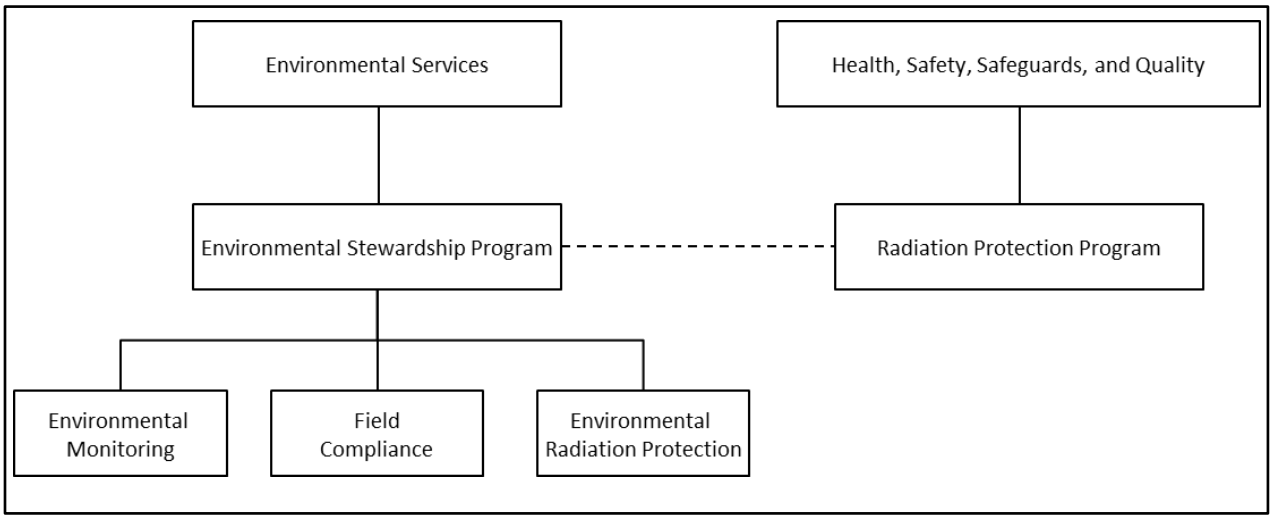

Figure 1. Environmental Stewardship Program

2.2 FIELD COMPLIANCE

Field Compliance also is managed within the Environmental Stewardship program. Field Compliance is responsible for aspects of the ERPP, as defined in lower-level performance documents [e.g., Environmental Monitoring Plan (EMP), CP2-ES-0006, and *Waste Water Accumulation, Storage, and Disposal*, CP3-WM-0022]. Field Compliance provides guidance and oversight with regard to the implementation of DOE O 458.1 and its supporting guidance, as it applies to the work activities associated with the Deactivation and Remediation contract. To ensure there are no conflicts with production goals, Field Compliance reports to upper management through a chain that is independent of the Environmental Radiation Protection organization.

2.3 RADIATION PROTECTION ORGANIZATION

Radiation Protection is managed within the Health, Safety, Safeguards, and Quality organization. Radiation Protection is responsible for aspects of the ERPP, as defined in lower-level performance documents (e.g., *ALARA Program*, CP3-RP-1114, and *Radiation Exposure Limits*, CP3-RP-1101). Radiation Protection also provides support to the Environmental Stewardship program in complying with program requirements. To ensure there are no conflicts with production goals, the Radiological Protection

organization reports to upper management through a chain that is independent of the Environmental Stewardship program.

3. ENVIRONMENTAL ALARA PROGRAM

The Deactivation and Remediation Contractor ALARA Program has been developed in a manner consistent with DOE O 458.1. The Environmental ALARA Program has been developed and implemented using a combination of physical design features, environmental monitoring, and administrative controls. During routine operations, these controls ensure that the radiation doses to the public and the environment are ALARA. The Environmental ALARA Program process is applied to activities that could present potential exposures to the public and potential environmental releases.

The Environmental ALARA Program incorporates a graded approach. The method of implementing the Environmental ALARA Program depends on the complexity and magnitude of potential radiological consequences. Complex activities with greater potential for exposure involve more engineering, monitoring, and administrative control measures to control exposures. Environmental air monitoring, area dosimetry, personnel monitoring, etc., play key roles in ensuring that releases of radioactive contamination is prevented/mitigated in accordance with site ALARA goals.

3.1 ALARA POLICY

The ALARA Policy for the Deactivation and Remediation is presented in CP1-RP-0002, *ALARA Performance Goals For Exposure To Ionizing Radiation*. The ALARA Policy establishes a management policy for both occupational and environmental radiological exposure.

The ALARA philosophy is predicated upon the theory that any radiation exposure, however small, carries with it some risk that should be balanced by an offsetting benefit. The Deactivation and Remediation Contractor ensures that any activity that involves exposure to radiation or radioactive materials is assessed to determine the most appropriate exposure controls for those activities having a net beneficial outcome.

The Deactivation and Remediation Contractor's policy requires the performance of activities in a safe/environmentally protective manner that meets or exceeds the applicable requirements of DOE O 458.1. Four Rivers Nuclear Partnership, LLC, Project Management affirms the following:

1. Excellent performance is evident when site missions are completed and public and environmental radiation exposures are maintained well below limits, radioactivity is well controlled, radiological releases are reviewed and evaluated, and radiological spills or uncontrolled releases are prevented.

2. Continuing improvement is essential to excellence in environmental radiological control.

3. It is the responsibility of management and each worker to comply with this ERPP and to practice ALARA during all work activities.

4. Cooperate with other site contracts to meet DOE goals for radiological effluents, including but not limited to, sharing information, identifying causes of anomalies, and reporting effluent release concentrations.

3.2 ENVIRONMENTAL ALARA GOALS

The Deactivation and Remediation Contractor will use the ALARA process to evaluate the environmental program. Performance tracking mechanisms will be used to identify and, as appropriate, to correct adverse trends. The ALARA reviews of the environmental program will be performed, as necessary, to accommodate changes in the scope, unanticipated tasks, or radiological conditions. Environmental ALARA goals for the site are included in *ALARA Performance Goals for Exposure to Ionizing Radiation*, CP1-RP-0002, and include the following:

- Number of radiological and environmental-related occurrence reports, excluding legacy contamination, is zero;
- Number of unplanned effluent discharges to the environment greater than 100 mrem/year calculated using the DOE-approved DCS values is zero;
- Number of unplanned airborne radioactivity discharges to the environment resulting in any member of the public receiving a dose greater than the 40 *CFR* Part 61.92 standard of 10 mrem/yr, is zero;
- The annual average concentration of a given radionuclide in surface water is less than DOE‑approved DCS value for water or, for multiple radionuclides, the composite DCS must be the sum of the fractional DCS values derived from DOE-approved DCS values [the composite DCS value is less than 1]; and/or
- No discharge contributes greater than 10 mrem annual TED to members of the public.

The environmental ALARA process follows the methods and techniques described in *ALARA Program*, CP3-RP-1114; DOE-HDBK-1215-2014, *Optimizing Radiation Protection of the Public and the Environment for Use with DOE O 458.1*, *ALARA Requirements* (DOE 2014a); or another appropriate ALARA process that is vetted and approved by DOE. 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. The analysis can be either quantitative or qualitative, but in either case, the results will be documented. As the project progresses, the types of physical design controls and administrative controls used to implement the environmental 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 public and environmental radiation exposures are within the limits established per the requirements of DOE O 458.1.

4. DOSE LIMITS

4.1 PUBLIC DOSE LIMITS

Public doses resulting from radiation exposures associated with deactivation and remediation activities will be controlled ALARA and within the DOE O 458.1 limits identified in Table 1. The public dose limits apply to members of the public located off DOE Reservation and on DOE Reservation outside of controlled areas. The procedure *Radiation Exposure Limits*, CP3-RP-1101, implements these public dose

limits. Occurrences of radiological contamination follow *Occurrence Reporting*, CP3-QA-3005, and DOE O 232.2A, *Occurrence Reporting and Processing of Operations Information*.

4.2 TEMPORARY DOSE LIMITS

If special circumstances could affect a Deactivation and Remediation Contractor's radiological activity in such a manner that the potential dose to a member of the public could exceed a TED of 100 mrem in a year, then the Deactivation and Remediation Contractor will submit a request for specific authorization for a temporary public dose limit higher than 100 mrem in a year to the responsible DOE Field Element Manager, per the requirements of DOE O 458.1, which includes plans for ensuring no more than 500 mrem TED provided that the average TED over any contiguous five-year period does not exceed 100 mrem per year.

Table 1. Public Dose Limits

Category	Type of Dose	Dose Limit
Member of the Public[2]	Total effective dose (TED)	100 mrem per year
	Lens of the eye equivalent dose	1,500 mrem per year
	Sum of the equivalent dose to the skin or extremities	5,000 mrem per year
	Temporary dose limit of TED to a member of the public. This temporary dose limit is only at the request of the DOE Field Element Manager and may only be employed with the approval of a Cognizant DOE Secretarial Officer in consultation with the DOE Chief Health, Safety, and Security Officer.	No more than 500 mrem, provided that the average over any 5 contiguous years does not exceed 100 mrem per year
	Radiological activities from management and storage of radioactive waste from all exposure pathways and radiation sources associated with the waste, except for transportation and radon and its decay products.	TED of 25 mrem per year
	Emissions of radionuclides to the ambient air from Deactivation and Remediation Contractor activities (40 *CFR* § 61.92).	10 mrem per year
	Annual average dose equivalent to the total body or any internal organ from beta particle or photon radioactivity from man-made radionuclides in drinking water (40 *CFR* § 141.66(d)).	4 mrem per year

4.3 DIRECT RADIATION

An identified source of potential exposure to the public from radiation emanating from radionuclides contained in structures and other objects at the Paducah Site is gamma radiation from the uranium cylinder storage yards. It is not realistic that members of the public would be exposed to more than

[2] Excepts dose from radon or its decay products, dose received by medical services, dose received by medical research volunteers, dose from background sources or occupational exposure under Nuclear Regulatory Commission, Agreement State License, and 10 *CFR* Part 835.

negligible amounts of gamma radiation from these uranium cylinders found in the storage yards due to limited exposure time, distance from the access points of the public to the cylinder yards, and shielding.

The External Gamma Radiation Monitoring Program is designed to provide exposure data on direct radiation from DOE operations to members of the public. The primary factor in selecting the monitoring locations is the potential for a member of the public to be exposed to direct radiation. The highest potential radiation exposure to the public is at the plant perimeter. The monitoring program conducts area gamma radiation dose monitoring using thermoluminescent dosimeters. Devices of this type are capable of measuring exposure resulting from gamma radiation and are used throughout the industry to perform Environmental Monitoring.

Environmental Monitoring of direct radiation is performed as described in the current Fiscal Year version of the EMP, CP2-ES-0006.

4.4 RADIATION EXPOSURE CONTROL

4.4.1 Physical Design Features

In addition to meeting the public radiation dose limits established in Table 1, the Deactivation and Remediation Contractor has instituted measures to control radiation doses at levels that are ALARA. To the extent practicable, the ALARA process will be implemented through the use of physical design features and Best Available Technology (BAT).

Because of the comprehensive scope associated with the project, a mix of short-term and long-term controls will be used to ensure exposures remain ALARA. The physical design features and engineered controls include, but are not limited to, portable and fixed ventilation systems, confinement and containment structures, and other BAT. Administrative controls also may be used; however, engineered controls and design features are preferred. The type and application of specific controls to be used are determined during project planning and hazard assessment activities; additional monitoring may be performed to verify the effectiveness of these controls and to determine the amount of radioactivity discharged to the environment as a result of the specific controls used.

4.4.2 Administrative Controls

Administrative controls are used to supplement the prescribed physical design features and where physical design features are demonstrated to be impractical.

Administrative controls used to implement the ALARA process may include, as appropriate for the planned activities, administrative control levels (ACLs), performance goals, written procedures, and postings to restrict access.

Through policies and procedures, the Deactivation and Remediation Contractor establishes project ACLs for the release of radiological materials equal to or less than DOE requirements. If determined to be effective in controlling public and environmental exposure, the Deactivation and Remediation Contractor may establish project or work-group-specific ACLs. The actual ACLs are established by the Deactivation and Remediation Contractor’s management.

5. AIRBORNE RADIOACTIVE EFFLUENTS

5.1 AIRBORNE EFFLUENTS MONITORING AND SURVEILLANCE

Airborne radioactive effluents are monitored in accordance with the EMP and requirements from 40 *CFR* Part 61, Subpart H. Stack emissions will be monitored consistent with the requirements of the Deactivation and Remediation Contractor's Title V air permit (V-14-012 R3). Planned activities or start-up of new activities that have potential radionuclide emissions are evaluated against National Emissions Standards for Hazardous Air Pollutants (NESHAP) requirements and then will be evaluated per the requirements of DOE O 458.1 and site ALARA goals (Section 3.2) prior to discharge. Unplanned discharges to the environment are evaluated when detected to determine potential impacts to off-site personnel and the environment. Results from radioactive air monitoring are used to ensure ALARA is properly implemented, to track performance, and to effect changes, as needed, to minimize radioactive air pollution.

The Deactivation and Remediation Contractor will work under the NESHAP Management Plan (CP2-ES-0002) and prepare the Annual Summary of Radionuclide Air Emissions (NESHAP Report).

Dose Modeling. DOE operations at the PGDP site have limited potential for atmospheric releases of radiological hazardous materials. Actual ambient air radionuclide concentrations at PGDP are continuously monitored, and the levels are compared against conservative values in the calculation of compliance with environmental standards. In accordance with DOE O 458.1, the public dose from air emissions is estimated by use of the U.S. Environmental Protection Agency Clean Air Act Assessment Package-1988 personal computer version (CAP-88 PC) modeling software. In general, meteorological data used in air quality modeling applications should be representative[3] of conditions affecting the transport and dispersion of pollutants in the "area of interest," as determined by the locations of the sources and receptors being modeled. The CAP-88 PC model assumes steady state air dispersion of emitted radionuclides results in a public dose based on multiple radionuclide uptake methods.

Meteorological data is necessary to model the dispersion of airborne radiological emissions so exposures from emissions can be estimated when direct exposure monitoring is not used. CAP-88 PC relies on the meteorological data set to estimate the dispersion of the pollutant radionuclides. The meteorological data set used for PGDP air emission modeling is the five-year stability array distribution for the years 1988 through 1992[4] from the 60-m station on the PGDP meteorological tower. The data set was generated in compliance with the appropriate guidance and met the data quality requirements (EPA 2000; DOE 2004). The quality of the PGDP data set is commensurate with the level of site radiological activities, the site topographical characteristics, and the distance to critical receptors. While the data set uses 5 years of data to account for seasonal variations, the data set does not account for any long-term change in wind patterns over decades. Use of the historical data set is still considered representative of the site because the on-site terrain has remained constant; the terrain is an industrial site that is flat and partially wooded; and the on-site data set includes the resultant air flow from the terrain.

PGDP site operations historically have contributed little, if any, dose to the public. The ambient air concentration of radionuclides is far below the acceptable limits at the ambient air stations. The detection results from these locations have been below the 40 *CFR* Part 61, Appendix E, Table 2, concentration

[3] A quantitative method does not exist for determining representativeness absolutely.
[4] Meteorological tower operations ceased in 1993.

levels for environmental compliance. The CAP-88 PC model estimated dose, presented in the Annual Site Environmental Reports (ASERs), also has been much lower than the public dose limit of 10 mrem/year. Note: Doses calculated in CAP-88 PC are presented in the historical unit of committed effective dose equivalent.

Choosing a different meteorological data set for CAP-88 PC potentially would cause a small change in the dose estimate; however, based on the above discussion and due to the very low dose resulting from site radionuclide emissions, the model results would remain well below the safe public dose standard. Based on these conditions, the CAP-88 PC program continues to use the existing on-site data set.

5.2 RADON

PGDP has no 11e (2) by-product material, as defined in the Atomic Energy Act (AEA) (as amended). The AEA, as amended, states that discrete sources of radium-226 must be treated like 11e (2) by-product material; therefore, the limit on radon-222 emissions of 20 pCi/m^2-sec would apply to any radium-226 sources managed by the Deactivation and Remediation Contractor. An evaluation of radium-containing waste at PGDP was performed in the *Authorized Limits Request for Solid Waste Disposal at C-746-U Landfill at the Paducah Gaseous Diffusion Plant* (C-746-U Landfill Authorized Limits) (DOE 2011a) and support documents. [5] Results of the evaluation demonstrate that radon emissions will not be a significant concern. Without a significant source of radon emissions to the site, radon monitoring is not performed, and this section is not applicable to PGDP operations.

6. CONTROL AND MANAGEMENT OF RADIONUCLIDE IN LIQUID DISCHARGES

Control and management of radionuclides in liquid discharges is confirmed by monitoring of the effluent discharge through the outfalls, site environmental surveillance sampling, and evaluations of planned and unplanned liquid discharges. The EMP documents the rationale, sampling frequency, and parameters for environmental monitoring relevant to this ERPP. The EMP additionally documents the parameters used to calculate the dose from exposure to surface water and sediments to the maximally exposed individual. Characterization is dependent for the potential for on- and off-site impacts. Assessment of radiological consequences and modeling is presented in the ASER.

Radionuclide analysis is performed on selected samples as outlined in the EMP to evaluate the compliance of site discharges. DCS values established in DOE-STD-1196-2011, *Derived Concentration Technical Standard*, are "radiological quantities used in the design and conduct of radiological environmental protection programs at DOE facilities and sites. These quantities provide reference values to control effluent releases from DOE facilities and may be used in implementing the as low as reasonably achievable (ALARA) process for environmental programs" (DOE 2011b). Results from radionuclide analyses are compared with drinking water DCS to calculate dose.

[5] Authorized limits for the C-746-U Landfill are implemented under DOE 2019.

Except for tritium[6] and sanitary sewers, DOE O 458.1, Section 4.g.(5), requires a BAT if at the point of discharge any of the following occurs:

- The discharge contributes greater than 10 mrem annual TED to members of the public.
- The collective dose from all DOE sources is greater than 100 person-rem, and the liquid discharge contributes 50% or more of this collective dose.
- The annual average concentration of a given radionuclide is greater than the DOE-approved DCS value for water contained in DOE-STD-1196-2011, or for multiple radionuclides, the composite DCS must be the sum of the fractional DCS values derived from DOE-approved DCS values. The composite DCS value is greater than 1.

To ensure multiple sources will not result in doses exceeding the DOE public dose limit of 100 mrem/year, the Deactivation and Remediation Contractor follows the DOE recommendation in DOE-HDBK-1216-2015, *Environmental Radiological Effluent Monitoring and Environmental Surveillance* (DOE 2015a) that potential doses from a single pathway to a maximally exposed individual be constrained so as not to exceed 10% to 25% of the public dose limit of 100 mrem/year.

6.1 EFFLUENT DISCHARGE

The DOE site routinely discharges liquids from treatment of wastewater, planned activities, or startup of new activities to the environment. Each of these events is evaluated prior to discharge per the requirements of DOE O 458.1, the Kentucky Pollutant Discharge Elimination System (KPDES) permit, and site ALARA goals. Effluent description, analytical data or process knowledge of the contents of the effluent, Field Compliance concurrence, along with the concurrence of the facility owner, if processed through a treatment unit, are documented.

Permitted surface water discharges at the Paducah Site include rainfall runoff from cylinder yards, landfills, and effluent from site processes. The EMP sets forth the sampling requirements and parameters for these outfalls. The outfalls are sampled for radionuclides as required by DOE O 458.1 and the KPDES permit, and as specified each year in the EMP for planned activities, and site ALARA goals (Section 3.2). Collection of radiological parameters to assess dose per DOE O 458.1, which is not permit required, will be collected immediately downstream of the KPDES compliance sampling points at each site outfall. The ASER presents the analytical results and an assessment of any radiological consequences to demonstrate compliance with DOE O 458.1.

6.2 SETTLEABLE SOLIDS

DOE O 458.1 requires that liquid discharges containing radionuclides from DOE activities do not exceed an annual average at the point of discharge of either of the following:

- 5 pCi per gram above background of settleable solids for alpha emitting radionuclides, or
- 50 pCi per gram above background of settleable solids for beta-gamma-emitting radionuclides.

[6] Tritium has not been identified as a radionuclide of concern at the Paducah Site.

The radioactivity of settleable solids will be determined as described in DOE-HDBK-1216-2015, *Environmental Radiological Effluent Monitoring and Environmental Surveillance* (DOE 2015a). The gravimetric test (APHA 2012, Section 2540 F, Settleable Solids) will be used to determine settleable solids in mg/L in the water sample. The gravimetric test method in Section 2540 F, 3.b, will be used to determine both the total suspended solids and nonsettleable solids. The solid fractions of the total suspended solids and nonsettleable solids samples should be retained for later radioactivity measurements. The radioactivity of alpha-emitting radionuclides in pCi/g and the radioactivity of beta-emitting radionuclides in pCi/g will be determined in the recovered solid fraction of each of the total suspended solids and nonsettleable solids samples.

6.3 SANITARY SEWER SYSTEM

The Deactivation and Remediation Contractor operates a permitted sanitary sewer system for PGDP in accordance with the current KPDES Permit and DOE Orders (see text in Section 6 introduction of this document). Environmental radiological protection guidelines are incorporated into site plans and procedures to minimize radiological contamination discharges. Discharge of liquids containing radionuclides into the sanitary sewer complies with the ALARA process and applicable procedures. Potential sources of radiological contamination into the sanitary sewer include the on-site laboratory, if operating, and C-746-U Landfill leachate, if being disposed of at C-615.

The sanitary sewer treatment plant is operated to minimize long-term buildup of radionuclides in the sewage sludge. The sludge is dried prior to sampling and disposal. Effluent from the sewage treatment plant flows through KPDES Outfall 004. Sampling for radiological parameters in the effluent and sewer sludge will performed in accordance with the EMP.

6.4 ENVIRONMENTAL SURVEILLANCE SAMPLING

Environmental surveillance sampling at the site is conducted to verify the effectiveness of in-plant measures used for controlling the release of radioactive materials, evaluate the buildup of environmental radioactivity, capture areas not normally captured in routine plant effluents, and for public information purposes. The off-site environmental surveillance sampling is established on the basis of an evaluation of radionuclide composition of the liquid waste discharges from the facility and the environmental parameters that affect their dispersion and dilution in the environment. The EMP defines radionuclides and frequencies of sampling events as required by DOE O 458.1 and planned activities. Locations for these sites are evaluated based on available data each time the EMP is revised. Since most radionuclide levels in the surrounding plant sediment and surface water have been historically low it is anticipated that effluents will pose minimal risk and that only a few sample locations will be necessary each year for surveillance sampling. Priority of locations are given to areas where members of the public have access and which capture the sum discharges of all site activities present and historical, identify radionuclides, evaluate changes in the site effluent characteristics, and identify areas protective of the public and the environment. Consistent with this plan, information obtained from environmental surveillance sampling is used to effect changes in controls implemented to prevent/control releases and achieve ALARA goals.

6.5 UNPLANNED DISCHARGES

Unplanned discharges to the environment will be evaluated following release as soon as possible to determine contaminants of concern, number of samples and necessary protective actions. The site strives to have no unplanned discharges to the environment.

7. RADIOACTIVE WASTE AND SPENT NUCLEAR FUEL

7.1 RADIOACTIVE WASTE

The Deactivation and Remediation Contractor has implemented procedures, practices, and monitoring in accordance with Section 4 of this ERPP to ensure that management, storage, and disposal of radioactive waste is maintained ALARA and does not result in a TED of greater than 25 mrem/year to the public or any releases to the environment. Radioactive waste is managed to meet the requirements of DOE O 435.1.

7.2 BY-PRODUCT MATERIAL

As defined by the Section 11e.(2) of the AEA, there is no by-product material at PGDP. Material defined as Section 11e.(3) or 11e.(4) by-product material in the AEA (e.g., sealed radioactive sources) is managed under 10 *CFR* Part 835.

8. PROTECTION OF DRINKING WATER AND GROUNDWATER

Pathway assumptions considered in the assessments of radiological exposures are presented in the EMP.

8.1 ON-SITE DRINKING WATER TREATMENT PLANT

The Deactivation and Remediation Contractor operates a permitted drinking water system in accordance with 401 *KAR* Chapter 8, *Public Water Supply*, regulations for on-site use. Water is withdrawn from the Ohio River and treated to meet regulatory standards. Because groundwater is not used for drinking water, there is no potential from plant-derived radiological contamination within the drinking water system. No members of the public are supplied drinking water from this system.

8.2 PROTECTION OF GROUNDWATER

The potential for migration of radiological constituents present in liquid discharges to act as a source of radiological contamination to groundwater was evaluated to meet the requirements set forth in DOE O 458.1 that requires groundwater be protected from radiological contamination to ensure compliance with dose limits in DOE O 458.1 and consistent with ALARA process requirements. To this end, this program ensures the following are performed:

1. Baseline conditions of the groundwater quantity and quality are documented;
2. Possible sources of, and potential for, radiological contamination are identified and assessed;
3. Strategies to control radiological contamination are documented and implemented;
4. Monitoring methodologies are documented and implemented; and
5. Groundwater monitoring activities are integrated with other environmental monitoring activities.

Based on previous remedial investigations conducted at PGDP, radiological contamination is present in the groundwater due to past practices at PGDP. The PGDP began implementation of a Groundwater Protection Plan (GPP) in August 1995. The objectives of the GPP are to ensure protection for all current and future uses of groundwater and to prevent additional groundwater pollution at the PGDP. The GPP includes a description of the facility history and operations; a summary of the physical characteristics of the site, including geology and hydrology; a listing of activities that have the potential to impact groundwater; and practices selected to protect groundwater from future impacts. The groundwater protection practices that have been implemented at PGDP include:

- Groundwater monitoring
- Environmental surveillance monitoring
- KPDES outfall discharge monitoring
- Surface water observation and monitoring
- Surface and subsurface soil sampling
- Well sampling
- Subsurface penetrations
- Implementation of the site Spill Prevention, Control, and Countermeasure Plan (SPCC) and Facility Response Plan
- Appropriate storage of bulk quantities of materials, recyclables, and wastes
- Waste management
- Release prevention and control
- Transfer of material off-site
- Groundwater treatment and source remediation

To eliminate exposure to contaminated groundwater, a removal action (i.e., the PGDP Water Policy) was put into place.

Site sampling per the EMP evaluates if there is potential for radionuclides from the Deactivation and Remediation Contractor's radiological activities contained in liquid effluents to cause private or public drinking water systems to exceed the drinking water maximum contamination levels in 40 *CFR* Part 141, *National Primary Drinking Water Regulations*.

8.3 PROTECTION OF SURFACE WATER

The Deactivation and Remediation Contractor evaluates processes and activities with liquid effluents prior to discharge per the requirements of DOE O 458.1, the KPDES permit, and site ALARA goals. Discharges from PGDP enter Bayou Creek and Little Bayou Creek from either side of PGDP, with the on-site North-South Diversion Ditch flowing from the landfill area into Little Bayou Creek. These two creeks combine shortly before flowing into the Ohio River north of the plant. Planned or unplanned discharges typically flow into one of these two streams prior to flowing to the river. Planned discharges are evaluated prior to release into the streams and unplanned discharges are evaluated when detected to determine protective actions necessary to protect soils and groundwater. Analytical results and potential dose exposure calculations are presented in the ASER.

8.4 APPROACH APPLIED TO LIQUID DISCHARGES

Liquid surface discharges from PGDP are monitored and compared to established DCSs that are protective of human health and the environment, as described in Section 6. Surface discharges maintained at a protective level, as described in Section 6, also are protective of groundwater in the Regional Gravel Aquifer based on findings of prior remedial investigations at the site that evaluated the potential for soils to act as sources to groundwater (DOE 2013; DOE 2016).

Surface water is not used for drinking water in the immediate PGDP area.[7] The nearest drinking water pathway for consumption of surface water at a public drinking water system is at Cairo, Illinois, which collects surface water from the Ohio River. The EMP outlines locations and radionuclides for environmental surveillance samples in the vicinity of the PGDP. These samples are evaluated for compliance with drinking water maximum radiological contamination limits in 40 *CFR* Part 141.

9. PROTECTION OF BIOTA

Sampling of aquatic organisms over previous years in the streams that directly receive plant discharges (Bayou Creek and Little Bayou Creek) has been extensive and the sampling was eliminated under direction of the KPDES permit as it could result in deleterious effects on the aquatic community. Sediment sampling is used as the predictive environmental media sampled in accordance with the EMP. Sediment surveillance sampling is performed to monitor the behavior of the radionuclides in the environment. Sediment sampling concentrations and liquid discharge concentrations are compared to biota concentration guides (BCGs) (DOE 2002). If the sum of the fractions for all radionuclides data/BCG comparisons are less than one, then sampling indicate levels sufficient to protect biota in the environment. A sum of fractions for sediment sampling concentrations and liquid discharge concentrations/BCG greater than one indicate further evaluation is needed in accordance with DOE O 458.1 and DOE-STD-1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2002). Additional information regarding the biota pathway is presented in the EMP.

[7] DOE established a Water Policy in 1994 that included provisions to extend a municipal water line to the entire area of the groundwater contamination originating from the Paducah Site. DOE has established agreements with the affected residents and pays their water bills.

10. RELEASE AND CLEARANCE OF PROPERTY

10.1 AUTHORIZED LIMITS

The Deactivation and Remediation Contractor will continue to use previously approved guidelines and limits (such as the surface activity guidelines) as preapproved Authorized Limits until they are replaced or preapproved Authorized Limits issued under DOE O 458.1. Authorized limits have been approved for the C-746-U Landfill (DOE 2019a) and for DOE-owned property outside the Limited Area (DOE 2014b). Additionally, authorized limits for lube oil and transformer oil have been approved by DOE for thermal destruction at Clean Harbors in Deer Park, Texas (DOE 2015b), and Veolia in Port Arthur, Texas (DOE 2015c). Authorized Limits also have been approved for unrestricted release of aqueous hydrofluoric acid generated during DUF_6 conversion operations (DOE 2005); for shipping low-level waste to Waste Control Specialists, LLC, Resource Conservation and Recovery Act (RCRA) Landfill; and for disposal of waste containing residual radioactive materials at the Energy*Solutions* Carter Valley Landfill in Tennessee.

10.2 DOE O 458.1 APPROVED AUTHORIZED LIMITS FOR THE WASTE CONTROL SPECIALISTS, LLC, RESOURCE CONSERVATION AND RECOVERY ACT DISPOSAL LANDFILL, DATED DECEMBER 22, 2015

The Deactivation and Remediation Contractor will use approved DOE December 22, 2015, Authorized Limits for the disposition of various Paducah waste streams in Waste Controls Specialists, LLC, Resource Conservation and Recovery Act Disposal Landfill as applicable to the landfill's waste acceptance criteria. These waste streams include, but are not limited to, RCRA and Toxic Substances Control Act-waste and debris-and soil-like material that contain residual radioactivity.

10.3 RESIDUAL RADIOACTIVE MATERIAL

The Deactivation and Remediation Contactor has an established process for release of materials that potentially contain residual radioactive materials. This process is documented within the Radiation Protection organization and utilizes *Radioactive Contamination Control and Monitoring*, CP3-RP-1109. Property potentially containing residual radioactive material will be evaluated employing this process to determine if they can be cleared from the Deactivation and Remediation Contractor control. Once the property is demonstrated not to contain residual radioactive material or is evaluated and appropriately monitored or surveyed to determine that any residual radioactive material levels are within acceptable limits, the Deactivation and Remediation Contractor will work with DOE to gain concurrence prior to release (DOE 2019b).

11. RECORDS RETENTION AND REPORTING REQUIREMENTS

11.1 ERPP RECORDS

The records of ERPP-related activities are prepared, maintained, and dispositioned in accordance with task order requirements and applicable procedures such as *Radiation Protection Program Records*,

CP3-RP-1401, and *Records Management Process*, CP3-RD-0010. Required records will be retained until final disposition is concurred upon by DOE. ERPP records include the following.

- Information and data necessary to identify and characterize releases of radioactive material to the environment, their fate in the environment, and their probable impact on radiation dose to members of the public, and any impacts on ecological systems.

- Documentation of individual and collective dose to members of the public due to radiological activities. This includes documentation of site-specific information on radiation source dispersion patterns, location, and demography of members of the public in the vicinity of the radiological activity and assumed default values or site-specific parameters used in calculations.

- Requests for specific authorization for temporary public dose limits, and subsequent approvals and other related actions.

- Documentation of actions taken to implement the ALARA process.

- Documentation of actions taken to demonstrate compliance with the public dose limit.

- Documentation of actions taken to implement the BAT selection process in regulating liquid discharges, including documentation of analyses and factors considered to be important, including alternative processes, for the BAT selection process.

- Effluent monitoring and environmental surveillance information and data.

- Documentation related to the long-term management of radioactive waste and residual radioactive material.

- Final documentation for clearance of property containing residual radioactive material.

- Written notification of applicable federal, state or local regulatory agencies or Tribal governments as defined in the Order.

- Annual summaries related to clearance of property.

- Radiological survey results.

- Results of functional checks to allow reconstruction of counts in the event an error is discovered.

11.2 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 ERPP records include these:

- Units of disintegrations per minute per 100 cm^2 (dpm/100 cm^2) for measurements of radioactive surface contamination; and

- Multiples and subdivisions of derived air concentrations (DACs) and DAC-hours for measurements of airborne radioactivity and individual exposure to airborne radioactivity.

- Analytical results from environmental samples typically are reported in pCi/g (for soil and sediment) and pCi/L for surface water and groundwater.

The International System of Units 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 or for reference with scientific standards.

11.3 REPORTING

The Deactivation and Remediation Contractor reports information in the ASER per requirements in DOE O 458.1. Other annual reports are submitted to summarize information on particular pathways in accordance with their applicable regulations. These reports include, but are not limited to, the NESHAP Annual Reports and External Radiation Monitoring Annual Report. Additional trending reports of site environmental radiological parameters are provided at DOE request to support comparison, trending, and decisions.

12. RESOURCE ASSESSMENT

Funding required to develop and implement a fully compliant ERPP has been factored into the Deactivation and Remediation Contractor project work. Appropriate levels of funding have been assigned for management of this ERPP, development of programmatic documents, and acquisition of equipment, sampling, analysis, training, and personnel to meet all commitments fully.

13. PRIORITIZATION

The Deactivation and Remediation Contractor recognizes the applicable elements of DOE O 458.1 with priority given to *CFR* requirements as applicable. Other elements of DOE O 458.1 are implemented as applicable with a lower priority than *CFR* requirements if they do not conflict. In the event of a conflict between the *CFR* and DOE Order, the *CFR* will take priority. DOE O 458.1 objectives are accomplished through integration with the Environmental Management Systems (EMS). An EMS is a continuing cycle of planning, implementing, evaluating, and improving processes and actions undertaken to achieve environmental goals. The EMS Description (CP2-ES-0101) was developed pursuant to DOE P 450.4, *Safety Management System Policy*.

14. REFERENCES

DOE (U.S. Department of Energy) 2002. *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*, DOE–STD–1153–2002, U.S. Department of Energy, Washington, DC, July.

DOE 2004. *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, DOE/EH-0173T, Chapter 4 (Revised), U.S. Department of Energy, Washington, DC, December.

DOE 2005. Memorandum from W. Murphie to A. Wallow, "Release Limits for Hydrofluoric Acid and Calcium Fluoride from Depleted Uranium Hexafluoride (DUF6) Conversion," (PPPO-01-402-05), dated August 12, 2005.

DOE 2011a. *Authorized Limits Request for Solid Waste Disposal at C-746-U Landfill at the Paducah Gaseous Diffusion Plant*, U.S. Department of Energy, Paducah, KY.

DOE 2011b. *Derived Concentration Technical Standard*, DOE-STD-1196-2011, U.S. Department of Energy, Washington, DC, April.

DOE 2013. *Soils Operable Unit Remedial Investigation Report at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-0358&D2/R1, U.S. Department of Energy, Paducah, KY, February.

DOE 2014a. *Optimizing Radiation Protection of the Public and the Environment for use with DOE O 458.1, ALARA Requirements*, DOE-HDBK-1215-2014, U.S. Department of Energy, Washington, DC, October.

DOE 2014b. Memorandum from W. Murphie to J. Woodard, "Authorized Limits for the U.S. Department of Energy Owned Property Outside the Limited Area in Paducah, Kentucky Approval and Implementation Requirements," (PPPO-02-1270699-14), U.S. Department of Energy, Paducah, KY, dated October 16.

DOE 2015a. *Environmental Radiological Effluent Monitoring and Environmental Surveillance*, DOE-HDBK-1216-2015, U.S. Department of Energy, Washington, DC, March.

DOE 2015b. Letter from J. Woodard to C. Murphy, "Contract No. DE-EM001131, Task Order DE-DT0007774: Fluor Federal Services, Inc., Paducah Deactivation Project Authorized Limits for Lube Oil and Dielectric Fluids," (PPPO-02-2910425-15B), dated June 5.

DOE 2015b. Letter from K. Ausbrooks and K. Jefferies to B. Nichols, "Authorized Release of Paducah Site Buildings C-310, C-315, C-335, C-337, and C-409 Lubricating Oil (Campaign 2)," dated June 19.

DOE 2016. *Soils Operable Unit Remedial Investigation 2 Report at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-02306&D2, U.S. Department of Energy, Paducah, KY, March.

DOE 2019a. Letter from J. Woodard to J. Bradford, "Contract No. DE-EM0004895: C-746-U Landfill Authorized Limits Implementation Requirements," PPPO-02-5683395-19, dated August 16.

DOE 2019b. Letter from J. Woodard to M. Redfield, "Oversight of the Free Release of Radiologically Contaminated Equipment and Materials from Portsmouth/Paducah Project Office Facilities," PPPO-03-5656986-19B, dated August 21.

EPA (U.S. Environmental Protection Agency) 2000. *Meteorological Monitoring Guidance for Regulatory Modeling Applications*, EPA-454/R-99-005, U.S. Environmental Protection Agency, Research Triangle Park, NC, February.