DOE/EIS-0541

Draft Environmental Impact Statement for Plutonium Pit Production at the Savannah River Site in South Carolina

April 2020

U.S. Department of Energy
National Nuclear Security Administration
Savannah River Site

Volume 2

CONVERSIONS

To Convert Into Metric			To Convert Into English		
If You Know	**Multiple By**	**To Get**	**If you Know**	**Multiple By**	**To Get**
Length					
Inch	2.54	Centimeter	Centimeter	0.3937	Inch
Foot	30.48	Centimeter	Centimeter	0.0328	Foot
Foot	0.3048	Meter	Meter	3.281	Foot
Yard	0.9144	Meter	Meter	1.0936	Yard
Mile	1.60934	Kilometer	Kilometer	0.62414	Mile
Area					
Square inch	6.4516	Square centimeter	Square centimeter	0.155	Square inch
Square foot	0.092903	Square meter	Square meter	10.7639	Square foot
Square yard	0.8361	Square meter	Square meter	1.196	Square yard
Acre	0.40469	Hectare	Hectare	2.471	Acre
Square mile	2.58999	Square kilometer	Square kilometer	0.3861	Square mile
Volume					
Fluid ounce	29.574	Milliliter	Milliliter	0.0338	Fluid ounce
Gallon	3.7854	Liter	Liter	0.26417	Gallon
Cubic foot	0.028317	Cubic meter	Cubic meter	35.315	Cubic foot
Cubic yard	0.76455	Cubic meter	Cubic meter	1.308	Cubic yard
Weight					
Ounce	28.3495	Gram	Gram	0.03527	Ounce
Pound	0.45360	Kilogram	Kilogram	2.2046	Pound
Short ton	0.90718	Metric ton	Metric ton	1.1023	Short ton
Force					
Dyne	0.00001	Newton	Newton	0.00001	Dyne
Temperature					
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5th then add 32	Fahrenheit

METRIC PREFIXES

Prefix	Symbol	Multiplication factor
exa-	E	1,000,000,000,000,000,000 = 10^{18}
peta-	P	1,000,000,000,000,000 = 10^{15}
tera-	T	1,000,000,000,000 = 10^{12}
giga-	G	1,000,000,000 = 10^{9}
mega-	M	1,000,000 = 10^{6}
kilo-	k	1,000 = 10^{3}
deca-	D	10 = 10^{1}
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	µ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}

APPENDIX A

Methodologies Used in this SRS Plutonium Pit Production EIS

CONTENTS

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

μg/m^3	micrograms per cubic meter
AERMOD	AMS/EPA Regulatory Model
ALOHA	Aerial Location of Hazardous Atmospheres
AMS	American Meteorological Society
Complex Transformation SPEIS	*Final Complex Transformation Supplemental Programmatic Environmental Impact Statement*
CPC	Consolidated Plutonium Center
DOE	U.S. Department of Energy
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
HLW	high-level radioactive waste
LCF	latent cancer fatality
LLW	low-level radioactive waste
MACCS	MELCOR Accident Consequence Code System
MEI	maximally exposed individual
MLLW	mixed low-level radioactive waste
NAAQS	National Ambient Air Quality Standards
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NNSA	National Nuclear Security Administration
NRC	U.S. Nuclear Regulatory Commission
RIMS-II	Regional Input-Output Modeling System
ROI	region of influence
SPD SEIS	Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement
SRPPF	Savannah River Plutonium Processing Facility
SRS	Savannah River Site
TRU	transuranic
USDOT	U.S. Department of Energy
WIPP	Waste Isolation Pilot Plant

A METHODOLOGIES USED IN THIS SRS PLUTONIUM PIT PRODUCTION EIS

INTRODUCTION

This appendix describes the methods the National Nuclear Security Administration (NNSA) used to assess the potential direct and indirect impacts of the Proposed Action of this *Environmental Impact Statement for Plutonium Pit Production at the Savannah River Site in South Carolina* (DOE/EIS-0541) (SRS Pit Production EIS). The methodology for assessing cumulative impacts is described in Chapter 5. Resource methodologies are presented in the same order as the resources in Chapters 3 and 4. This EIS evaluates the environmental impacts of the alternatives within a defined region of influence (ROI), as described for each resource below. The ROIs encompass geographic areas within which any significant impact would be expected to occur. The level of detail in the description of each resource methodology varies with the likelihood of a potential impact to the resource.

A.1 LAND USE AND VISUAL RESOURCES

A.1.1 Land Use

Description of Affected Resources. "Land use" is the term used to describe the human use of land. It represents the economic and cultural activities (e.g., agricultural, residential, industrial, mining, and recreational uses) that are practiced at a given place. The analysis of impacts to land use considers land use plans and policies, zoning regulations, and existing land use as appropriate for the site analyzed. The potential impacts associated with changes to land use as a result of the alternatives are also discussed. The ROI for land use and visual resources is F Area, SRS, and areas immediately adjacent to SRS.

Description of Impact Assessment. Land use changes associated with the Proposed Action could potentially affect developed land within the SRS F Area. This EIS assesses land use impacts based on the extent and type of land that would be affected. The land use analysis also considers potential direct impacts resulting from the conversion of, or the incompatibility of, land use changes with special-status lands, such as national parks/monuments or prime farmland, and other protected lands, such as Federal- and State-controlled lands (e.g., public land administered by the Bureau of Land Management or other government agency).

A.1.2 Visual Resources

Description of Affected Resource. Visual resources include natural and manmade physical features that give a particular landscape its character and value. The features that form the overall impression a viewer receives of an area include landform, vegetation, water, color, adjacent scenery, rarity, and manmade (cultural) modifications.

Description of Impact Assessment. This EIS uses the following criteria in the visual resources analysis: scenic quality, visual sensitivity, distance, and visibility zones from key public viewpoints. The analysis is comparative in nature and consists of a qualitative examination of potential changes in visual resources, scenic values (attractiveness), and view corridors (visibility). Aspects of visual modification examined include site development or modification activities that could alter the visibility of structures at each of the alternative sites or obscure views of the surrounding landscape, and changes in land cover that could make structures more visible.

The methodology used to identify and assess the potential impacts of the Proposed Action on visual resources is based on the Bureau of Land Management Visual Resource Management inventory and contrast rating systems, although the proposed location would not cross lands administered by the Bureau. The Visual Resource Management System provides a systematic approach for evaluating the potential changes to visual resources that may result from the action and that the U.S. Department of Energy (DOE) typically uses it in its evaluations pursuant to the National Environmental Policy Act. The major concepts of the Bureau's Visual Resource Management methodologies that this EIS followed are as listed:

- Establish an understanding of the existing visual character and qualities of the landscape environment of the proposed project area;
- Determine areas from which the Proposed Action would be visible;
- Estimate the visual expectations and response of the viewers to visual changes resulting from the Proposed Action; and
- Identify the visual contrast resulting from changes to the existing landscape character and qualities in the project area as a result of the Proposed Action.

A.2 GEOLOGY AND SOILS

Description of Affected Resources. The ROI for geology and soils is F Area, SRS, and nearby offsite areas. This EIS presents collated and summarized information on the regional structural geology, stratigraphy, and soils. In addition, the EIS evaluates the seismicity of the region surrounding each site to provide a perspective on the probability of earthquakes in the area and their likely severity. This information is also used in the EIS evaluation of accidents from natural phenomena.

Description of Impact Assessment. The EIS evaluates the proposed Savannah River Plutonium Processing Facility (SRPPF) for the amount of disturbance that may affect the geology and/or soils of the ROI. These impacts could include potential erosion impacts and impacts to geologic economic resources. Impacts, if any, are evaluated and a determination made as to severity.

A.3 WATER RESOURCES

A.3.1 Surface Water

Description of Affected Resource. Surface waters in the general area of SRS include rivers, streams, lakes, reservoirs, and ponds, including Carolina bays, which are natural depressions capable of accumulating water from stormwater runoff. This EIS defines the setting further by the area's topography, which dictates the direction of overland water flow and the potential receiving waters (e.g., streams, rivers, lakes) for the surface areas. These are commonly referred to as watersheds; for example, the land areas draining to a specific stream are defined as that stream's watershed. The ROI for surface water is those waters within the SRS and their associated watersheds, emphasizing surface waters that could be impacted by SRPPF operations. The EIS identifies the watersheds and surface waters within the ROI and the downstream surface waters that receive or could receive water from the SRS. The downstream ROI goes to the first significant use of the water as a point to gauge possible impacts.

The EIS presents existing water quality within the ROI in terms of the South Carolina Department of Health and Environment Control water classifications. These classifications are associated with intended beneficial uses for the waters and specific water quality standards needed to support those uses. The State is required to collect water-quality data to determine if water quality standards are being achieved and to identify those surface waters or segments of surface waters that do not attain the applicable standards. The EIS identifies any nonattainment waters in the ROI based on the State's most recent reporting. The description of existing water quality also considers discharges permitted under the National Pollutant Discharge Elimination System program and whether discharges are in compliance.

The EIS identifies floodplains (or flood zones) in the ROI. These are generally areas bordering a waterbody that may be covered during flooding events. NNSA uses maps and drainage studies, such as the Federal Emergency Management Agency Flood Insurance Rate Maps, to identify floodplains. Floods with a statistical recurrence interval of 100 years is the normal basis for these rate maps; however, DOE regulations require evaluation of activities that could have adverse impacts from the larger, but less frequent, 500-year flood. Accordingly, the EIS evaluates 100- and 500-year floodplains.

Finally, the EIS evaluates water use within the SRS and in the three-county (Aiken, Barnwell, and Allendale) area in which SRS is located. The evaluation compares water use data (i.e., how the water is used and the volume of water used in the area) to water needs of the Proposed Action. Water use within the SRS is described along with the source of that water.

Description of Impact Assessment. The EIS evaluates the following: (1) possible changes in quantity or quality of stormwater runoff during construction activities; (2) the type, rate, and characteristics of any wastewater generated during operations; and (3) the type and quantity of water needed to support construction and operations. Changes in stormwater volumes and directions have the potential to adversely impact existing discharge points or receiving waters. Spills or leaks of contaminants from heavy equipment during construction could affect stormwater runoff. The EIS evaluates wastewater from SRPPF operations in terms of treatment and capacity of existing facilities. The Proposed Action's estimated water use is compared to the availability of water resources and the capacity of existing treatment and distribution systems to provide that water. Finally, the EIS evaluates the potential for the SRPPF to be within the 100- or 500-year floodplains.

A.3.2 Groundwater

Description of Affected Resources. Groundwater is described in terms of the regional groundwater system in which the SRS is located; more specifically, in terms of the local aquifers. The EIS presents the local groundwater system of aquifers and confining units in terms of general water quality, depths from the ground surface, and rates and direction of groundwater movement. The discussion of groundwater quality from past SRS activities and the associated ongoing remedial activities includes mapped locations of groundwater contaminant plumes. Groundwater use is presented in the same manner and uses the same reference sources as surface water.

Description of Impact Assessment. This EIS evaluates potential impacts to groundwater resources that could result from a potential release of contaminants during construction and discharge of wastewaters during operations that could reach groundwater. The evaluation also considers whether the Proposed Action could affect or be affected by existing groundwater contaminant plumes. The EIS evaluates the potential for groundwater as a source for the proposed SRPPF and, as appropriate, compares it to the availability of groundwater resources and the capacity of existing treatment and distribution systems to provide that water.

A.4 AIR QUALITY AND NOISE

A.4.1 Air Quality

Description of Affected Resource. The ROI for air quality is SRS and nearby offsite areas within the Interstate Air Quality Control Region Code No. 53, where notable air quality impacts could potentially occur. The air quality impact analysis evaluates the criteria, hazardous/toxic air pollutants, and greenhouse gases from the Proposed Action. Criteria pollutants are defined in 40 CFR Part 50. The National Ambient Air Quality Standards (NAAQS) exist for primary (public) and secondary (agricultural) sources. Title III of the *1990 Clean Air Act* amendments gives the regulations for certain hazardous air pollutants and is known as the National Emission Standards for Hazardous Air Pollutants (NESHAPS). South Carolina has incorporated the Federal NAAQS and NESHAPS by reference. In addition, there is a State program that establishes maximum allowable ambient concentrations for toxic air pollutants that is more extensive than the Federal hazardous air pollutant list.

Description of Impact Assessment. This EIS uses the AERMOD air quality model to determine whether emissions from new sources impact the air and create exceedances of the NAAQS or NESHAPS limits. The American Meteorological Society/EPA Regulatory Model, or AERMOD, is a steady-state Gaussian plume model that is used to assess pollutant concentrations from a wide variety of sources associated with an industrial complex. AERMOD is applicable to directly emitted air pollutants and employs best state-of-practice parameterizations for characterizing the meteorological influences and dispersion.

The SRS operating permit amendment application provides emissions data for current SRS operations. Modeled ambient concentration of criteria pollutants are given in recent EISs. Because SRS is currently in an attainment area, new construction or modifications to existing facilities must be evaluated for Prevention of Significant Deterioration permitting. If the emissions from the planned new construction or modification exceed one of the significant level thresholds, then such permitting may be required. Significance levels are concentrations below which no further analysis is necessary for a pollutant for purposes of permitting operational emissions.

The estimated criteria pollutants emissions for the Proposed Action are based on the backup diesel generators and 15,000 gallons of fuel per year. This EIS factors the results of the dispersion modeling analyses conducted for the Complex Transformation SPEIS or the SPD SEIS by the ratio of operation emissions estimated for this Proposed Action to the operation emissions estimated for activities in the SEISs to develop the maximum concentrations (μg/m^3) at the SRS boundary. This EIS uses both SEISs to provide estimates to compare to the various regulatory limits.

The maximum concentration values are the highest 1st-high concentrations calculated at a specific receptor. Use of the highest 1st-high concentrations is appropriate for comparison with significance levels. However, use of the highest 1st-high concentrations is not always appropriate for comparison with ambient air quality standards. The ambient air quality standards allow the use of a variety of methods for evaluating the number of exceedances allowed before the standard is considered to not be met. For example, U.S. Environmental Protection Agency (EPA) guidance (EPA 2011) on demonstrating compliance with the 1-hour nitrogen dioxide NAAQS is to use the eighth-highest daily maximum 1-hour value (not the highest 1-hour value) as an unbiased surrogate for the 98th percentile.

Construction. There would be temporary increases in air quality impacts from construction equipment, trucks, and construction employee vehicles. Exhaust emissions from these sources would result in releases of sulfur dioxide, nitrogen oxide, PM_{10}, total suspended particulates, volatile organic compounds, and carbon monoxide. The calculation of emissions from construction equipment is based on the EPA Mobile Source Emission Factor Model, MOVES2014b backup technical document (EPA 2018) and 700,000 gallons of diesel fuel per year.

The Proposed Action would disturb land during construction. Fugitive dust generated during the clearing, grading, and other earth-moving operations is dependent on a number of factors, including silt and moisture content of the soil, wind speed, and area disturbed. The EIS estimates fugitive dust emissions based on the conservative EPA emission factor of 1.2 tons per acre per month of activity (EPA 1995). This emission factor represents total suspended particulates. PM_{10} emissions are assumed to be 35 percent of total suspended particles (MRI 1999). $PM_{2.5}$ emissions are estimated by applying a particle size multiplier of 0.10 to PM_{10} emissions. Water would be applied to disturbed areas, reducing emission rates by 50 percent.

No radiological releases to the environment are expected from construction activities.

Operations. This EIS uses the results of the AERMOD analysis to evaluate impacts of nonradiological emissions from operations. The EIS then combines the predicted concentrations at the nearest SRS boundary with the regional background concentrations for comparison with the ambient air quality standards to assess compliance. Pollutant emissions that contribute to or cause a violation of air quality standards are considered to have a major impact.

Operational emissions are expected to be insignificant due to the characteristics of the process and the level of air pollution control. This EIS compares the increases in air emissions to emissions from existing SRS operations to determine if detailed modeling is necessary to demonstrate NAAQS compliance. Modeling is not necessary for minor increases and/or situations in which the ambient concentrations of pollutants are well below NAAQS standards. Backup diesel generators are assumed to operate up to 100 hours per year, or 15,000 gallons of diesel fuel use per year.

This EIS bases estimates of greenhouse gas emissions from stationary (e.g., backup diesel generators) and mobile sources (e.g., employee vehicular traffic) on EPA emission factors and number of employees for the various scenarios.

A.4.2 Noise

Description of Affected Resource. This EIS uses current SRS documentation (e.g., site annual reports, recent EISs) for its noise evaluation. Resources potentially affected by noise include wildlife and sensitive receptors in the vicinity of the SRS. The ROI for noise is SRS, F Area, and nearby offsite areas where notable noise impacts could occur.

Description of Impact Assessment. The methodology used to determine environmental impacts with respect to noise involves a two-step analysis. The first step is to identify noise levels associated with implementation of the Proposed Action and determine if they are likely to exceed noise levels defining ambient background conditions. If these noise levels could exceed ambient conditions, the analysis determines whether the impacts are significant, using a qualitative assessment of the increase or decrease in noise level experienced by receptors near the source.

The noise assessment includes a description of the noise sources and noise levels anticipated for construction and operations. Unmitigated logarithmic sound attenuation is assumed to estimate the distance needed for sound levels to achieve an acceptable level for both human and wildlife populations.

A.5 ECOLOGICAL RESOURCES

Description of Affected Resources. The affected ecological resources include terrestrial and aquatic plants and animals. Subsets of these categories include threatened and endangered species and specific protected habitats, such as wetlands or set-aside areas. The ROI for ecological resources is defined by the lands occupied by and immediately surrounding (approximately 200 to 400 feet) the proposed SRPPF complex, F Area, SRS, and adjacent areas.

For aquatic resources, such as streams and wetlands and aquatic species occupying those habitats, the ROI also includes those areas farther from the proposed SRPPF complex that could be affected by wastewater discharges and stormwater runoff and sedimentation. In the case of threatened and endangered species and other special-interest species, biotic information includes species distribution within the SRS. NNSA reviewed ecological data from earlier SRS projects, wetlands surveys, floodplain delineations, and plant and animal inventories in the ROI to identify the locations of plant and animal species, floodplains, and wetlands and to identify the potential impact from physical, chemical, or radiological stressors. Descriptions in the EIS are at a summary level and focus on five categories: terrestrial resources, wetlands, floodplains, aquatic resources, and threatened and endangered and protected species.

Description of Impact Assessment. During construction, land-clearing activities, erosion and sedimentation, and human disturbance, including noise have the potential to impact ecological resources. During operations, land use changes, radionuclide emissions, water withdrawal, wastewater discharge, and human disturbance and noise may affect biotic resources. In general, the analysis assesses potential impacts based on the degree to which various habitats or species could be affected relative to the existing affected environment. Where appropriate, impacts are evaluated against Federal and State protection regulations and standards. In general, the analysis of impacts to ecological resources is qualitative rather than quantitative. The analysis evaluates the amount of land disturbed and identifies any critical habitats or special-status species that could be affected.

Terrestrial Resources. The analysis evaluates potential impacts of the Proposed Action on terrestrial plant communities by comparing data on existing site vegetation communities to proposed land requirements for construction and operation. The analysis of impacts to wildlife is based to a large extent on plant community loss or modification, which directly affects animal habitat. The analysis also considers potential impacts from human disturbance, including construction and operational noise. The loss of important or sensitive habitats and species is considered more important than the loss of regionally abundant habitats or species.

Wetlands. The evaluation of potential impact to wetlands from the implementation of Proposed Action is similar to the methods used to determine potential impacts on terrestrial plant communities; that is, comparing locations of wetlands to the location of land requirements of the proposed SRPPF complex. Sedimentation impacts are evaluated based on the proximity of wetlands to the proposed SRPPF project areas. Impacts resulting from wastewater discharge and other transport pathways (e.g., spills) into a wetland system are evaluated, recognizing that effluents would be required to meet applicable Federal and State standards. In assessing impacts to wetlands, the analyses identifies whether any wetlands would likely be affected by new facilities.

Floodplains. Floodplains include any lowlands that border a waterbody and encompass areas that may be covered by overflow during flood stages. This EIS uses maps and environmental documents to identify floodplains. Locations of proposed SRPPF facilities are evaluated in relation to any 100-year floodplains in vicinity of the Proposed Action. The evaluation considers both distance from and elevations above the floodplain of proposed facilities in determining whether the proposed action would either impact the floodplain (i.e., affect the function of the floodplain) or would flooding potential affect the proposed SRPPF.

Aquatic Resources. The impact analysis considers the location of any aquatic resources in relation to the land requirements of the proposed SRPPF complex. Impacts to aquatic resources resulting from sedimentation and wastewater discharge are evaluated as described for wetlands by identifying potential pathways that could connect proposed SRPPF activities to aquatic resources. Potential impacts from radionuclides are not addressed for the same reasons described for terrestrial resources.

Threatened and Endangered Species (other protected species and areas). The EIS evaluates impacts on threatened and endangered species and other special-interest species or areas in a similar manner as for terrestrial and aquatic resources because the sources of potential impacts are similar. The EIS uses U.S. Fish and Wildlife Service, State agencies databases, and existing SRS threatened and endangered species management programs and documents to identify the species potentially present in the ROI. The EIS uses this information, site environmental and engineering data, and provisions of the *Endangered Species Act* to evaluate whether the Proposed Action could impact any threatened or endangered plant or animal (or its habitat). In assessing impacts to threatened and endangered species, the EIS considers the known locations of threatened, endangered, and protected species or set-aside areas in the ROI and whether the land area for the proposed SRPPF complex, in particular, contains any suitable habitat for these species or protected areas.

A.6 CULTURAL AND PALEONTOLOGICAL RESOURCES

Description of Affected Resources. Cultural resources are physical manifestations of culture, specifically archaeological sites, architectural properties, ethnographic resources, and other historical resources relating to human activities, society, and cultural institutions that define communities and link them to their surroundings. They include expressions of human culture and history in the physical environment, such as prehistoric and historic archaeological sites, buildings, structures, objects, and districts, which are considered important to a culture or community. Cultural resources also include locations of important historic events and aspects of the natural environment, such as natural features of the land or biota, which are part of traditional lifeways and practices.

This EIS reviews cultural resources by three general categories: archaeological resources, historic resources, and Native American resources. Archaeological resources include any material remains of past human life or activities that are of archaeological interest (16 U.S.C. §§ 470aa–mm). By definition, these resources pre-date written records. Historic resources include the material remains and landscape alterations that have occurred since the arrival of Europeans to the area. Due to the focus of this EIS on DOE facilities, historic resources often include resources associated with the Manhattan Project, World War II, and Cold War. Native American resources are material remains, locations, and natural resources important to Native Americans for traditional religious or heritage reasons (25 U.S.C §§ 3001–3013). These resources are rooted in the community's history or are important in maintaining cultural identity.

Paleontological resources are the fossil remains of past life forms. Fossils are the remains of once-living organisms such as plants, animals, fungi, and bacteria that have been replaced by rock material. Fossils also include imprints or traces of organisms preserved in rock, such as impressions, burrows, and trackways. Paleontological resources are considered a fragile and nonrenewable scientific record of the history of life on earth, and so represent an important component of America's natural heritage.

The ROI for cultural and paleontological resources is the area within which cultural and paleontological resources could be physically impacted by construction and operations activities in and around the proposed SRPPF and its associated infrastructure.

Description of Impact Assessment. The analyses of potential impacts to cultural and paleontological resources are very similar because the Proposed Action would affect the two resources similarly. The analyses address the potential direct and indirect impacts from construction activities and operation of the facility. Most potential impacts are those resulting from ground-breaking activities; however, the analysis considers other types of impacts, such as reduced access by practitioners to resources; introduction of visual, audible, or atmospheric elements out of character with the resources; increased visitation to sensitive areas; and changes to nearby drainage and erosion patterns. All analyses account for the previous disturbance of the project area from the Mixed-Oxide Fuel Fabrication Facility construction activities.

A.7 SITE INFRASTRUCTURE

Description of Affected Resources. Potentially affected site infrastructure resources include electrical distribution systems, fuel, domestic water, and sanitary sewer systems. The ROI is the entire SRS.

Description of Impact Assessment. The EIS assessment of potential impacts to site infrastructure focuses on the ability of the site to support the Proposed Action. The analysis evaluates supporting infrastructure demands, such as electricity, fuel, domestic water, and sanitary wastewater requirements. The analysis addresses whether there would be sufficient available and peak capacity to support the pit production mission.

A.8 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

A.8.1 Socioeconomics

Description of Affected Resources. The analysis of socioeconomics considers the attributes of human social and economic interactions from the Proposed Action and the impacts on the ROI, which is defined as the four-county area in which more than 86 percent of SRS employees reside—Aiken and Barnwell counties, South Carolina, and Columbia and Richmond counties, Georgia. The potential for socioeconomic impacts is greatest in local jurisdictions. The ROI is based on the current residential location of full-time SRS workers directly involved in the SRS activities and encompasses the area in which most of these workers spend their wages and salaries. The EIS socioeconomic analysis reviews the local demographics, regional and local economy, local housing, and community services.

Description of Impact Assessment. The EIS calculates indirect employment generated by SRS operations using a weighted average of Regional Input-Output Modeling System (RIMS II) direct-effect employment multipliers from the U.S. Bureau of Economic Analysis for select industries that most accurately reflect the major activities at the site. The Bureau of Economic Analysis develops RIMS II multipliers using input-output tables that show the distribution of inputs purchased and outputs sold for each industry. A national input-output table, representing approximately 500 different industries, is adjusted using Bureau of Economic Analysis regional economic accounts to accurately reflect the structure of a given area. The SRS site-specific operations multiplier for the EIS is based on the following industries included in the RIMS II models: Management of Companies and Enterprises; Scientific Research and Development; Investigation and Security Services; Waste Management and Remediation; Other Basic Inorganic Chemical Manufacturing; Forest Nurseries, Forest Products, and Forest Tracts; Environmental and Other Technical Consulting Services; and Construction. This method resulted in an estimated SRS direct-effect employment multiplier of 2.19 (NNSA 2015).

A.8.2 Environmental Justice

The ROI for environmental justice includes parts of 28 counties throughout South Carolina and Georgia that comprise an area within a 50-mile radius of the proposed SRPPF. The ROI is used to assess potential effects on the economy as well as effects that are more localized in political jurisdictions surrounding the site. This residential distribution reflects existing commuting patterns and attractiveness of area communities for people employed at SRS and is used to estimate the future distribution of direct workers. The evaluation of impacts is based on the degree to which change in population affects the local economy, housing market, and community services.

Description of Impact Assessment. The EIS uses population data from the 2017 Savannah River Site environmental report (SRNS 2018), U.S. Census Bureau, and State population projections for Georgia and South Carolina to calculate the population within a 50-mile radius of the center of the SRS. The 50-mile radius population in the 2017 environmental report is 781,060 and is based on the Census Bureau's 2010 data (SRNS 2018). The percent change for the counties that make up the 50-mile radius is based on the published growth rate projections for the states of South Carolina and Georgia. Table A-1 presents the population increases for the ROI based on these data. The analysis then increases the 2010 population presented in the 2017 environmental report by the percentages presented below to determine the population projection for 2030 (Table A-1).

Table A-1—Population Projection for 2030

Timeframe	Percent Increase	Year/Population Projection
2010–2015	3.1	2015/805,273
2015–2020	2.7	2020/827,050
2020–2025	2.3	2025/846,037
2025–2030	2.0	2030/862,957

Sources: SRNS 2017; GAOPB 2019; SCRFAO 2019

The threshold for identifying minority and low-income communities surrounding the SRS is consistent with CEQ guidance (CEQ 1997, p. 25) for identifying minority populations using either the 50-percent threshold or a "meaningfully greater" percentage of minority or low-income individuals in the general population. For this EIS, NNSA defines "meaningfully greater" as 20 percentage points above the population percentage in the general population. Once minority and low-income were identified, the impacts analysis focused on whether there would be any high and adverse human health effects.

A.9 WASTE MANAGEMENT

Description of Affected Resources. Potentially affected resources include the SRS processes and facilities currently in place to treat, store, and dispose of waste. The ROI for waste management is the SRS and any offsite facilities where SRS waste is sent for management or disposal. The EIS defines the following SRS waste streams: high-level radioactive waste (HLW); transuranic radioactive (TRU) waste, including mixed TRU waste; low-level radioactive waste (LLW); mixed low-level waste (MLLW); hazardous waste; and solid (sanitary or municipal) waste, including construction and demolition waste that is neither hazardous nor radioactive. The EIS also discusses the management of sanitary wastewater. The emphasis for the affected resources is on those waste types that would be (or could be) generated by the Proposed Action. The Proposed Action would not produce HLW; however, HLW management at SRS is a significant element of SRS waste management operations, and elements of HLW management are included in the management of other radioactive wastes.

The EIS briefly discussed each waste type with regard to typical characteristics of the waste involved, the amount generated per year, and the manner in which it is managed. Waste management actions or processes were described in terms of throughput and capacity and were evaluated to identify any regulatory or permit issues (e.g., throughput limitations, violations, adverse findings) that might indicate adverse environmental impacts.

Description of Impact Assessment. The EIS evaluates potential waste management impacts based on the waste types and estimated volumes from the Proposed Action. The EIS also evaluates waste types to determine whether they are consistent with existing SRS waste streams and appropriate for management under the same procedures and processes. The EIS compares estimated waste volumes from the Proposed Action with routine SRS waste generation to determine if procedures, processes, or infrastructure capacity could possibly be overwhelmed by the additional waste loads. The EIS also evaluates the regulatory or permit status of existing waste management activities to determine if additional waste volumes could possibly cause regulatory issues or worsen existing compliance issues.

The EIS evaluation includes the Waste Isolation Pilot Plant (WIPP) in New Mexico because it is the only location designated for the disposal of TRU waste. The assessment of impacts at WIPP is limited to how increased shipments from the Proposed Action could impact WIPP's ongoing waste receipt operations. Long-term impacts associated with potential effects on WIPP's capacity and planned lifespan are discussed as cumulative impacts (Chapter 5) because those impacts would be the result of all wastes (from all waste generators) going to the facility.

The EIS also addresses potential radioactive waste disposal at the Nevada Nuclear Security Site. This site is an alternative for the disposal of LLW and MLLW from the proposed SRPPF. The evaluation is limited to potential impacts to the level of ongoing waste disposal operations at that site.

A.10 HUMAN HEALTH

Description of Affected Resources. Potential impacts on public and worker health and safety include radiological and nonradiological exposure pathways and occupational injuries, illnesses, and fatalities resulting from construction activities and normal (accident-free) operations of the completed facility. Exposure pathways include inhalation, immersion, ingestion, and exposure to external sources. Occupational ROIs include involved and noninvolved workers. The ROI for human health and safety is F Area and offsite areas within a 50-mile radius of the proposed SRPPF, where radiation, radionuclide, and hazardous chemical exposures could occur.

Because operations at SRS have the potential to release measurable quantities of radionuclides to the environment that result in exposure to the worker and the public, NNSA conducts environmental surveillance and monitoring activities at SRS. These activities provide data that are used to evaluate radiation exposures that contribute doses to the public. Each year, environmental data from SRS are collected and analyzed. The results of these environmental monitoring activities are summarized in the annual site environmental reports. The environmental monitoring conducted at SRS consists of two major activities: effluent monitoring and environmental surveillance.

Effluent monitoring involves the collection and analysis of samples or measurements of liquid (waterborne) and gaseous (airborne) effluents prior to release into the environment. These analytical data provide the basis for the evaluation and official reporting of contaminants, assessment of radiation and chemical exposures to the public, and demonstration of compliance with applicable standards and permit requirements.

Environmental surveillance data provide a direct measurement of contaminants in air, water, groundwater, soil, food, biota, and other media subsequent to effluent release into the environment. These data verify SRS' compliance status and, combined with data from effluent monitoring, allow the determination of chemical and radiation dose and exposure assessment of NNSA operations and effects, if any, on the local environment. The primary source of data for the EIS analysis of radiation exposure to the public for the No-Action Alternative is the effluent and environmental surveillance data presented in the environmental reports. Under the No-Action Alternative, the existing MFFF would remain unused and NNSA would utilize the capabilities at LANL to meet the Nation's long-term needs for pit manufacturing. DOE evaluated the impacts of the pit production capacity at LANL in the 2019 SPEIS SA (NNSA 2019) and the 2020 LANL SA (NNSA 2020).

Description of Impact Assessment. The following describes the EIS methodology to assess the human health impacts during normal operations. Additional details are in Appendix B, Section B.1.3, to this EIS.

The EIS assesses radiological impacts for workers involved in proposed SRPPF operations (both involved workers and noninvolved security personnel) and for the public (maximally exposed individual [MEI] and population). Health impacts to involved workers are based on information provided by Savannah River Nuclear Solutions (SRNS 2020). The EIS uses a multiplier of 0.0006 latent cancer fatality (LCF) per rem or person-rem of exposure based on *Estimating Radiation Risk from Total Effective Dose Equivalents (TEDE)* (DOE 2003b) to convert radiological doses to health effects (LCFs). Similarly, health impacts to the MEI and population are based on doses calculated by the radiological air analyses.

The EIS analysis calculates radiation doses for the MEI and the entire population residing within 50 miles of the center of the SRS. This analysis performs dose calculations from normal operations using the CAP-88 package of computer codes, which was developed under EPA sponsorship to demonstrate compliance with 40 CFR Part 61, Subpart H, which governs the emissions of radionuclides other than radon from DOE facilities. This package implements a steady-state Gaussian plume atmospheric dispersion model to calculate concentrations of radionuclides in the air and on the ground and uses U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.109 (NRC 1977a) food-chain models to calculate radionuclide concentrations in foodstuffs (vegetables, meat, and milk) and subsequent intakes by humans.

The calculations use meteorological data in the form of joint frequency distributions of wind direction, wind speed class, and atmospheric stability category. For occupants of residences within the ROI, the dose calculations assume that the occupant remains at home (actually, unprotected outside the house) during the entire year and obtains food according to the rural pattern defined in the NESHAP background documents. This pattern specifies that 70 percent of the vegetables and produce, 44.2 percent of the meat, and 39.9 percent of the milk consumed are produced in the local area (e.g., a home garden). The remaining portion of each food is assumed to be produced within 50 miles of the site. The same assumptions are used for occupants of businesses, but the resulting doses are divided by two to account for businesses being occupied for less than one-half a year, and that less than one-half of a worker's food intake occurs at work. For collective effective dose equivalent estimates, the EIS uses CAP-88 production rates to calculate the production of beef, milk, and crops within 50 miles of the SRS.

The EIS evaluates occupational injury, illness, and fatality estimates using occupational incidence rates of major industry groups based on U.S. Department of Labor, Bureau of Labor Statistics injury, illness, and fatality information for similar activities. These rates are compared to person-hour estimates for the Proposed Action. Occupational injury, illness, and fatality categories used in this analysis are in accordance with Occupational Safety and Health Administration definitions. Incident rates are presented for facility construction and operations.

The EIS evaluates facility operations to determine if any chemical-related health impacts would be associated with normal (accident-free) operations. Initial screens for the hazard analysis did not identify any controls necessary to protect the public or workers from direct chemical exposures. Facility design features that minimize the worker exposures during facility operations act as defense-in-depth controls. In addition to these controls, worker protection would be augmented by facility safety programs such as Integrated Safety Management System, work planning, chemical hygiene, industrial hygiene personnel monitoring, and emergency preparedness.

A.11 ACCIDENT ANALYSIS

Description of Affected Resources. Potential impacts to human health and safety from postulated accidents include radiological and nonradiological exposures. For both radiological and chemical accidents associated with operations, the affected resources are the facility and site workers and the offsite population. Specifically, for radiological accidents, the impact is incremental adverse health effects (i.e., additional LCFs) for a noninvolved worker, the offsite MEI, and the offsite population within 50 miles. For chemical accidents, airborne concentrations and potential health effects were calculated for the noninvolved worker and the offsite MEI.

Description of Impact Assessment. The following describe the EIS methodology to assess the human health impacts during accidents. Additional details are in Appendix B, Section B.3, to this EIS.

Postulated accidents can be initiated by internal operations (e.g., fire, spill, criticality), external events (e.g., airplane crash), or natural phenomena (e.g., earthquake, flood). This EIS evaluates unmitigated accident scenarios chosen to reflect the range and kinds of accidents that are postulated. The range of accidents is from low-frequency, high-consequence events (probabilities as low as approximately 10^{-6}, or once in 1 million years) to high-frequency, low-consequence events (probabilities as high as approximately 10^{-2}, or once in 100 years) in order to assess potential risks.

The accident analyses are performed in accordance with the *Recommendations for Analyzing Accidents Under the National Environmental Policy Act* (DOE 2002). Appendix B to this EIS provides additional information on the accident methodology. For radiological accidents, point estimates of radiation dose and, for the offsite population, corresponding incremental LCFs are calculated for a hypothetical noninvolved worker from release points at F Area, the offsite MEI, and the offsite population within 50 miles. For nonradiological accidents, estimates of airborne concentrations of chemical substances are calculated for a hypothetical noninvolved worker and the offsite MEI.

For radiological and chemical accidents, the analysis follows four general analytical steps:

1. Screen operations at the facilities to identify those with the potential to contribute to offsite risk.
2. Identify and screen postulated accident scenarios associated with those operations.
3. Calculate source terms (release rates and frequencies) for these unmitigated scenarios assuming no mitigation of releases or frequencies.
4. Calculate onsite and offsite consequences (impacts to the health and safety of workers and the general public) of these scenarios.

Due to the similarity of the proposed SRPPF's design to the design of the Consolidated Plutonium Center (CPC) analyzed at SRS in the Complex Transformation SEIS (NNSA 2008), and because accident parameters for the SRPPF are preliminary at this time, the EIS uses adjusted CPC results to account for any differences rather than performing the entire accident analyses again. The EIS uses the MELCOR Accident Consequence Code System (MACCS) to calculate unmitigated consequences of accidental releases of radioactivity for the CPC with the following changes for the proposed SRPPF:

- Material-at-risk used to calculate the source term, and
- Local meteorological conditions.

However, the following MACCS CPC input data remain unchanged for the proposed SRPPF:

- Estimated location of the proposed SRPPF and its distance from the site boundary;
- Parameters used to calculate the source term, i.e., airborne release fraction, respirable fraction, damage ratio, leak path fraction;
- Release heights (i.e., stack release, building release, or ground level release);
- MEI and noninvolved worker locations;
- 2030 offsite 50-mile population distribution (projected from 2000 Census data); and
- Offsite agricultural and economic data.

The consequences of accidental releases of hazardous chemicals are calculated using the Aerial Location of Hazardous Atmospheres (ALOHA) code based on best available information (SRNS 2020). In addition to the source term data, input data for the ALOHA code is similar to that required for the radiological accident analysis, with the exception that offsite agricultural and economic data are not required.

Intentional Destructive Acts

The Complex Transformation SPEIS includes a classified appendix that analyzes the potential impacts of intentional destructive acts (e.g., sabotage, terrorism). The conclusion in the classified appendix can be summarized as follows: "Depending on the malevolent, terrorist, or intentional destructive acts, impacts would be similar to, or exceed, accident impacts analyzed in the SPEIS"

(NNSA 2008). In preparing this SRS Pit Production EIS, NNSA reviewed the classified appendix that was prepared for the Complex Transformation SPEIS to address intentional destructive acts. Based on that review, NNSA concluded that the classified appendix analysis is reasonable and adequate to represent the Proposed Action in this EIS and does not need to be revised (NNSA 2019).

A.12 TRANSPORTATION

Description of Affected Resources. The ROI for transportation is SRS, adjacent areas, and the corridors between the SRS and other sites where radiological and hazardous material transportation could occur. The foundation of the methodology for the transportation analysis in this EIS is the transportation analysis in the SPD SEIS (NNSA 2015, Appendix E), which described the transportation activities analyzed, computer codes used and the pertinent data that served as input to those codes, transportation modes, receptors, the packaging used for the material being transported, offsite routes and population along each route for each material and waste type, and the radionuclide inventory assumed to be representative of each type of radiological material and waste. This information is applicable to the transportation activities under the Proposed Action. Specifically, the following materials and routes from the SPD SEIS are relevant to this EIS:

- Transport of pits between Pantex and SRS,
- Transport of highly enriched uranium between SRS and the Y-12 Plant on the Oak Ridge Reservation,
- Transport of plutonium materials between the Los Alamos National Laboratory and SRS,
- Transport of TRU waste in TRUPACT II packaging between SRS and WIPP, and
- Transport of LLW and MLLW between SRS and the Nevada Nuclear Security Site.

In preparing this EIS, NNSA modified important parameters from the SPD EIS, such as the number of shipments, to more closely represent the current Proposed Action. The EIS uses the routing computer program TRAGIS (Johnson and Michelhaugh 2003) to determine the potential routes for these shipments. The TRAGIS computer program is a geographic information system-based transportation analysis computer program used to identify the highway, rail, and waterway routes for transporting radioactive materials within the United States. The features in TRAGIS allow users to determine routes for shipment of radioactive materials that conform to U.S. Department of Transportation (USDOT) regulations as specified in 49 CFR Part 397 and to determine the population densities along those routes.

The Proposed Action would also involve offsite transport of nonradiological materials and wastes (e.g., beryllium shipments from Los Alamos National Laboratory or another supplier, and hazardous waste shipments from SRS to treatment or disposal facilities), which are independently analyzed.

Description of Impact Assessment. The EIS presents transportation impacts in two parts: impacts from incident-free or routine transportation and impacts from transportation accidents. The analysis of impacts from incident-free transportation focuses on radiological shipments because the public and workers can receive a radiation dose during normal transport activities. These impacts are expressed in terms of LCFs.

Impacts associated with transportation accidents are further divided into radiological and nonradiological impacts. Radiological impacts from accident conditions consider foreseeable scenarios that could damage transportation packages, leading to releases of radioactive materials to the environment and are expressed in terms of LCFs. The radiological risks from transporting materials and wastes are estimated in terms of the number of LCFs among the crew and the exposed population. A health risk conversion factor of 0.0006 LCF per rem or person-rem of exposure is used for both the public and workers (DOE 2003b).

The nonradiological impacts of both radiological and nonradiological shipments are expressed in terms of traffic fatalities and were determined by multiplying the number of miles to be driven, based on the number of shipments, by the route-specific fatality rate.

Population Along the Route. As noted earlier, the SPD SEIS (NNSA 2015, Table E-1) determined transportation routes and the population densities along those route. These population densities are representative of the population along the routes in the year 2020 and were determined using state-level data. For offsite transport, highway routes were determined using TRAGIS (Johnson and Michelhaugh 2003). The population densities along each route were derived from 2000 Census data (Johnson and Michelhaugh 2003). State-level Census data for 2010 were used in relation to the 2000 Census data to project the population densities to 2020 levels for the SPD SEIS.

For this EIS, NNSA estimated population densities for the year 2030, the expected start date of full SRPPF operations. Projecting populations further into the future would introduce more uncertainty into the analyses and would be considered speculative. For each transportation route, the EIS uses state-level population estimates based on population projections for each state to develop population factors. Table A-2 shows these factors, which represent the percentage increase in population from 2020 to 2030.

These factors are used in conjunction with the distance traveled in each state along the route to develop a route-specific population factor, shown in Table A-3. The EIS then multiplies the incident-free and accident population radiation doses by the route-specific factor to obtain the estimated 2030 population dose. This approach to revising the 2020 population dose is appropriate because the radiation dose to the population is proportional to the change in population (assuming that all other aspects of the radiological shipments have not changed since their development for the SPD SEIS).

Table A-2—Population Factors for Changes in State-Level Populations from 2020 to 2030

State	Population Factor
Alabama	1.02
Arkansas	1.04
Arizona	1.13
California	1.08
Georgia	1.10
Louisiana	1.04
Mississippi	1.00
Nevada	1.15
New Mexico	1.02
Oklahoma	1.06
South Carolina	1.12
Tennessee	1.08
Texas	1.17
Utah	1.17

Source: UVA 2018

Table A-3—Route-Specific Population Factor Adjustment from 2020 to 2030

Route to and from SRS	Route-Specific Population Change Factor
Pantex, Texas	1.08
Y-12 Plant at Oak Ridge, Tennessee	1.10
Los Alamos National Laboratory, New Mexico	1.07
WIPP, New Mexico	1.10
Nevada Nuclear Security Site, Nevada	1.09

Incident-Free Transportation. Radiological impacts of incident-free transportation include impacts on members of the public and crew from radiation emanating from materials in the shipment. The SPD SEIS used the RADTRAN 6 computer code (Weiner et al. 2014) for incident-free risk assessments to estimate the impacts on populations, as well as for incident-free assessments associated with MEIs. RADTRAN 6 was developed by Sandia National Laboratories to calculate individual and population risks associated with the transportation of radioactive materials by a variety of modes, including truck, rail, air, ship, and barge. DOE only considers truck transport for this EIS analysis because no rail or barge shipments are expected for activities specific to the proposed SRPPF. The technical assumptions in the RADTRAN 6 computer code have not changed since its use in the SPD SEIS; therefore, the SPD SEIS analyses for determining per-shipment risks for the routes listed above are applicable to this analysis for this EIS.[1] NNSA adjusted the radiation dose and risk to the populations along the routes using the population change factors list in Table A-3.

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[1] The SPD SEIS used RADTRAN Version 6 to estimate potential health impacts to workers and the public resulting from transportation of radiological materials (e.g., pits, plutonium metal and powder, highly enriched uranium, TRU waste, and LLW) among DOE and commercial sites. In 2015, the Defense Nuclear Facilities Safety Board identified quality assurance issues associated with RADTRAN. For this reason, in more recent applications of RADTRAN for other EISs, DOE has validated RADTRAN results using alternative methods. For this EIS, NNSA based its unit risk factors on the unit risk factors from the SPD SEIS and validated these unit risk factors using alternative methods, modifying the results accordingly.

The EIS determines radiological impacts for crew members and the general population. For truck shipments, the crew members are the drivers of the shipment vehicle. The general population is composed of the persons residing within 0.5 mile of the truck route (off-link), persons sharing the road (on-link), and persons at stops. Exposures to workers who would load and unload the shipments are not included in this analysis but are included in the occupational estimates for plant workers (see Chapter 4, Section 4.10, of this EIS).

Radiation doses to MEIs for routine offsite transportation are estimated for the following scenarios:

- A person caught in traffic and located four feet from the surface of the shipping container for 30 minutes,
- A resident living 98 feet from the highway used to transport the shipping container, and
- A service station worker at a distance of 52 feet from the shipping container for 50 minutes.

The maximally exposed transportation worker would be a truck crew member who could be a DOE employee or a driver for a commercial carrier. In addition to following USDOT requirements, a DOE employee would also need to comply with DOE regulations at 10 CFR Part 835, which limits worker radiation doses to five rem per year; however, DOE's goal is to maintain radiological exposure as low as reasonably achievable. DOE has therefore established the administrative exposure guideline of two rem per year (DOE-STD-1098-2017). This limit would apply to any non-TRU waste shipment conducted by DOE personnel. Drivers of TRU waste shipments to WIPP have an administrative exposure guideline of one rem per year (WTS 2006). Commercial drivers are subject to Occupational Safety and Health Administration regulations, which limits the wholebody dose to five rem per year (29 CFR 1910.1996[b]), and the USDOT requirement of two millirem per hour in the truck cab (49 CFR 173.411). Commercial drivers typically do not transport radioactive materials that have high dose rates external to the package; therefore, for purposes of analysis, a maximally exposed driver would not be expected to exceed the DOE administrative exposure guideline of two rem per year for non-TRU waste shipments. Other workers include inspectors who would inspect the truck and its cargo along the route. One inspector is assumed to be at a distance of 3.3 feet from the cargo for a duration of one hour.

The radiation doses and risks to the MEIs provided on a per-shipment basis in the SPD SEIS are applicable to the analysis in this EIS because the materials, packaging, and routes are assumed to be the same and therefore do not need to be modified for this EIS.

Transportation Accidents. The offsite transportation accident analysis consider the impact of accidents during the transportation of materials. Under accident conditions, impacts on human health and the environment could result from the release and dispersal of radioactive material. The EIS assesses transportation accident impacts using an accident analysis methodology developed by NRC using various methodologies found in the *Final Environmental Impact Statement on the Transportation of Radioactive Materials by Air and Other Modes* (Radioactive Material Transportation Study; NUREG-0170); *Shipping Container Response to Severe Highway and Railway Accident Conditions* (Modal Study; NUREG/CR-4829); and *Reexamination of Spent Fuel Shipping Risk Estimates* (Reexamination Study; NUREG/CR-6672) (NRC 1977b, 1987, 2000). Accidents that could potentially breach the shipping container are represented by a spectrum of accident severities and radioactive release conditions.

Historically, most transportation accidents involving radioactive materials have resulted in little or no release of radioactive material from the shipping container. Consequently, the analysis of accident risks takes into account a spectrum of accidents ranging from high-probability accidents of low severity to hypothetical high-severity accidents with a correspondingly low probability of occurrence. The accident analysis calculates the probabilities and consequences from this spectrum of accidents.

To provide a reasonable assessment of the radiological transportation accident impacts, the EIS performs two types of analysis. In the first accident analysis, an accident risk assessment takes into account the probabilities and consequences of a spectrum of potential accident severities using a methodology developed by NRC (NRC 1977b, 1987, 2000). For the spectrum of accidents considered in the analysis, accident consequences in terms of collective "dose risk" to the population within 50 miles are determined using the RADTRAN 6 computer program. The RADTRAN 6 code sums the product of consequences and probability over all accident severity categories to obtain a probability-weighted risk value referred to in this appendix as "dose risk," which is expressed in units of person-rem.

For accidents where a waste container or the cask shielding is undamaged, the EIS evaluates population and individual radiation exposure from the waste package for the duration that would be needed to recover and resume shipment. The collective dose over all segments of transportation routes is evaluated for an affected population within 0.5 mile from the accident location. This dose is an external dose and is approximately inversely proportional to the square of the distance of the affected population from an accident. Any additional dose to those residing beyond 0.5 mile from the accident would be negligible. The calculated dose to an individual (first responder) assumes the individual would be located 6.6 to 33 feet from the package.

Vehicle accident and fatality rates are taken from data provided in state-level accident rates for surface freight transportation and are specific to heavy combination trucks. Accident rates are generically defined as the number of accident involvements (or fatalities) in a given year per unit of travel in that same year. For safe, secure transport systems, DOE determined an accident rate of 4.4×10^{-7} accident per mile (NNSA 2015). The route-specific commercial truck accident rates are adjusted to reflect the safe, secure transport system accident rate. Accident fatalities for safe, secure transport systems are estimated using the commercial truck transport fatality per accident ratios within each zone.

Accident severity categories for potential radioactive waste transportation accidents are described in the Radioactive Material Transportation Study (NRC 1977b) for radioactive waste in general, and the Modal Study (NRC 1987) and the Reexamination Study (NRC 2000) for spent nuclear fuel. The methods described in the Modal Study and the Reexamination Study are applicable to transportation of radioactive materials in a Type B spent fuel cask. The accident severity categories presented in the Radioactive Material Transportation Study would be applicable to all other waste transported off site.

Radiological consequences in the EIS are calculated by assigning radionuclide release fractions on the basis of the type of material or waste, the type of shipping container, and the accident severity category. The release fraction is defined as the fraction of the radioactivity in the container that could be released to the atmosphere in a given severity of accident. Release fractions vary according to the waste type and the physical or chemical properties of the radioisotopes.

Representative release fractions in the EIS are developed for each waste and container type on the basis of DOE and NRC reports (NNSA 2015). The severity categories and corresponding release fractions provided in these documents cover a range of accidents from no impact (zero speed) to impacts with speed in excess of 120 miles per hour onto an unyielding surface. Traffic accidents that could occur at the facility would be of minor impact due to lower local speed, with no release potential.

For radioactive wastes transported in a Type B cask, the particulate release fractions in the EIS are developed consistent with the models in the Reexamination Study (NRC 2000) and adapted in the *Final West Valley Demonstration Project Waste Management Environmental Impact Statement* (DOE 2003a). For wastes transported in Type A containers (e.g., 55-gallon drums and boxes), the fractions of radioactive material released from the shipping container in the EIS are based on recommended values from the Radioactive Material Transportation Study and the DOE handbook, "Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facility" (DOE 1994). For contact-handled and remote-handled TRU waste, the EIS uses the release fractions corresponding to the Radioactive Material Transportation Study severity categories as adapted in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997).

For those accidents in which the waste container or cask shielding were undamaged and no radioactive material was released, the EIS assumes that it would take 12 hours to recover from the accident and resume shipment for commercial shipments, and 6 hours for safe, secure transport shipments. During this period, no individual would remain close to the cask. A first responder is assumed to stay at a location 6.6 to 33 feet from the package for one hour (NNSA 2015).

The second accident analysis in the EIS is performed to represent the maximum reasonably foreseeable impacts to individuals and populations should an accident occur. The EIS uses the RISKIND computer program (Yuan et al. 1995) to calculate maximum radiological consequences for an urban or suburban population zone for an accidental release with a likelihood of occurrence greater than 1 in 10 million per year. The RISKIND computer code was developed for DOE's Office of Civilian Radioactive Waste Management to estimate potential radiological consequences and health risks to individuals and the collective population from exposures from the transportation of spent nuclear fuel; however, this code is also applicable to transportation of other cargo types, as the code can model complex atmospheric dispersion and estimate radiation doses to MEIs near the accident. These RISKIND analyses supplement the collective risk results calculated with RADTRAN 6 to address areas of specific concern to individuals and population subgroups. In the EIS, NNSA adjusts all probabilities of an accident and population dose and risk values determined for the SPD SEIS transportation accident analyses that are applicable to this EIS using the number of shipments applicable to this analysis and population change factors described above.

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APPENDIX B

Human Health and Accidents

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
AERMOD	AMS/EPA Regulatory Model
ALARA	as low as reasonably achievable
ALOHA	Aerial Location of Hazardous Atmospheres
AMS	American Meteorological Society
ARF	airborne release fraction
BEIR	Biological Effects of Ionizing Radiation
CEDE	committed effective dose equivalent
CEQ	Council on Environmental Quality
Complex Transformation SPEIS	*Final Complex Transformation Supplemental Programmatic Environmental Impact Statement*
DOE	U.S. Department of Energy
DR	damage ratio
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ERPG	emergency response planning guideline
HEPA	high-efficiency particulate air
ICRP	International Commission on Radiological Protection
ISCORS	Interagency Steering Committee on Radiation Standards
LCF	latent cancer fatality
LOC	level-of-concern
LPF	leak path factor
MACCS	MELCOR Accident Consequence Code System
MAR	materials at risk
MEI	maximally exposed individual
mrem	millirem
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NIOSH	National Institute for Occupational Safety and Health
NNSA	National Nuclear Security Administration
NRC	U.S. Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit
ppm	parts per million
RF	respirable fraction
ROI	region of influence
SAR	safety analysis report
SARA	*Superfund Amendments and Reauthorization Act*
SPD SEIS	Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement
SRPPF	Savannah River Plutonium Processing Facility
SRS	Savannah River Site
TEDE	total effective dose equivalent
TEEL	temporary emergency exposure limit
TWA	time-weighted average
U	uranium

B HUMAN HEALTH AND ACCIDENTS

This appendix provides supplemental information pertaining to potential human health impacts associated with radiation exposures, chemical exposures, accidents, and worker safety issues due to operation of the proposed Savannah River Plutonium Processing Facility (SRPPF), as presented in Chapter 4 of this *Environmental Impact Statement for Plutonium Pit Production at the Savannah River Site in South Carolina* (DOE/EIS-0541) (SRS Pit Production EIS).

B.1 RADIOLOGICAL IMPACTS ON HUMAN HEALTH

B.1.1 Radiation and Radioactivity

Humans are constantly exposed to naturally occurring radiation through sources such as from the universe and from the earth's rocks and soils. This type of radiation is referred to as background radiation and it is always around us. Background radiation remains relatively constant over time and is present in the environment today just as it was hundreds of years ago. In addition, humans are also exposed to manmade sources of radiation, including medical and dental x-rays, household smoke detectors, materials released from coal burning power plants, and nuclear facilities. The following sections describe some important principles concerning the nature, types, sources, and effects of radiation and radioactivity.

B.1.1.1 What Is Radiation?

Some atoms have large amounts of energy and are inherently unstable. They may reach a stable, less-energetic state through the emission of subatomic particles or electromagnetic radiation, a process referred to as radioactivity. The main subatomic particles that comprise an atom are electrons, protons, and neutrons. Electrons are negatively charged particles that are principally responsible for chemical reactivity. Protons are positively charged particles, and neutrons are neutral. Protons and neutrons are located in the center of the atom, called the nucleus. Electrons reside in a designated space around the nucleus. The total number of protons in an atom is called its atomic number.

Atoms of different types are known as elements. There are more than 100 natural and manmade elements. Atoms of the same element always contain the same number of protons and electrons, but may differ by their number of constituent neutrons. Such atoms of elements with a different number of neutrons are called the isotopes of the element. The total number of protons and neutrons in the nucleus of an atom is called its mass number, which is used to identify the isotope. For example, the element uranium has 92 protons. Therefore, all isotopes of uranium have 92 protons. Each isotope of uranium is designated by its unique mass number: uranium-238 (U-238), the principal naturally occurring isotope of uranium, has 92 protons and 146 neutrons; U-234 has 92 protons and 142 neutrons; and U-235 has 92 protons and 143 neutrons. Atoms can lose or gain electrons in a process known as ionization.

Ionizing radiation has enough energy to free electrons from atoms, creating ions that can cause biological damage. Although it is potentially harmful to human health, ionizing radiation is used in a variety of ways, many of which are familiar. An x-ray machine is one source of ionizing radiation. Likewise, most home smoke detectors use a small source of ionizing radiation to detect smoke particles in the room's air. The two most common mechanisms in which ionizing radiation is generated are the electrical acceleration of atomic particles such as electrons (as in x-ray machines) and the emission of energy from nuclear reactions in atoms. Examples of ionizing radiation include alpha, beta, and gamma radiation.

Alpha radiation occurs when a particle consisting of two protons and two neutrons is emitted from the nucleus of an unstable atom. Alpha particles, because of their relatively large size, do not travel very far and do not penetrate materials well. Alpha particles lose their energy almost as soon as they collide with anything, and therefore a sheet of notebook paper or the skin's surface can be used to block the penetration of most alpha particles. Alpha emitters only become a source of radiation dose after they are inhaled, ingested, or otherwise taken into the body.

Beta (β) radiation occurs when an electron (β^-) or positron (i.e., an electron with a positive charge, β^+) is emitted from an atom. Beta particles are much lighter than alpha particles and therefore can travel faster and farther. Greater precautions must be taken to guard against beta radiation and some shielding is usually recommended to limit exposure to beta radiation. Beta particles can pass through a sheet of paper but can be stopped by a thin sheet of aluminum foil or glass. Most of the radiation dose from beta particles occurs in the first tissue they penetrate, such as the skin, or dose may occur as the result of internal deposition (e.g., inhalation or ingestion) of beta emitters.

Gamma (γ) and x-ray radiation are known as electromagnetic radiation and are emitted as energy packets called photons, similar to light and radio waves, but from a different energy region of the electromagnetic spectrum. Gamma rays and x-rays are the most penetrating type of radiation. Gamma rays are emitted from the nucleus as waves of pure energy, whereas x-rays originate from the electron field surrounding the nucleus. Gamma rays travel at the speed of light, and because they are so penetrating, concrete, lead, or steel is required to shield them. The amount of shielding required depends upon the energy and intensity of the gamma or x-radiation. For example, to absorb 95 percent of the gamma radiation from a cobalt-60 source, 6 centimeters of lead, 10 centimeters of iron, or 33 centimeters of concrete would be needed.

The neutron is another particle that contributes to radiation exposure, both directly and indirectly. Indirect exposure results from gamma rays and alpha particles that are emitted after neutrons are captured in matter. A neutron has about one quarter of the weight of an alpha particle and can travel 2.5 times faster than an alpha particle. Neutrons are less penetrating than gamma rays because they have mass, but neutrons are more penetrating than beta particles because they are uncharged. They can be shielded effectively by water, graphite, paraffin, or concrete.

Some elements, such as uranium, radium, plutonium, and thorium, share a common characteristic: they are unstable or radioactive. Such radioactive isotopes are called radionuclides or radioisotopes. As these elements attempt to change into more stable forms, they emit invisible rays of energy or particles at rates that decrease with time. This emission is known as radioactive decay. The time it takes a material to lose half of its original radioactivity is referred to as its half-life. Each radioactive isotope has a characteristic half-life. The half-life may vary from a millionth of a second to millions of years, depending upon the radionuclide. Eventually, the radioactivity will essentially disappear.

As a radioactive element emits radioactivity, it often changes into an entirely different element that may or may not be radioactive. Eventually, however, a stable element is formed. This transformation may require several steps, known as a decay chain. Radium, for example, is a naturally occurring radioactive element with a half-life of 1,600 years. It emits an alpha particle and becomes radon, a radioactive gas with a half-life of only 3.8 days. Radon decays to polonium and, through a series of steps, to bismuth, and ultimately to lead.

Non-ionizing radiation is a type of low-energy radiation that does not have enough energy to remove an electron from an atom or molecule; that is, non-ionizing radiation bounces off or passes through matter without displacing electrons. Examples include visible, infrared, and ultraviolet light; microwaves; radio waves; and radiofrequency energy from cell phones. Most types of non-ionizing radiation have not been found to cause cancer. In this EIS, the term radiation is used to describe ionizing radiation.

B.1.1.2 How Is Radiation Measured?

Scientists and engineers use a variety of units to quantify the measurement of radiation. These different units can be used to determine the amount, and intensity of radiation. Radiation is usually measured in curies, rads, or rems. The curie describes the rate at which radioactive material emits radiation, or how many atoms in the material decay (or disintegrate) in a given time period. One curie is equal to 37 billion (3.7×10^{10}) disintegrations (decays) per second.

Absorbed radiation dose is the amount of energy deposited in a unit mass of material, such as a gram of tissue. Radiation dose is expressed in units of rad. One rad is 0.01 joule of energy deposited per kilogram of absorbing material. A joule is a very small amount of energy. For example, a 100-watt light bulb on for 0.01 seconds would use one joule of energy.

A rem is a unit of equivalent dose, which is the absorbed dose modified by a weighting factor to account for the relative biological effectiveness of different types of radiation. The rem is used to measure the effects of radiation on the body. As such, one rem of one type of radiation is presumed to have the same biological effects as one rem of any other type of radiation. This standard allows comparison of the biological effects of different types of radiation. Note that the term millirem (mrem) is also often used. A millirem is one one-thousandth (0.001) of a rem.

B.1.1.3 How Does Radiation Affect the Human Body?

Ionizing radiation affects the body through two basic mechanisms. The ionization of atoms can generate chemical changes in body fluids and cellular material. Also, in some cases, the amount of energy transferred can be sufficient to actually knock an atom out of its chemical bonds, again resulting in chemical changes. These chemical changes can lead to alteration or disruption of the normal function of the affected area. At low levels of exposure, such as the levels experienced in an occupational or environmental setting, these chemical changes are very small and ineffective.

The body has a wide variety of mechanisms that repair the damage induced. However, occasionally, these changes can cause irreparable damage that could ultimately lead to initiation of a cancer, or a change to genetic material that could be passed to the next generation. The probability for the occurrence of health effects of this nature depends upon the type and amount of radiation received, and the sensitivity of the part of the body receiving the dose.

At much higher levels of acute wholebody exposure, at least 10 to 20 times higher than the legal limits for occupational exposures (the 10 CFR 835.202 annual limit for occupational exposures is five rem), damage is much more immediate, direct, and observable. Health effects range from reversible changes in the blood to vomiting, loss of hair, temporary or permanent sterility, and other changes leading ultimately to death at acute exposures (above about 100 times the regulatory limits). In these cases, the severity of the health effect is dependent upon the amount and type of radiation received (Bolus 2017; Alexander et al. 2007; Curling et al. 2013; EPA 2017; NRC 2012). Exposures to radiation at these levels are quite rare.

For low levels of radiation exposure, the probabilities for induction of various cancers or genetic effects have been extensively studied by both national and international expert groups. The problem is that the potential for health effects at low levels is extremely difficult to determine without extremely large, well-characterized populations. For example, to get a statistically valid estimate of the number of cancers caused by an external dose equivalent of 1 rem, 10 million people would be required for the test group, with another 10 million for the control group. The risk factors for radiation-induced cancer at low levels of exposure are very small, and it is extremely important to account for the many nonradiation-related mechanisms for cancer induction, such as smoking, diet, lifestyle, chemical exposure, and genetic predisposition. These multiple factors also make it difficult to establish cause-and-effect relationships that could attribute high or low cancer rates to specific initiators.

The most significant ill-health effects that result from environmental and occupational radiation exposure are cancer fatalities. These ill-health effects are referred to as “latent” cancer fatalities (LCFs) because the cancer may take many years to develop and for death to occur. Section B.1.4 describes the relationship between radiation exposure and LCFs. Furthermore, when death does occur, these ill-health effects may not actually have been the cause of death.

Health impacts from radiation exposure, whether from sources external or internal to the body, generally are identified as somatic (affecting the individual exposed) or genetic (affecting descendants of the exposed individual). Radiation is more likely to produce somatic effects rather than genetic effects. The somatic risks of most importance are the induction of cancers.

For a uniform irradiation of the body, the incidence of cancer varies among organs and tissues. The thyroid and skin demonstrate a greater sensitivity than other organs; however, such cancers also produce relatively low mortality rates because they are relatively amenable to medical treatment.

Children have an elevated sensitivity to radiation exposure. Young children are more sensitive to radiation exposure than are adults in two ways. First, children receive a larger dose from a given external exposure than an adult. As an example, for plutonium-239, for a given exposure to a radionuclide, a child receives an up to 229-percent larger dose than an adult, depending on the age of the child and the exposure pathway (EPA 2002, 2019). The second way in which young children are more sensitive to radiation than adults is the dose-to-risk relationship, that is, for a given dose, a young child has a larger risk of developing fatal cancer.

Table B-1 presents the cancer mortality dose-to-risk coefficients for different ages at exposure for males and females from uniform wholebody exposure. Table B-1 shows that the dose-to-risk factor can range from 0.00017 cancer fatalities per rem for an 80-year-old male to 0.0021 cancer fatalities per rem for a newborn female. This range in cancer fatalities encompasses the 0.0006 cancer fatalities per rem used in this EIS and discussed in more detail in Section B.1.4, which takes into consideration all age ranges. Additionally, according to the American Cancer Society (ACS 2019), a female has a 38-percent chance of developing fatal cancer. If a 30-year-old woman were to receive a radiation dose of 1 rem, she would (according to Table B-1) increase that risk by 0.06 percent to 38.06 percent.

Table B-1—Additional Cancer Mortality Total Dose-to-Risk Coefficients

Sex	**Age at Exposure**										
	0	**5**	**10**	**15**	**20**	**30**	**40**	**50**	**60**	**70**	**80**
	Cancer Mortality Risk (per person-rem)										
Male	1.2×10^{-3}	9.1×10^{-4}	7.6×10^{-4}	6.4×10^{-4}	5.4×10^{-4}	4.0×10^{-4}	3.9×10^{-4}	3.8×10^{-4}	3.4×10^{-4}	2.7×10^{-4}	1.7×10^{-4}
Female	2.1×10^{-3}	1.6×10^{-3}	1.3×10^{-3}	1.1×10^{-3}	8.8×10^{-4}	6.0×10^{-4}	5.5×10^{-4}	5.0×10^{-4}	4.3×10^{-4}	3.3×10^{-4}	2.0×10^{-4}

Source: EPA 2011, Table 3-13a and 3-13b

International Commission on Radiological Protection (ICRP) Publication 90 (ICRP 2003) provides a detailed assessment of radiation exposures to the embryo and fetus using experimental animal data. The embryo and fetus are highly radiosensitive during the entire period of prenatal development. Based on this report, the risk of lethality is greatest in the first few weeks of pregnancy. The risk of certain specific malformations, which is at the greatest risk during the first trimester of pregnancy, has an estimated dose threshold of around 10 rem. The risk of reducing the intelligence quotient from irradiation can be described as a reduction coefficient of around 0.3 intelligence quotient point per rem, which probably has a threshold, with the greatest sensitivity occurring during weeks 8 to 15 of the pregnancy. Regarding the inducement of cancer, the ICRP assumed that the nominal coefficient for risk of a fatal cancer is, at most, a few times that for the population as a whole (i.e., a few times the coefficient of 0.0006 fatal cancer per rem). The conclusions in Publication 90 support the conclusions made in the previously published ICRP Publication 60 (ICRP 1991), which provides a basis for recommendations on protection standards and guidance for occupational exposures of pregnant women. Cancer inducement is at least as likely following exposure in the first trimester as in later trimesters. National Council on Radiation Protection and Measurements Report Number 126 (NCRP 2015) generally supports the conclusions in ICRP Publication 90.

B.1.1.4 What Are Some Types of Radiation Dose Measurements?

The amount of ionizing radiation that the individual receives during the exposure is referred to as dose. An external dose is delivered only during the actual time of exposure to the external radiation source. An internal dose, however, continues to be delivered as long as the radioactive material is in the body, although both radioactive decay and elimination of the radionuclide by ordinary metabolic processes decrease the dose rate with the passage of time. The measurement of radiation dose is called radiation dosimetry and is completed by a variety of methods depending upon the characteristics of the incident radiation. External radiation is measured as a value called deep dose equivalent. Internal radiation is measured in terms of the committed effective dose equivalent (CEDE). The sum of the two contributions (deep dose equivalent and CEDE) provides the total dose to the individual, called the total effective dose equivalent (TEDE). Often, the radiation dose to a selected group or population is of interest and is referred to as the collective dose equivalent, with the measurement units of person-rem.

B.1.1.5 What Are Some Sources of Radiation?

Several different sources of radiation have been identified. Most sources are naturally occurring, or background sources, which can be categorized as cosmic, terrestrial, or internal radiation sources. Manmade radiation sources include consumer products, medical sources, and other miscellaneous sources. The average American receives a total of about 620 millirem per year from all sources of radiation (NCRP 2009). The following discussion presents a breakdown of this average exposure.

Cosmic radiation is ionizing radiation resulting from energetically charged particles from space that continuously hit the earth's atmosphere. These particles and the secondary particles and photons they create are referred to as cosmic radiation. Because the atmosphere provides some shielding against cosmic radiation, the intensity of this radiation increases with altitude above sea level. For example, a person in Denver, Colorado, is exposed to more cosmic radiation than a person in New Orleans, Louisiana. The average annual dose from cosmic radiation to a person in the United States is about 33 millirem (NCRP 2009).

Terrestrial radiation is emitted from the radioactive materials in the earth's rocks, soils, and minerals. Radon, radon progeny, potassium, isotopes of thorium, and isotopes of uranium are the elements responsible for most terrestrial radiation. The average annual dose from terrestrial radiation is about 21 millirem (NCRP 2009), but the dose varies geographically across the country. Typically, doses on the Atlantic and Gulf coastal plains are lowest, while doses in the mountains of the western United States are highest.

Internal radiation arises from the human body metabolizing natural radioactive material that has entered the body by inhalation, ingestion, or through an open wound. Natural radionuclides in the body include isotopes of uranium, thorium, radium, radon, bismuth, polonium, potassium, rubidium, and carbon. The major contributors to the annual dose equivalent for internal radioactivity are the short-lived decay products of radon, which contribute about 228 millirem per year (NCRP 2009). The average American dose from other internal radionuclides is about 29 millirem per year (NCRP 2009), most of which results from potassium-40 and polonium-210. Internal exposure can also come from manmade radiation. (Ingestion is primarily associated with natural radioactive materials [e.g., potassium-40]. Inhalation is associated with both natural and manmade radioactive materials with the dose delivered to the bronchi of the lungs—without the body metabolizing the material. Open wounds are primarily a concern for internal radiation exposure resulting from occupational settings.)

Medical source radiation is an important diagnostic tool and is the main source of exposure to the public from manmade radiation. Exposure is deliberate and directly beneficial to the patient exposed. In general, medical exposures from diagnostic or therapeutic x-rays result from beams directed to specific areas of the body. Thus, all body organs generally are not irradiated uniformly. Nuclear medicine examinations and treatments involve the internal administration of radioactive compounds or radiopharmaceuticals by injection, inhalation, consumption, or insertion. Even then, radionuclides are not distributed uniformly throughout the body. Radiation and radioactive materials also are used in the preparation of medical instruments, including the sterilization of heat-sensitive products such as plastic heart valves. Computed tomography, interventional fluoroscopy, and conventional radiography and fluoroscopy result in average annual exposures of 147, 43, and 33 millirem, respectively (NCRP 2009). Nuclear medical procedures result in an average annual exposure of 77 millirem (NCRP 2009). It is recognized that the averaging of medical doses over the entire population does not account for the potentially significant variations in annual dose among individuals, where greater doses are received by older or less healthy members of the population.

A few additional sources of radiation contribute minor doses to individuals in the United States. For example, consumer products and activities, such as cigarette smoking, building materials, commercial air travel, and mining and agriculture, contribute an average annual exposure of 13 millirem (NCRP 2009). Additionally, industrial, security, medical, educational, and research activities, such as exposure from nuclear-medicine patients, nuclear-power generation, DOE installations, decommissioning and radioactive waste, and security inspection systems, contribute an average annual exposure of 0.3 millirem (NCRP 2009).

B.1.2 Radioactive Materials in This EIS

The release of radiological contaminants into the environment at National Nuclear Security Administration (NNSA) sites occurs as a result of nuclear weapons production, research and development, maintenance, and waste management activities. This section describes the primary types of radioactive sources at NNSA sites, how DOE regulates radiation and radioactive materials, and the data sources and methodologies used to evaluate the potential health effects of radiation exposure to the worker and public.

B.1.2.1 What Are Some Sources That May Lead to Radiation Exposure?

Historically, NNSA has conducted many operations that involve the use of uranium, plutonium, tritium, and other radionuclides. These have included nuclear material production; recovery and recycle operations; purification processes; and metal forming, machining, and material handling operations. The releases from these operations consisted primarily of particulates, liquids, fumes, and vapors.

Airborne emissions contribute to the potential for radiation dose at, and around, NNSA sites with operations involving radioactive materials. National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations specify that any source that potentially can contribute greater than 0.1 mrem per year TEDE to an offsite individual is to be considered a "major source" and emissions from that source must be continuously sampled. As such, there are a number of process exhaust stacks at NNSA sites that are considered major sources.

In addition to major sources, there are a number of minor sources that have the potential to emit radionuclides to the atmosphere. Minor sources are composed of any ventilation systems or components such as vents, laboratory hoods, room exhausts, and stacks that do not meet the criteria for a major source but are located in or vent from a radiological control area. Emissions from NNSA facility ventilation systems are estimated from radiation control data collected on airborne radioactivity concentrations in the work areas. Other emissions from unmonitored processes and laboratory exhausts are categorized as minor emission sources. Additionally, as explained in Section B.3, accidents can release radionuclides that can result in radiation exposure.

In addition, there are also areas of potential fugitive and diffuse sources at NNSA sites, such as contaminated soils and structures. Diffuse and fugitive sources include any source that is spatially distributed, diffuse in nature, or not emitted with forced air from a stack, vent, or other confined conduit. Radionuclides are transported entirely by diffusion or thermally driven air currents. Typical examples include emissions from building breathing; resuspension of contaminated soils, debris, or other materials; unventilated tanks; ponds, lakes, and streams; wastewater treatment systems; outdoor storage and processing areas; and leaks in piping, valves, or other process equipment.

Liquid discharges are another source of radiation release and exposure. Three types of liquid discharge sources at NNSA sites include treatment facilities, other point- and area-source discharges, and in-stream locations. If required, a radiological monitoring plan is in place at NNSA sites required to address compliance with DOE orders.

B.1.2.2 How Is Radiation Exposure Regulated?

The U.S. Department of Energy (DOE) regulates the release of radioactive materials and the potential level of radiation doses to workers and the public for its facilities. Provisions of the *Atomic Energy Act* (as amended by the *Price-Anderson Amendments Act of 1988*) authorize DOE to establish Federal rules controlling radiological activities at the DOE sites. The Act also authorizes DOE to impose civil and criminal penalties for violations of these requirements. Some NNSA activities are also regulated through DOE directives. Occupational radiation protection is regulated by 10 CFR Part 835, “Occupational Radiation Protection.” DOE has set occupational dose limits for an individual worker at 5,000 millirem per year. NNSA sites have set administrative exposure guidelines at a fraction of this exposure limit to help enforce the goal to manage and control worker exposure to radiation and radioactive material as low as reasonably achievable (ALARA).

Environmental radiation protection is currently regulated contractually with DOE Order 458.1. This order is applicable to all DOE/NNSA contractor entities managing radioactive materials. This order sets annual dose standards to members of the public, as a consequence of routine DOE operations, of 100 millirem through all exposure pathways. DOE Order 458.1 refers to the exposure limits of 40 CFR Part 61. 40 CFR Part 61, Subpart H, “National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities,” is applicable to the proposed SRPPF and has a dose limit of 10 millirem per year to an individual member of the public due to all airborne releases of radionuclides. DOE Order 458.1 also refers to 40 CFR Part 141, which limits exposures for the drinking water pathway to 4 millirem per an individual member of the public.

The U.S. Environmental Protection Agency (EPA) uses the National Council on Radiation Protection and Measurements and the ICRP recommendations and sets specific annual exposure limits in radiation protection guidance to federal agency documents. Each regulatory organization then establishes its own set of radiation standards. The various exposure limits set by DOE and the EPA for radiation workers and members of the public are given in Table B-2.

Table B-2—Exposure Limits for Members of the Public and Radiation Workers

Guidance Criteria (organization)	Public Exposure Limit at the Site Boundary	Worker Exposure Limit
10 CFR Part 835 (DOE)	N/A	5,000 millirem per year[a]
10 CFR 835.1002 (DOE)	N/A	1,000 millirem per year[b]
	N/A	2,000 millirem per year[c]
DOE Order 458.1 (DOE)[d]	100 millirem per year (all pathways)	N/A
40 CFR Part 61, Subpart H (EPA)[e]	10 millirem per year (all air pathways)	N/A
40 CFR Part 141 (EPA)	4 millirem per year (drinking water pathways)	N/A

N/A = not applicable.

a. Although this is a limit (or level) that is enforced by DOE, worker doses must be managed in accordance with ALARA principles. Refer to footnote b.

b. This is a facility design objective for continuously occupied areas; 0.5 mrem/hr × 2,000 hr/yr.

c. This is an administrative exposure guideline.

d. DOE Order 458.1 invokes the requirements of 40 CFR Part 61, Subpart H, and 40 CFR Part 141 for the air pathways and drinking water pathway, respectively.

e. DOE Order 458.1 also refers to 40 CFR Part 61, Subparts Q and T, but these subparts are not applicable to the proposed SRPPF.

B.1.2.3 Data Sources Used to Evaluate Public Health Consequences from Routine Operations

Because NNSA operations have the potential to release measurable quantities of radionuclides to the environment that result in exposure to the worker and the public, NNSA conducts environmental surveillance and monitoring activities at its sites. These activities provide data that are used to evaluate radiation exposures that contribute doses to the public. Each year, environmental data from the NNSA sites are collected and analyzed. The results of these environmental monitoring activities are summarized in annual site environmental reports for each site. The environmental monitoring conducted at most NNSA sites consists of two major activities: effluent monitoring and environmental surveillance.

Effluent monitoring involves the collection and analysis of samples or measurements of liquid (waterborne) and gaseous (airborne) effluents prior to release into the environment. These analytical data provide the basis for the evaluation and official reporting of contaminants, assessment of radiation and chemical exposures to the public, and demonstration of compliance with applicable standards and permit requirements.

Environmental surveillance data provide a direct measurement of contaminants in air, water, groundwater, soil, food, biota, and other media subsequent to effluent release into the environment. These data verify the NNSA site's compliance status and, combined with data from effluent monitoring, allow the determination of chemical and radiation dose and exposure assessment of NNSA operations and effects, if any, on the local environment. The effluent and environmental surveillance data presented in the annual site environment reports were used as the primary source of data for the EIS analysis of radiation exposure to the public for the No-Action Alternative.

B.1.3 Methodology for Estimating Radiological Impacts

The public health consequences of radionuclides released to the atmosphere from normal operations at NNSA sites are characterized and calculated in the applicable annual site environmental report. Radiation doses are calculated for the maximally exposed individual (MEI) (a hypothetical member of the public located at the closest site boundary) and the entire population residing within 50 miles of the center of the site. For this EIS, NNSA uses the EPA's CAP-88 package of computer codes[2] to make dose calculations from normal operations. This package implements a steady-state Gaussian plume atmospheric dispersion model to calculate concentrations of radionuclides in the air and on the ground and uses Regulatory Guide 1.109 (NRC 1977) food-chain models to calculate radionuclide concentrations in foodstuffs (vegetables, meat, and milk) and subsequent intakes by humans.

Meteorological data used in the calculations are in the form of joint frequency distributions of wind direction, wind speed class, and atmospheric stability category. For occupants of residences, the dose calculations assume that the occupant remains at home (actually, unprotected outside the house) during the entire year and obtains food according to the rural pattern defined in the NESHAP background documents (EPA 1989). This pattern specifies that 70 percent of the vegetables and produce, 44.2 percent of the meat, and 39.9 percent of the milk consumed are produced in the local area (e.g., a home garden). The remaining portion of each food is assumed to be produced within 50 miles of the site. The same assumptions are used for occupants of businesses, but the resulting doses are divided by two to compensate for the fact that businesses are occupied for less than one-half a year and that less than one-half of a worker's food intake occurs at work. For collective effective dose equivalent estimates, production of beef, milk, and crops within 50 miles of the site are calculated using production rates provided with CAP-88.

B.1.4 Risk Characterization and Interpretation of Radiological Data

To provide the background for discussions of impacts, this section explains the basic concepts used in the evaluation of radiation effects. Radiation can cause a variety of damaging health effects in humans. The most significant effects are LCFs. This EIS uses LCFs to measure the estimated risk due to radiation exposure.

Cancer is a group of diseases characterized by the uncontrolled growth and spread of abnormal cells. Cancer is caused by both external factors (tobacco, infectious organisms, chemicals, and radiation) and internal factors (inherited mutations, hormones, immune conditions, and mutations that occur from metabolism). For the U.S. population of about 330 million, the American Cancer Society estimated that, in 2019, about 1,762,450 new cancer cases would be diagnosed and about 606,880 cancer deaths would occur. Approximately 19 percent of U.S. cancer deaths are estimated to be caused by smoking and about 18 percent are related to excess weight or obesity, physical inactivity, excess alcohol consumption, and poor nutrition. The average U.S. resident has about 4 chances in 10 of developing an invasive cancer over his or her lifetime (39 percent probability for males, 38 percent for females) (ACS 2019). Nearly 21 percent of all deaths in the United States are due to cancer (Kochanek et al. 2019).

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[2] The Clean Air Act Assessment Package – 1988 (CAP-88) was developed under EPA sponsorship to demonstrate compliance with 40 CFR Part 61, Subpart H, which governs the emissions of radionuclides other than radon from DOE facilities.

The National Research Council's Biological Effects of Ionizing Radiation (BEIR) Committee has prepared a series of reports to advise the Federal Government on the health consequences of radiation exposure. Based on its 1990 report, *Health Effects of Exposure to Low Levels of Ionizing Radiation, BEIR V* (National Research Council 1990), the former Committee on Interagency Radiation Research and Policy Coordination recommended cancer risk factors of 0.0005 per rem for the public and 0.0004 per rem for working-age populations (CIRRPC 1992). In 2002, the Interagency Steering Committee on Radiation Standards (ISCORS) recommended that Federal agencies use conversion factors of 0.0006 fatal cancer per rem for mortality and 0.0008 cancer per rem for morbidity when making qualitative or semi-quantitative estimates of risk from radiation exposure to members of the general public (DOE 2003). No separate values were recommended for workers. The DOE Office of Environmental and Policy Guidance subsequently recommended that DOE personnel and contractors use the risk factors recommended by ISCORS, stating that, for most purposes, the value for the general population (0.0006 fatal cancer per rem) could be used for both workers and members of the public in *National Environmental Policy Act* (NEPA) analyses (DOE 2003).

Publications by both the BEIR Committee and the ICRP support the continued use of the ISCORS-recommended risk values. *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2* (National Research Council 2006) reported fatal cancer risk factors of 0.00048 per rem for males and 0.00066 per rem for females in a population with an age distribution similar to that of the entire U.S. population (average value of 0.00057 per rem for a population with equal numbers of males and females). ICRP Publication 103 (Valentin 2007) recommends nominal cancer risk coefficients of 0.00041 and 0.00055 per rem for adults and the general population, respectively, and estimates the risk from heritable effects to be about 3 to 4 percent of the nominal fatal cancer risk.

Accordingly, this EIS used a risk factor of 0.0006 LCF per rem to estimate risk due to radiation doses from normal operations and accidents. For high, acute individual doses (greater than or equal to 20 rem), the health risk factor was multiplied by two (NCRP 1993). The presentation of risks from radiation exposure associated with SRPPF activities are the increased risks of developing a cancer; that is, they are in addition to the risk of cancer from all other causes.

Using the risk factors discussed above, a calculated dose can be used to estimate the risk of an LCF. For example, if each member of a population of 100,000 people were exposed to a one-time dose of 100 millirem (0.1 rem), the collective dose would be 10,000 person-rem (100,000 persons times 0.1 rem). Using the risk factor of 0.0006 LCF per person-rem, this collective dose is expected to cause six additional LCFs in this population (10,000 person-rem times 0.0006 LCF per person-rem).

Calculations of the number of LCFs sometimes do not yield whole numbers and typically yield a number less than one. For example, if each individual of a population of 100,000 people were to receive an annual dose of 1 millirem (0.001 rem), the collective dose would be 100 person-rem, and the corresponding risk of an LCF would be 0.06 (100,000 persons times 0.001 rem times 0.0006 LCF per person-rem). A fractional result should be interpreted as a statistical estimate. That is, 0.06 is the average number of LCFs expected if many groups of 100,000 people were to experience the same radiation exposure situation. For most groups, no LCFs would occur; in a few groups, one LCF would occur; in a very small number of groups, two or more LCFs would occur. The average number of LCFs over all of the groups would be 0.06 (just like the average of 0, 0, 0, and 1 is 1 divided by 4, or 0.25). In the preceding example, the most likely outcome for any single group would be 0 LCFs.

The numerical estimates of LCFs presented in this EIS were obtained using a linear extrapolation from the nominal risk estimated for lifetime total cancer mortality resulting from a dose of 0.1 grays (10 rad). Other methods of extrapolation to the low-dose region could yield higher or lower numerical estimates of LCFs. Studies of human populations exposed to low doses are inadequate to demonstrate the actual level of risk. There is scientific uncertainty about cancer risk in the low-dose region below the range of epidemiologic observation. However, a comprehensive review of available biological and biophysical data supports a "linear no-threshold" risk model in which the risk of cancer proceeds in a linear fashion at lower doses without a threshold, and the smallest dose has the potential to cause a small increase in risk to humans (National Research Council 2006).

As stated in Section B.1.3, acute exposures to high levels of radiation (above about 100 times the regulatory limits) can lead to illness and even death within days or weeks of the exposure. It is generally believed that while exposure below 350 rem could result in illness, there is little chance of exposures at this level resulting in death. However, death within two to six days of exposure would occur to between 10 and 100 percent of the individuals exposed to levels between 350 and 750 rem. If the exposure level is increased to between 750 and 1,000 rem, then the death of 90 to 100 percent of the exposed individuals would occur within one to three weeks. Finally, if the exposure level is greater than 1,000 rem, then death to 100 percent of the exposed individuals would occur within 2 to 12 days. This information was obtained from Alexander et al. (2007, Table 3); other references (e.g., Curling et al. 2013; Bolus 2017; EPA 2017; NRC 2012) have slightly different exposure levels with slightly different death probabilities. However, all references are consistent, in that radiation exposures greater than 1,000 rem would result in the death of the individual within days or weeks. For this EIS, it was assumed that calculated post-accident exposures greater than 1,000 rem would result in the prompt fatality of the exposed individual (i.e., death within days or weeks of exposure).

B.1.5 Risk Estimates and Health Effects for Potential Radiation Exposures to Workers

For the purpose of evaluating radiation exposure on an ongoing basis, NNSA workers may be designated as radiation workers, nonradiation workers, or visitors, based upon the potential level of exposure they are expected to encounter in performing their work assignments. For purposes of estimating radiation doses to workers resulting from potential accidents, NNSA looks at involved workers (those workers actually working with radioactive materials) and noninvolved workers (those workers performing other tasks near the involved workers).

Radiation workers have job assignments that place them in proximity to radiation-producing equipment and/or radioactive materials. These workers are trained for unescorted access to radiological areas and may also be trained radiation workers from another DOE site. These workers are assigned to areas that could potentially contribute to an annual TEDE of more than 100 millirem per year. All trained radiation workers wear dosimeters.

Nonradiation workers are those not currently trained as radiation workers but whose job assignment may require their occasional presence within a radiologically controlled area with an escort. They may be exposed to transient radiation fields as they pass by or through a particular area, but their job assignments are such that annual dose equivalents in excess of 100 millirem are unlikely. Based upon the locations where such personnel work on a daily basis, they may be issued a personal nuclear accident dosimeter.

Visitors are individuals who are not trained radiation workers and are not expected to receive 100 millirem in a year. Their presence in radiological areas is limited, in terms of time and access. These individuals generally enter specified radiological areas on a limited basis for walk-through or tours with a trained escort. As appropriate, visitors participate in dosimetry monitoring when requested by the hosting division.

NNSA's Radiation Protection Program

A primary goal of the NNSA Radiation Protection Program is to keep worker exposures to radiation and radioactive material ALARA. Such a program must evaluate both external and internal exposures with the goal to minimize worker radiation dose. The worker radiation dose presented in this EIS is the total TEDE incurred by workers as a result of normal operations. This dose is the sum of the external wholebody dose, including dose from both photons and neutrons, and internal dose, as required by 10 CFR Part 835. The internal dose is the 50-year CEDE. These values are determined through the NNSA External and Internal Dosimetry programs.

The External Dosimetry Program at NNSA sites provides personnel monitoring information necessary to determine the dose equivalent received following external exposure of a person to ionizing radiation. The program is based on the concepts of effective dose equivalent, as described in publications of the ICRP and the International Commission on Radiation Quantities and Units.

The Internal Dose Monitoring Program at NNSA sites estimates the quantity and distribution of radionuclides to which a worker may have been exposed. The Internal Dose Monitoring Program consists of urinalysis, fecal analysis, lung counting, continuous air monitoring, and retrospective air sampling. Dose assessments are generally based on bioassay data. Bioassay monitoring methods and participation frequencies are required to be established for individuals who are likely to receive intakes that could result in a CEDE that is greater than 100 millirem.

B.2 HAZARDOUS CHEMICAL IMPACTS TO HUMAN HEALTH

B.2.1 Chemicals and Human Health

Chemicals are used in everyday tasks—as pesticides in gardens, cleaning products in homes, insulating materials in buildings, and as ingredients in medications. Potentially hazardous chemicals can be found in all of these products, but usually the quantities are not large enough to cause adverse health effects. In contrast to home use, chemicals used in industrial settings are often found in concentrations that may affect the health of individuals in the workplace and in the surrounding community.

For the Proposed Action in this EIS, the chemicals with the highest hazards were determined to be nitric acid and hydrochloric acid, and chlorine. This determination was based on considerations of vapor pressure, acceptable concentration, and quantity available for release. The following sections describe both the carcinogenic and noncarcinogenic effects of chemicals on the body and how these effects are assessed.

How Do Chemicals Affect the Body?

Industrial pollutants may be released either intentionally or accidentally to the environment in quantities that could result in health effects to those who come in contact with them. Chemicals that are airborne or released from stacks and vents, can migrate in the prevailing wind direction for many miles. The public may then be exposed by inhaling chemical vapors or particles of dust contaminated by the pollutants. Additionally, the pollutants may be deposited on the surface soil and biota (plants and animals) and subsequent human exposure could occur. Chemicals may also be released from industries as liquid or solid waste (effluent) and can migrate or be transported from the point of release to a location where exposure could occur.

Exposure is defined as the contact of a person with a chemical or physical agent. For exposure to occur, a chemical source or contaminated media, such as soil, water, or air, must exist. This source may serve as a point of exposure, or contaminants may be transported away from the source to a point where exposure could occur. In addition, an individual (receptor) must come into either direct or indirect contact with the contaminant. Contact with a chemical can occur through ingestion, inhalation, dermal contact, or external exposure. The exposure may occur over a short (acute or subchronic) or long (chronic) period of time. These methods of contact are typically referred to as exposure routes. The process of assessing all of the methods by which an individual might be exposed to a chemical is referred to as an exposure assessment.

Once an individual is exposed to a hazardous chemical, the body’s metabolic processes typically alter the chemical structure of the compound in its efforts to expel the chemical from the system. For example, when compounds are inhaled into the lungs they may be absorbed depending on their size (for particulates) or solubility (for gases and vapors) through the lining of the lungs directly into the blood stream. After absorption, chemicals are distributed in the body and may be metabolized, usually by the liver, into metabolites that may be more toxic than the parent compound. The compound may reach its target tissue, organ, or portion of the body where it will exert an effect before it is excreted via the kidneys, liver, or lungs. The relative toxicity of a compound is affected by the physical and chemical characteristics of the contaminant, the physical and chemical processes ongoing in the human body, and the overall health of an individual. For example, infants, the elderly, and pregnant women are considered more susceptible to certain chemicals.

B.2.2 How Does DOE Regulate Chemical Exposures?

B.2.2.1 Environmental Protection Standards

It is the SRS environmental policy that all activities be carried out “in compliance with all applicable Federal, State, and local laws; statutes; regulations; Federal executive orders, directives, and guides; and national consensus standards” (DOE 2014). As such, complying with environmental regulations and DOE orders is integral to SRS operations (SRNS 2018). Key Federal environmental laws applicable to the SRS include the following:

- *Resource Conservation and Recovery Act*
- *Comprehensive Environmental Response, Compensation, and Liability Act*, as amended by the *Superfund Amendments and Reauthorization Act* (SARA)
- *Federal Facility Compliance Act*
- *Safe Drinking Water Act*
- *Clean Water Act* (which resulted in the establishment of the National Pollutant Discharge Elimination System and pretreatment regulations for publicly owned treatment works)
- *Clean Air Act* (Title III, "Hazardous Air pollutants Rad-NESHAP, Asbestos NESHAP")
- *Toxic Substances Control Act*
- *Federal Insecticide, Fungicide, and Rodenticide Act*

Many of these acts include environmental standards that must be met to ensure the protection of the public and the environment. Most of the Acts require completed permit applications in order to treat, store, dispose of, or release contaminants to the environment. The applicable environmental standards and reporting requirements are set forth in the issued permits and must be met to ensure compliance.

The *Emergency Planning and Community Right-To-Know Act*, also referred to as SARA Title III, requires reporting of emergency planning information, hazardous chemical inventories, and environmental releases to Federal, State, and local authorities. The annual Toxic Release Inventory Report provides information regarding any releases of toxic chemicals into the environment, waste management activities, and pollution prevention activities associated with those chemicals.

B.2.2.2 Regulated Occupational Exposure Limits

The Occupational Safety and Health Administration (OSHA) establishes limits for hazardous chemicals. The permissible exposure limits (PELs) represent the legal concentration levels set by OSHA that are safe for eight-hour exposures without causing noncancer health effects. Other agencies, including the National Institute for Occupational Safety and Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH), provide guidelines. The NIOSH guidelines are recommended exposure limits, and the ACGIH guides are threshold limit values. Occupational limits are further defined as time-weighted averages (TWAs), or concentrations for a conventional eight-hour work day and a 40-hour work week, to which it is believed nearly all workers may be exposed, day after day, without adverse effects. Often, ceiling limits, or airborne concentrations that should not be exceeded during any part of the work day, are also specified. In addition to the TWA and ceiling limit, short-term exposure limits may be set. Short-term exposure limits are 15-minute TWA exposures that should not be exceeded at any time during a work day, even if the eight-hour TWA is within limits. OSHA also uses action levels to trigger certain provisions of a standard (e.g., appropriate workplace precautions, training, and medical surveillance) for workers whose exposures could approach the PEL.

B.2.2.3 Department of Energy Regulation of Worker Safety

DOE Order 440.1B, "Worker Protection Management for DOE Federal and Contractor Employees," regulates the health and safety of workers at all DOE sites. This comprehensive standard directs the contractor facilities to establish the framework for an effective worker protection program that will reduce or prevent injuries, illnesses, and accidental losses by providing DOE Federal and contractor workers with a safe and healthful workplace. Baseline exposure assessments are outlined in this requirement, along with day-by-day health and safety responsibilities.

Industrial hygiene limits for occupational chemical exposures at Federal sites are regulated by 29 CFR Part 1910 and 29 CFR Part 1926, including the PELs set by OSHA. DOE requires that all sites comply with the PELs unless a lower limit (more protective) exists in the ACGIH threshold limit values.

B.3 ACCIDENTS

B.3.1 Introduction

An accident is a sequence of one or more unplanned events with potential unmitigated outcomes that endanger the health and safety of workers and/or the public. An accident can involve a combined release of energy and hazardous materials (radiological or chemical) that might cause prompt or latent health effects. The sequence usually begins with an initiating event, such as a human error, equipment failure, or earthquake, followed by a succession of other events that could be dependent or independent of the initial event, which dictates the accident's progression and the extent of materials released. Initiating events fall into three categories:

- **Internal initiators** normally originate in and around the plant or facility (for this EIS, the proposed SRPPF) and are always the result of facility operations. Examples include equipment or structural failures and human errors.

- **External initiators**, such as an aircraft crash, are independent of facility operations and normally originate from outside the facility. Some external initiators affect the ability of the facility to maintain its confinement of hazardous materials because of potential structural damage.

- **Natural phenomena initiators** are natural occurrences that are independent of facility operations and occurrences at nearby facilities or operations. Examples include earthquakes, high winds, floods, lightning, and wildfires. Although natural phenomena initiators are independent of external facilities, their occurrence can involve those facilities and compound the progression of the accident.

If an accident were to occur involving the release of radioactive or chemical materials, workers, members of the public, and the environment would be at risk. Workers in the facility where the accident occurs would be particularly vulnerable to the effects of the accident because of their location. The offsite public would also be at risk of exposure to the extent that meteorological conditions exist for the atmospheric dispersion of released hazardous materials. Using approved computer models, the dispersion of released hazardous materials and their effects are predicted. However, prediction of latent potential health effects becomes increasingly difficult to quantify for facility workers as the distance between the accident location and the worker decreases. This is because the individual worker exposure cannot be precisely defined with respect to the presence of shielding and other protective features. The worker also may be injured or killed by physical effects of the accident itself.

The potential for facility accidents and the magnitudes of their consequences are important factors in evaluating the alternatives addressed in this EIS. The health risk issues are twofold:

- Whether accidents at any of the individual facilities (or reasonable combinations thereof) pose unacceptable health risks to workers or the general public; and
- Whether alternative locations for facilities (or reasonable combinations thereof) can provide lesser public or worker health risks. These lesser risks may arise either from a greater isolation of the site from the public or from a reduced frequency of such external accident initiators as seismic events.

Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 CFR Parts 1500–1508) require agencies, in their EISs, to evaluate the reasonably foreseeable significant adverse environmental impacts of proposed actions. Under 40 CFR 1502.22, CEQ stated that “reasonably foreseeable” includes impacts that have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason. Accordingly, this EIS examines the range of reasonably foreseeable facility accidents. This analysis also responds to public comments received during the scoping process expressing concern with facility safety and consequent health risks, and the need to address these concerns in the decisionmaking process.

For the No-Action Alternative, the existing Mixed-Oxide Fuel Fabrication Facility would remain unused and would not contain any nuclear materials. There would be no notable accident risks or consequences from the Mixed-Oxide Fuel Fabrication Facility in such a configuration. NNSA would utilize the capabilities at LANL to meet the Nation’s long-term needs for pit manufacturing. DOE has evaluated the potential accident impacts of the pit production capacity at LANL in the 2019 SPEIS SA (NNSA 2019a) and the 2020 LANL SA (NNSA 2020).

For new, modified, or upgraded NNSA facilities, the identification of accident scenarios and associated data would normally be a product of safety analysis reports performed on completed facility designs. However, as of the writing of this EIS, the proposed SRPPF design has not been completed, and, thus, the safety analysis reports have not yet been completed. Accordingly, the accident information developed for this EIS is based upon information developed for, and presented in, the *Complex Transformation Supplemental Programmatic Environmental Impact Statement* (Complex Transformation SPEIS) (NNSA 2008) for a pit production facility located at the SRS, (i.e., similar to the proposed SRPPF) and supplemented with preliminary data from SRNS (2020).

In the Complex Transformation SPEIS, NNSA sought to identify a bounding accident in each of several classes of events (e.g., fire, explosion, spill, mechanical, criticality, natural phenomena initiators, and external initiators) applicable to pit production. The Complex Transformation SPEIS analysis also sought to identify bounding accidents over the spectrum of high to low probability of occurrence in order to include high-consequence/low-probability and low-consequence/high-probability accidents. Accident frequencies in this SRS Pit Production EIS are generally grouped into bins such as the following:

- "anticipated" (with estimated annual frequencies of greater than or equal to 1 in 100 [$\geq 1\times10^{-2}$]);
- "unlikely" (with estimated annual frequencies of greater than or equal to 1 in 100 to 1 in 10,000 [$\geq 1\times10^{-2}$ to 1×10^{-4}]);
- "extremely unlikely" (with estimated annual frequencies of greater than or equal to 1 in 10,000 to 1 in 1 million [$\geq 1\times10^{-4}$ to 1×10^{-6}]); and
- "beyond extremely unlikely" (less than 1 in 1 million [1×10^{-6}]).

The Complex Transformation SPEIS analyzed applicable pit production accidents to estimate risk (i.e., mathematical product of an accident's probability of occurrence and the accident's consequences) and health consequences (e.g., LCF) to a noninvolved worker, MEI, and the projected 2030 surrounding population within 50 miles of the proposed SRPPF. The analysis considered the potential likelihood of accident initiators (e.g., extremely unlikely seismic events). This calculation reflects the effects of such SRS-specific parameters as population size and distribution, meteorology, and distance to the site boundary.

The Complex Transformation SPEIS selected accidents (described in Section B.4 below) from a wide spectrum of potential accident scenarios. The selection process, screening criteria used, and conservative estimates of material at risk and source term ensure that the accidents chosen for evaluation in the Complex Transformation SPEIS bound the impacts of all reasonably foreseeable accidents that could occur. Thus, in the event that any other accident that was not evaluated in the Complex Transformation SPEIS were to occur, its impacts on workers and the public would be expected to be within the range of the impacts evaluated. All accidents are assumed to result in ground-level, one-hour duration releases unless indicated otherwise.

Where values for parameters for the proposed SRPPF are known to be different from the values used in the Complex Transformation SPEIS, the results from the Complex Transformation SPEIS were scaled using the ratio of the proposed SRPPF value to the Complex Transformation SPEIS value. For example, for the proposed SRPPF, the 2030 surrounding population within 50 miles of the SRPPF was calculated to be 862,957 persons, the Complex Transformation SPEIS used a population of 985,980 persons; therefore, the Complex Transformation SPEIS offsite population doses were multiplied by the ratio (862,957/985,980), 0.875, to determine the proposed SRPPF accident population doses.

Assessment of Vulnerability to Terrorist Threats

The methodology for the assessment of vulnerability to terrorist threats is discussed in Appendix A, Section A.12.3.

B.3.2 Consequence Analysis Methodology

The MELCOR Accident Consequence Code System (MACCS)[3] was used to estimate the radiological consequences of all stockpile stewardship and management facilities for all accidents in the Complex Transformation SPEIS. MACCS is a DOE/Nuclear Regulatory Commission (DOE/NRC)-sponsored computer code that has been widely used in support of probabilistic risk assessments for the nuclear power industry and in support of safety and NEPA documentation for facilities throughout the DOE Complex. A brief description of MACCS follows. A detailed description of the MACCS model is available in the three-volume report, *MELCOR Accident Consequence Code System (MACCS)* (NRC 1990).

MACCS models the offsite consequences of an accident that releases a plume of radioactive materials to the atmosphere. Should such an accidental release occur, the radioactive gases and aerosols in the plume would be transported by the prevailing wind while dispersing in the atmosphere. The environment would be contaminated by radioactive materials deposited from the plume, and the population would be exposed to radiation. The objectives of a MACCS calculation are to estimate the range and probability of the health induced by the radiation exposures not avoided by protective actions.

The MACCS code uses three distinct modules for consequence calculations: The ATMOS module performs atmospheric transport calculations, including dispersion, deposition, and decay. The EARLY module performs exposure calculations corresponding to the period immediately following the release. This module can also simulate evacuation from areas surrounding the release. EARLY exposure pathways include inhalation, cloudshine, and groundshine. The CHRONC module considers the time period following the early phase (i.e., after the plume has passed). CHRONC exposure pathways include groundshine, resuspension inhalation, and ingestion of contaminated food and water. CHRONC can simulate land use interdiction (e.g., decontamination). Other supporting input files include a meteorological data file and a site data file containing distributions of the population and agriculture surrounding the release site.

In order to understand MACCS, one must understand its two essential elements: (1) the time scale after an accident is divided into various “phases,” and (2) the region surrounding the facility is divided into a polar-coordinate grid. The time scale after the accident is divided into three phases: emergency phase, intermediate phase, and long-term phase. The emergency phase begins immediately after the accident and could last up to seven days. During this period, the exposure of the population to both radioactive clouds and contaminated ground is modeled. Various protective measures can be specified for this phase, including evacuation, sheltering, and dose-dependent relocation.

The intermediate phase can be used to represent a period during which evaluations are performed and decisions are made regarding the type of protective measure actions that need to be taken. During this phase, the radioactive clouds are assumed to be gone, and the only exposure pathways are those from the contaminated ground. The only protective measure that can be taken during this phase is temporary relocation.

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[3] MACCS is a fully integrated, engineering-level computer code developed at Sandia National Laboratories for the NRC. MACCS simulates the impact of severe accidents at nuclear power plants on the surrounding environment.

The long-term phase represents all time subsequent to the intermediate phase. The only exposure pathways considered are those resulting from the contaminated ground. A variety of protective measures can be taken during the long-term phase in order to reduce doses to acceptable levels: decontamination, interdiction, and condemnation of property.

As implemented, the MACCS model evaluates doses due to inhalation of airborne material, as well as external exposure to the passing plume. This represents the major portion of the dose that an individual would receive because of a facility accident. The longer-term effects of radioactive material deposited on the ground after a postulated accident, including the resuspension and subsequent inhalation of radioactive material and the ingestion of contaminated crops, were not modeled for this EIS because these pathways have been studied and found to contribute less significantly to the dosage than the inhalation of radioactive material in the passing plume; they are also controllable through interdiction. Instead, the deposition velocity of the radioactive material was set to zero, so that material that might otherwise be deposited on surfaces remained airborne and available for inhalation. Thus, the method used in this EIS is conservative compared with dose results that would be obtained if deposition and resuspension were taken into account.

The code handled the source terms by considering the materials at risk (MAR) as the inventory. The release fraction of each scenario was then the product of the various factors (damage ratio [DR], airborne release fraction [ARF], respirable fraction [RF], and leak path factor [LPF]) that describe the material available to actually impact a receptor. The meteorological data consisted of sequential hourly wind speed, wind direction, stability class, and precipitation for one year.

Each four-hour period of the annual meteorological site-specific dataset for SRS was randomly sampled, assuring a good representation of the entire meteorological dataset. The results from each of these samples were then ranked and combined (according to their frequency of occurrence), and the code presented the distribution of the results. This distribution includes statistics such as 95th percentile, 50th percentile, and mean dose. This EIS presents the mean dose. In preparing this EIS, NNSA evaluated whether the site-specific meteorology at SRS had changed notably since publication of the Complex Transformation SPEIS. Figure B-1 presents a 2002-2006 composite wind rose for SRS, which is a summary representation of the wind directions and frequencies during the period the Complex Transformation SPEIS was prepared. In comparing Figure B-1 with the most recent wind rose data (Figure 3-6 in Chapter 3), NNSA has concluded that wind directions and frequencies have not notably changed since publication of the Complex Transformation SPEIS and no adjustments to meteorology were required.

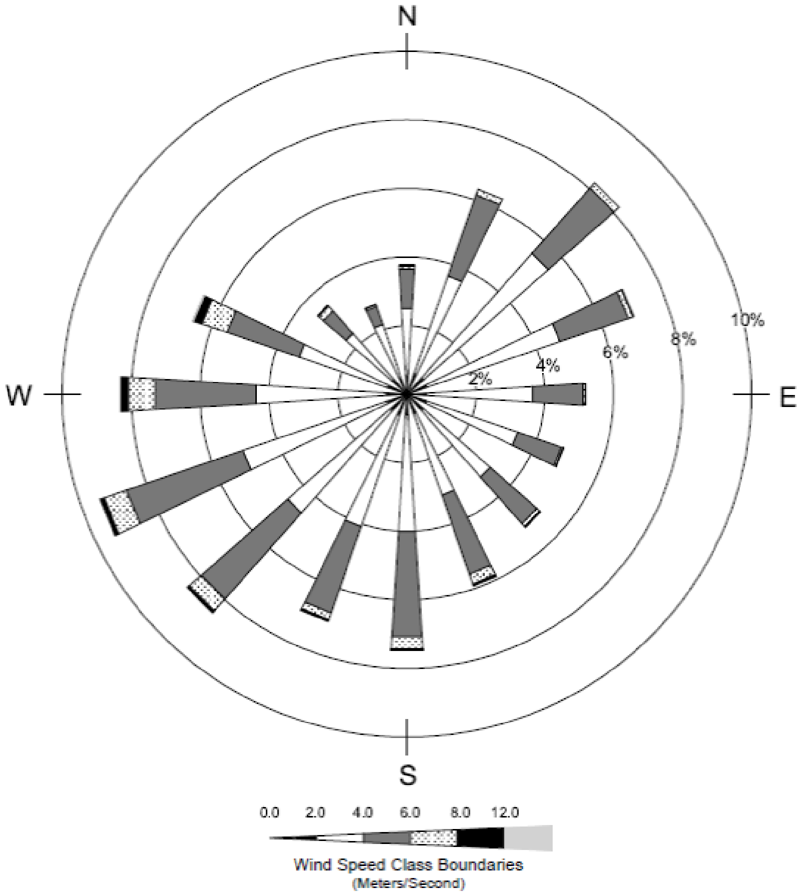

Figure B-1—SRS Composite Wind Rose (2002–2006) (Source: SRNS 2011)

Because of assumptions used in this EIS analysis, not all of the code's capabilities were used. For example, it was conservatively assumed that no special actions would be taken to avoid or mitigate exposure to the general population following an accidental release of radionuclides. Population and individual doses were statistically sampled by assuming an equally likely accident start time during any hour of the year. MEI and noninvolved worker doses were calculated using conservative assumptions, such as the wind blowing toward the MEI and locating the receptor along the plume centerline. The doses (50-year CEDE) were converted to LCFs using the factor of 0.0006 LCF per person-rem for both members of the public and workers (DOE 2002d); calculated LCFs were doubled for individual doses greater than 20 rem (NCRP 1993). The MEI and noninvolved worker are assumed to be exposed for the duration of the release; they or DOE would take protective or mitigative actions thereafter if required by the size of the release. Exposure to the general population continues after the release as a result of resuspension/inhalation and external exposure/ingestion of deposited radionuclides.

B.3.2.1 Analysis Conservatism and Uncertainty

The analysis of accidents is based on calculations relevant to hypothetical sequences of events and models of their potential impacts. The models provide estimates of the frequencies, source terms, pathways for dispersion, exposures, and the effects on human health and the environment as realistic as possible within the scope of the analysis. In many cases, the scarcity of experience with the postulated accidents leads to uncertainty in the calculation of the consequences and frequencies. This fact has promoted the use of models or input values that yield conservative estimates of consequences and frequency. Additionally, since no credit is taken for safety systems that may function during an event, these events do not represent expected conditions within the facility at any point in its lifetime.

Due to the layers of conservatism built into the accident analysis for the spectrum of postulated accidents, the estimated consequences and risks to the public represent the upper limit for the individual classes of accidents. A conservative approach is appropriate and standard practice for analyses of this type, that is, analyses that involve high degrees of uncertainty associated with analytical factors such as accident frequency, material at risk, and leak path.

B.3.2.2 Mitigation Measures

Mitigations to exposure and therefore mitigations to dose that would affect the postulated results of the accident scenarios are discussed below. In general, no mitigation was assumed for emergency response in the consequence analysis.

Emergency Response and Protective Actions

SRS has detailed plans for responding to accidents of the type described in this EIS, and the response activities would be closely coordinated with those of local communities. NNSA personnel are trained and drilled in the protective actions to be taken if a release of radioactive or otherwise toxic material occurs. The underlying principle for the protective action guides is that under emergency conditions, all reasonable measures should be taken to minimize the radiation exposure of the general public and emergency workers. In the absence of significant constraints, protective actions could be implemented when projected doses are lower than the ranges given in the protective action guides. No credit is taken for emergency response and protective actions in the consequence analysis.

High Efficiency Particulate Air Filtration

In all areas where unconfined plutonium or other radioactive materials can be handled and can exist in a dispersible form, high-efficiency particulate air (HEPA) filters provide a final barrier against the inadvertent release of radioactive aerosols into the outside environment. However, these filters would not trap volatile fission products such as the noble gases and iodine; such gases would be released into the outside environment.

HEPA filter efficiencies are 99.99 percent or greater with the minimum efficiency of 99.97 percent for 0.3-micron particles, the size most easily passed by the filter. To maximize containment of particles and provide redundancy, two HEPA filters in series would be used, as is the normal operational procedure at such NNSA facilities. Additional HEPA filtration would be used, as required, to ensure compliance with regulatory requirements. These HEPA filters are protected by building design features against the consequences of an earthquake or fire. Credit was taken for filtration in the consequence analysis when ventilation and building containment were shown by analysis to survive during the accident.

B.3.2.3 Chemical Releases

Safety analysis work uses the emergency response planning guidelines (ERPGs) and temporary emergency exposure limits (TEELs) for assessing human health effects for both facility workers and the general public.

ERPG Definitions

ERPG-1 is the maximum airborne concentration below which nearly all individuals could be exposed for up to one hour without experiencing mild transient adverse health effects or perceiving a clearly defined objectionable odor.

ERPG-2 is the maximum airborne concentration below which nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

ERPG-3 is the maximum airborne concentration below which nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects.

Similar to radiological, the chemical accident consequence analysis methodology developed for and presented in the Complex Transformation SPEIS (NNSA 2008) for a pit production facility located at the SRS was utilized in this EIS for the proposed SRPPF. The following description is the chemical accident consequence analysis methodology.

Consequences of accidental chemical releases were determined using the Aerial Location of Hazardous Atmospheres (ALOHA) computer code.[4] ALOHA is an EPA/National Oceanic and Atmospheric Administration-sponsored computer code that has been widely used in support of chemical accident responses and also in support of safety and NEPA documentation for DOE facilities.

The ALOHA code is a deterministic representation of atmospheric releases of toxic and hazardous chemicals. The code can predict the rate at which chemical vapors escape (e.g., from puddles or leaking tanks) into the atmosphere; a specified direct release rate is also an option. The ALOHA code uses a constant set of meteorological conditions (e.g., wind speed, stability class) to determine the downwind atmospheric concentrations. The sequential meteorological data sets used for the radiological accident analyses were re-ordered from high to low dispersion by applying a Gaussian dispersion model (such as that used by ALOHA) to the closest site boundary at the site. The median set of hourly conditions for the site (i.e., mean wind speed and mean stability) was used for the analysis; this is roughly equivalent to the conditions corresponding to the mean radiological dose estimates of MACCS.

In addition to the source term and downwind concentration calculations, ALOHA allows for the specification of concentration limits for the purpose of consequence assessment (e.g., assessment of human health risks from contaminant plume exposure). ALOHA refers to these concentration limits as level-of-concern (LOC) concentrations. While ERPGs and TEELs are not explicitly a

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[4] ALOHA® is the hazard modeling program for the CAMEO® software suite (https://www.epa.gov/cameo/what-cameo-software-suite), which is used widely to plan for and respond to chemical emergencies.

part of the ALOHA chemical database, ALOHA allows the user to input any value, including an ERPG or TEEL value, as the LOC concentration. The LOC value is superimposed on the ALOHA-generated plot of downwind concentration as a function of time to facilitate comparison. In addition, ALOHA will generate a footprint that shows the area (in terms of longitudinal and lateral boundaries) where the ground-level concentration reached or exceeded the LOC during puff or plume passage (the footprint is most useful for emergency response applications).

As with the radiological accidents, where values for parameters for the proposed SRPPF are known to be different from the values used in the Complex Transformation SPEIS, the chemical accident consequence from the Complex Transformation SPEIS were scaled using the ratio of the proposed SRPPF value to the Complex Transformation SPEIS value.

B.4 ACCIDENT SCENARIOS

Postulated SRPPF radiological and chemical accidents are described in Tables B-3 and B-4 at the end of this section. These tables also identify the estimated maximum MAR and source term and accident frequency.

B.4.1 Postulated Radiological Accidents

The accident scenarios shown in Tables B-3 and B-4 cover the types of hazardous situations appropriate for the proposed SRPPF. The list includes fires, spills, criticality and explosion events, site-specific externally initiated events, and natural phenomena events. For radiological accidents, the MAR is plutonium and the predominant form of exposure is through inhalation. The list also includes the potential release of toxic chemicals.

The accident source terms shown in Table B-3 indicate the quantity of radioactive material released to the environment with a potential for harm to the public and onsite workers. The radiological source terms are calculated by the equation:

$$\text{Source Term} = \text{MAR} \times \text{ARF} \times \text{RF} \times \text{DR} \times \text{LPF}$$

where:

MAR = The amount and form of radioactive material at risk of being released to the environment under accident conditions.
ARF = The airborne release fraction reflecting the fraction of damaged MAR that becomes airborne as a result of the accident.
RF = The respirable fraction reflecting the fraction of airborne radioactive material that is small enough to be inhaled by a human.
DR = The damage ratio reflecting the fraction of MAR that is damaged in the accident and available for release to the environment.
LPF = The leak path factor reflecting the fraction of respirable radioactive material that has a pathway out of the facility for dispersal in the environment.

Radiological Accident: Natural Phenomena Initiator—Extremely Unlikely Earthquake with Subsequent Fire

The earthquake accident scenario postulates a seismic event and seismically induced failure of interior walls. Combustible materials in the area are ignited, resulting in a fire that propagates areas of the facility that contain the largest quantity of plutonium metal. The MAR for 80 pits per year includes 3,986 kilograms (8,788 pounds) metal, 8.4 kilograms (18.5 pounds) powder, and 5.6 kilograms (12.3 pounds) solution. The bounding seismic accident with fire conservatively assumes DR = 1.0, resulting in all the MAR to be affected by the fire. The collapsed walls cause a loss of confinement, resulting in an assumed LPF = 1.0. The airborne respirable release fraction is estimated to be ARF × RF = 2.5×10^{-4} (metal), 6×10^{-5} (oxide), and 2×10^{-3} (solution). No credit is taken for the mitigating effects of safety systems, fire suppression efforts and equipment, plutonium cladding, the shipping containers, or the final building state (building collapse and rubble bed). The resulting source term for 80 pits per year is 1.0 kilograms (2.2 pounds) of plutonium metal, 0.0005 kilograms (0.0011 pounds) of plutonium oxide, and 0.011 kilograms (0.025 pounds) of plutonium solution. The accident frequency is estimated to be in the range of 1×10^{-6} to 1×10^{-4} per year, which includes the frequency of the initiating event (i.e., earthquake) and the frequency of following events that influence the impacts of the accident (e.g., subsequent fire, failure of mitigating safety systems [e.g., HVAC system with HEPA filters]). For the purpose of risk calculations, a conservative frequency of 1×10^{-4} per year is assumed (SRNS 2019).

Radiological Accident: Internal Initiator—Fire in a Single Fire Zone

A fire is postulated to start within a single fire zone, for instance, a glovebox, processing room, or storage vault. Possible causes of the fire include an electrical short circuit, equipment failure, welding equipment, or human error. The fire propagates to within the fire zone that contains the largest quantities of plutonium metal. The MAR is a maximum 2,000 kilograms (4,409 pounds) of plutonium metal. The bounding fire accident conservatively assumes a DR = 1.0, resulting in all of the MAR to be affected by the fire. No credit is taken for safety systems, building confinement, or filtration resulting in an assumed LPF = 1.0. The airborne respirable release fraction is estimated to be ARF × RF = 2.5×10^{-4}. No credit is taken for the mitigating effects of fire suppression efforts and equipment, plutonium cladding, or the shipping containers. The resulting source term is a ground-level, thermal release of 0.50 kilogram (1.1 pounds) of plutonium. The accident frequency is estimated to be in the range of 1×10^{-6} to 1×10^{-4} per year. For the purpose of risk calculations, a conservative frequency of 1×10^{-4} per year is assumed (SRNS 2019).

Radiological Accident: Internal Initiator—Explosion in a Furnace

A steam explosion/over-pressurization is postulated to occur in a furnace in the foundry. The steam explosion occurs due to a cooling water leak or an over-pressurization event. Because the proposed SRPPF design has only one furnace in a glovebox, the explosion/over-pressurization was assumed to impact the molten plutonium metal in a single furnace (SRNS 2020). The furnace is assumed to contain 4.5 kilogram (1.4 pounds) of plutonium in the form of molten metal. The airborne respirable release fraction was estimated to be ARF × RF = 0.5 for the molten plutonium. Negligible impacts from the shock/blast are postulated for any solid plutonium metal in the glovebox. The bounding scenario assumes DR = 1.0 and, although the SRPPF gloveboxes would be equipped with a filtered exhaust system (see Chapter 2, Section 2.3.5), LPF = 1.0, that is, no credit was taken for the glovebox HEPA filters. The resulting source term is 2.25 kilograms (5.0 pounds) of plutonium. The frequency of the accident is estimated to be in the range of 1×10^{-4} to 1×10^{-2} per year. For the purpose of risk calculations, a conservative frequency of 1×10^{-2} was used (SRNS 2020).

Radiological Accident: Internal Initiator—Nuclear Criticality

An inadvertent criticality is postulated based on any one of several potential events involving handling errors. Accumulation of fissile material in excess of criticality safety limits, addition of a moderator causing a critical configuration, or a seismic event causing collapse of storage vault racks are potential scenarios. The estimated frequency of a criticality is 1×10^{-2} per year (SRNS 2020).

Radiological Accident: Internal Initiator—Radioactive Material Spill

A spill of radioactive material (molten plutonium) occurs in the metal reduction glovebox due to a failure or rupture of the feed casting furnace. The event does not impact any other material that may be in the glovebox. The spill is assumed to involve 4.5 kilograms (9.9 pounds) of molten plutonium metal. An airborne release from disturbed metal surfaces is assumed as the release mechanism. The airborne respirable release fraction is estimated to be ARF × RF = 1×10^{-2}. A DR = 1.0 was conservatively assumed. For a bounding scenario, no credit is taken for safety systems, building confinement, or ventilation/filtration corresponding to LPF = 1.0. The resulting source term is a ground-level release of 0.045 kilogram (0.099 pound) of plutonium. The accident frequency is estimated to be in the range of 1×10^{-4} to 1×10^{-2} per year. For the purpose of risk calculations, a conservative frequency of 1×10^{-2} per year is assumed (SRNS 2020).

Table B-3—Postulated Radiological Accidents

Accident	Accident Description	Material at Risk	Source Term	Event Frequency (per year)
Natural Phenomena Initiators				
1. Extremely unlikely earthquake with subsequent fire	A seismic event is postulated, causing failure of internal walls or other overhead objects. The collapsed walls and overhead objects cause a loss of confinement and a potential release of radioactive materials in multiple areas of the facility. The seismic event could cause the ignition of combustible materials, initiating fires in multiple areas of the facility.	4,000 kg plutonium-239 equivalent: 99.65% metal 0.21% powder 0.14% solution	1.0 kg metal 0.0005 kg oxide 0.011 kg solution	1×10^{-6} to 1×10^{-4}
Internal Initiators				
1. Fire in a single fire zone	A fire is postulated to start within a glovebox, processing room, or storage vault. The fire propagates within the fire zone that contains the largest quantities of plutonium metal.	2,000 kg plutonium metal	0.50 kg plutonium	1×10^{-6} to 1×10^{-4}
2. Explosion in a furnace	A steam explosion/over-pressurization explosion is postulated to occur in a furnace.	4.5 kg molten plutonium metal	2.25 kg molten plutonium metal	1×10^{-4} to 1×10^{-2}
3. Nuclear criticality	An inadvertent criticality is postulated based on several potential events involving handling errors. Accumulation of fissile material in excess of criticality safety limits, addition of a moderator causing a critical configuration, or a seismic event causing collapse of storage vault racks are potential scenarios.	See SRNS 2020	5×10^{17} fissions	1×10^{-2}
4. Radioactive material spill	A loss of confinement and spill of molten plutonium into the metal reduction from a furnace within a glovebox is postulated.	4.5 kg molten plutonium metal	0.045 kg plutonium	1×10^{-4} to 1×10^{-2}

Accident	Accident Description	Material at Risk	Source Term	Event Frequency (per year)
External Initiators				
Addressed in classified appendix	Addressed in 2008 Complex Transformation SPEIS classified appendix (NNSA 2008a)	Addressed in 2008 Complex Transformation SPEIS classified appendix (NNSA 2008a)	Addressed in 2008 Complex Transformation SPEIS classified appendix (NNSA 2008a)	Addressed in 2008 Complex Transformation SPEIS classified appendix (NNSA 2008a)

kg = kilogram.
Source: SRNS 2020

Table B-4—Postulated Chemical Accidents

Accident	Accident Description	Material at Risk	Source Term	Event Frequency (per year)
Chemical Release Events				
1. Nitric acid release from bulk storage	Nitric acid is inadvertently released from bulk storage due to natural phenomena, equipment failure, mechanical impact, or human error during storage, handling, or process operations.	10,500 kg	10,500 kg	1×10^{-5} to 1×10^{-4}
2. Hydrochloric acid release from bulk storage	Hydrochloric acid is inadvertently released from bulk storage due to natural phenomena, equipment failure, mechanical impact, or human error during storage, handling, or process operations.	550 kg	550 kg	1×10^{-5} to 1×10^{-4}

kg = kilogram
Source: SRNS 2020

B.4.2 Postulated Chemical Accidents

The accident source terms for chemical accidents are shown in Table B-4 above. The impacts of chemical accidents are measured in terms of ERPG-2 and ERPG-3 concentration limits established by the American Industrial Hygiene Association. ERPG-2 is defined as the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their ability to take protective actions. ERPG-3 is defined as the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects.

Chemical Accident: Nitric Acid Release

An accidental release of nitric acid from bulk storage is postulated due to equipment failure, mechanical impact, or human error. The accident scenario postulates a major leak, such as a pipe rupture, and the released chemical forming a pool about one inch deep in the area around the point of release. Nitric acid is corrosive and can cause severe burns to all parts of the body. Its vapors may burn the respiratory tract and may cause pulmonary edema, which could prove fatal. The nitric acid is assumed to be stored outdoors in bulk quantity near the SRPPF. The maximum amount of nitric acid that could be released is 10,500 kilograms (23,149 pounds). The nitric acid is released by evaporation to the environment and is transported as an airborne plume with potential impacts in excess of ERPG-2 and ERPG-3 concentration limits to onsite workers and the offsite public. The ERPG-2 and ERPG-3 concentration limits for the chemical are 6 and 78 parts per million (ppm), respectively. The estimated frequency of this accident is in the range of 1×10^{-5} to 1×10^{-4} per year. For the purpose of risk calculations, a conservative frequency of 1×10^{-4} is assumed (SRNS 2020).

Chemical Accident: Hydrochloric Acid Release

An accidental release of hydrochloric acid from bulk storage is postulated due to equipment failure, mechanical impact, or human error. Hydrochloric acid is very irritating to the skin, eyes, and mucosal surfaces because of the rapid absorption by body moisture forming hydrochloric acid. It can cause serious burns. High or prolonged inhalation exposures may cause delayed pulmonary edema with cough, chest discomfort, and difficulty in breathing. Contact with vapor can damage the eyes. Ingestion may cause severe acid burns of the mouth, throat, esophagus, and stomach with burning pain of the mouth, throat, chest, and abdomen. Gross exposure may cause death. The hydrochloric acid is assumed to be stored outdoors in bulk quantity near the SRPPF. The maximum amount of hydrochloric acid that could be released is 600 kilogram (1,320 pounds). The hydrochloric acid is released by evaporation to the environment and is transported as an airborne plume with potential impacts in excess of ERPG-2 and ERPG-3 concentration limits to onsite workers and the offsite public. The ERPG-2 and ERPG-3 concentration limits for the chemical are 20 and 150 ppm, respectively. The estimated frequency of this accident is in the range of 1×10^{-5} to 1×10^{-4} per year. For the purpose of risk calculations, a conservative frequency of 1×10^{-4} is assumed (SRNS 2020).

B.4.3 Radiological Accident Frequency and Consequences

Tables B-5 and B-6 show the consequences and risks of the postulated set of radiological accidents at the proposed SRPPF for a noninvolved worker and the public (MEI and the general population living within 50 miles of the site).

Table B-5—Radiological Accident Frequency and Consequences – 80 Pits Per Year

Accident	Frequency	Maximally Exposed Individual[a,d]		Offsite Population[b]		Noninvolved Worker[c,d]	
		Dose (rem)	Latent Cancer Fatality	Dose (Person-rem)	Latent Cancer Fatality	Dose (rem)	Fatality[d,e]
Extremely unlikely earthquake with subsequent fire	1×10^{-4} to 1×10^{-6}	0.8	0 (0.00048)	3,610	2.2	372	0.45
Fire in a single fire zone	1×10^{-4} to 1×10^{-6}	0.41	0 (0.00024)	1,800	1.1	279	0.33
Explosion in a furnace	1×10^{-2} to 1×10^{-4}	1.8	0 (0.0011)	8,120	4.9	1,260	1.0
Nuclear criticality	1×10^{-2}	0.26	0 (0.00016)	1,160	0.70	180	0.22
Radioactive material spill	1×10^{-2}	0.0037	0 (2.2×10^{-6})	16.2	0 (0.0097)	2.5	0 (0.0015)

a. At site boundary, approximately 6.7 miles from release.
b. Based on a projected future population (year 2030) of 862,957 persons residing within 50 miles of SRS.
c. At a distance of 1,000 meters (3,281 feet).
d. The MEI and the noninvolved worker scenarios each assume that one person was exposed. If more than one person was exposed in either of these scenarios, then that scenario's dose would be per person, and the fatalities would be multiplied by the number of persons exposed.
e. If the dose is ≥ 1,000 rem, these are prompt fatalities; otherwise, they are LCFs
Source: SRNS 2020 (for accident scenarios and frequencies).

Table B-6—Annual Cancer/Fatality Risks – 80 Pits Per Year

Accident	Maximally Exposed Individual[a]	Offsite Population[b]	Noninvolved Worker[c]
Extremely unlikely earthquake with subsequent fire	0 (4.8×10^{-8})	0 (2.2×10^{-4})	0 (4.5×10^{-5})
Fire in a single fire zone	0 (2.4×10^{-8})	0 (1.1×10^{-4})	0 (3.3×10^{-5})
Explosion in a furnace	0 (1.1×10^{-5})	0 (4.9×10^{-2})	0.01[d]
Nuclear criticality	0 (2.0×10^{-11})	0 (3.8×10^{-8})	0 (8.8×10^{-9})
Radioactive material spill	0 (2.2×10^{-8})	0 (9.7×10^{-5})	0 (1.5×10^{-5})

a. At site boundary, approximately 6.7 miles from release.
b. Based on a projected future population (year 2030) of 862,957 persons residing within 50 miles of SRS.
c. At a distance of 1,000 meters (3,281 feet).
d. Since an explosion in a furnace would likely result in a prompt fatality, this value reflects the annual risk of a fatality rather than an annual risk of cancer
Source: SRNS 2020 (for accident scenarios and frequencies).

B.4.4 Chemical Accident Frequency and Consequences

The chemicals selected for evaluation are based on the aqueous feed preparation process, and are considered the most hazardous of all the chemicals used in this process. Determination of a chemical's hazardous ranking takes into account quantities available for release, protective concentration limits (ERPG-2), and evaporation rate.

Table B-7 presents the impacts of potential chemical accidents at the proposed SRPPF. The table shows the name of the chemical and the quantity potentially released during a severe accident. The impacts of chemical releases are measured in terms of ERPG-2 protective concentration limits given in ppm. The distances at which the limit is reached are also provided for the ERPG-2 limit. The concentration of the chemical at 1,000 meters (3,281 feet) from the accident is shown for comparison with the concentration limit for ERPG-2. The distance to the site boundary and the concentration at the site boundary are also shown for comparison with the ERPG-2 concentration limits and for determining if the limits are exceeded offsite.

Table B-7—Chemical Accident Frequency and Consequences – 80 Pits Per Year

Chemical Released	Quantity Released (kg)	ERPG-2		Concentration[a]		Frequency
		Limit (ppm)	Distance to Limit (km)	At 1,000 meters (ppm)	At Site Boundary (ppm)	
Nitric acid	10,500	6	0.17	0.189	<0.01	1×10^{-4}
Hydrochloric acid	600	20	0.13	0.23	<0.01	1×10^{-4}

a. Site boundary is at a distance of 6.7 miles.
Source: SRNS 2020

B.5 TRANSPORTATION RADIOLOGICAL ACCIDENTS

The offsite transportation accident analysis considered the impacts of accidents during the transportation of radiological materials. Under accident conditions, impacts to human health and the environment may result from the release and dispersal of radioactive material. Historically, most transportation accidents involving radioactive materials have resulted in little or no release of radioactive material from the shipping container. Consequently, the analysis of accident risks takes into account a spectrum of accidents ranging from high-probability accidents of low severity to hypothetical high-severity accidents that have a correspondingly low probability of occurrence. To provide DOE and the public with a reasonable assessment of the radiological transportation accident impacts, two types of analysis were performed. First, an accident risk assessment was performed that takes into account the probabilities and consequences of a spectrum of potential accident severities. Second, an analysis was performed to calculate potential impacts of maximum reasonably foreseeable impacts to individuals and populations should an accident occur. A description of these two analyses and their results are described in Section A.12 of Appendix A.

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APPENDIX C

Public Notices

84 FR 26849, “Notice of Intent To Prepare an Environmental Impact Statement for Plutonium Pit Production at the Savannah River Site.” *Federal Register*. Volume 84, Number 111, June 10, 2019.

Federal Register / Vol. 84, No. 111 / Monday, June 10, 2019 / Notices **26849**

The EA will also analyze a no action alternative under which the DWPF recycle wastewater would remain in the SRS liquid waste system until disposition occurs. As currently planned, beginning in FY 2024, the DWPF recycle wastewater would undergo a pre-treatment process prior to transfer to the SRS Effluent Treatment Project and the Saltstone Production Facility. The potential environmental impacts of the no action alternative are anticipated to be similar to those analyzed by the supplemental environmental impact statements for DWPF (DOE/EIS–0082–S) and Savannah River Site Salt Processing Alternatives (DOE/EIS–0082–S2), relative to the quantities of waste involved. DOE’s purpose and need for this proposal is to expand its disposal options, and hence no NEPA analyses on treatment and disposal at Federal disposal facilities will be conducted.

Potential Areas of Environmental Analysis

DOE has tentatively identified the following areas for detailed analysis in the EA. The list is not intended to be comprehensive or to predetermine the potential impacts to be analyzed.

- Impacts to the general population and workers from radiological and non-radiological releases, and other public and worker health and safety impacts.
- Impacts of emissions on air and water quality, including impacts of greenhouse gas emissions.
- Impacts on ecological systems and threatened and endangered species.
- Impacts on waste management activities.
- Impacts of transportation of radioactive materials to commercial treatment and disposal facilities.
- Impacts that could occur as a result of postulated accidents and intentional destructive acts (terrorist actions and sabotage).
- Potential disproportionately high and adverse effects on low-income and minority populations (environmental justice).
- Short-term and long-term land use impacts, including potential impacts of disposal.
- Cumulative impacts.

NEPA Process and Public Participation

DOE will issue a **Federal Register** Notice later this year on the availability of the Draft Commercial Disposal of Recycle Wastewater EA and will include instructions on how to submit public comments on the Draft EA. DOE adheres to all NEPA regulations including those related to public participation and stakeholder interactions. In general, the NEPA process requires meaningful opportunities for public participation. Key opportunities for public participation in the NEPA process include submitting comments on publicly available draft NEPA documents such as the Draft Commercial Disposal of Recycle Wastewater EA announced in this **Federal Register** Notice. Based on the EA analysis, DOE will either issue a Finding of No Significant Impact or announce its intention to prepare an environmental impact statement.

Signed at Washington, DC, on May 30, 2019.

Anne Marie White,

Assistant Secretary for Environmental Management.

[FR Doc. 2019–12114 Filed 6–7–19; 8:45 am]

BILLING CODE 6450–01–P

DEPARTMENT OF ENERGY

National Nuclear Security Administration

Notice of Intent To Prepare an Environmental Impact Statement for Plutonium Pit Production at the Savannah River Site

AGENCY: National Nuclear Security Administration, Department of Energy.

ACTION: Notice of intent.

SUMMARY: The Department of Energy (DOE) National Nuclear Security Administration (NNSA) hereby announces its intent, consistent with the National Environmental Policy Act (NEPA), to prepare an environmental impact statement (EIS) for plutonium pit production at the Savannah River Site (SRS) in South Carolina (the SRS EIS). The 2018 Nuclear Posture Review announced that the United States will pursue initiatives to ensure the necessary capability, capacity, and responsiveness of the nuclear weapons infrastructure and the needed skill of the workforce, including providing the enduring capability and capacity to produce no fewer than 80 plutonium pits per year by 2030. To achieve the Department of Defense (DoD) requirement, NNSA is proposing to repurpose the Mixed Oxide Fuel Fabrication Facility (MFFF) at SRS to produce plutonium pits while also maximizing pit production activities at Los Alamos National Laboratory (LANL) in New Mexico. NNSA also hereby provides information regarding its overall NEPA strategy related to fulfilling national requirements for pit production. NNSA will first conduct a programmatic review to assist in decisions and second conduct site-specific reviews. NNSA anticipates that it will prepare at least three documents including: A supplement analysis (SA) to the *Final Complex Transformation Supplemental Programmatic EIS* (Complex Transformation SPEIS); a site-specific EIS for the proposal to produce pits at SRS; and site-specific documentation for the proposal to authorize expanding pit production at LANL.

DATES: NNSA invites Federal and state agencies, state and local governments, Native American tribes, industry, other organizations, and members of the public to submit comments to assist in identifying environmental issues and in determining the appropriate scope of the SRS EIS until July 25, 2019. Comments received after this date will be considered to the extent practicable. NNSA will hold one public scoping meeting for the proposed EIS as follows:

- June 27, 2019 (5:00 p.m.–9:00 p.m. EST) at the North Augusta Community Center, 495 Brookside Ave. North Augusta, SC 29841.

Doors will open at 5:00 p.m. on June 27, 2019 at the community center for the public to view posters on display. NNSA will provide a brief presentation on the EIS beginning at 6:00 p.m. and then NNSA will accept public comments on the scope of the EIS.

ADDRESSES: Written comments on the scope of the EIS, requests to be placed on the EIS distribution list, and comments or questions on the scoping process should be sent to: Ms. Jennifer Nelson, NEPA Document Manager, National Nuclear Security Administration Savannah River Field Office, P.O. Box A, Aiken, SC 29802 or email to *NEPA-SRS@srs.gov.* If you would like to pre-register to comment during the public scoping meeting, send an email to *NEPA-SRS@srs.gov.* Before including your address, phone number, email address, or other personal identifying information in your comment, please be advised that your entire comment—including your personal identifying information—may be made publicly available. If you wish for NNSA to withhold your name and/or other personally identifiable information, please state this prominently at the beginning of your comment. You may also submit comments anonymously. Also, NNSA requests Federal, State, and local agencies that desire to be designated as cooperating agencies on the EIS to contact the NEPA Document Manager at the address listed in this section by the end of the scoping period.

impacts associated with pit production at different site alternatives: LANL in Los Alamos, New Mexico; SRS near Aiken, South Carolina; Pantex Plant near Amarillo, Texas; Y–12 National Security Complex in Oak Ridge, Tennessee; and the Nevada National Security Site north of Las Vegas, Nevada. At SRS, the Complex Transformation SPEIS also evaluated a pit production facility that would use the MFFF and pit disassembly and conversion facility infrastructure [73 FR 63470, October 24, 2008]. Additionally, pit production at LANL has been analyzed in several NEPA documents over the past two decades. Federal decisions (RODs) have authorized pit production levels of no more than approximately 20 pits per year at LANL [64 FR 50797, September 20, 1999]. However, higher levels of pit production have been analyzed in: The Complex Transformation SPEIS, which analyzed pit production levels as high as 125 pits per year for the 5 sites listed above [73 FR 77644, December 19, 2008]; and in the 2008 LANL Sitewide Environmental Impact Statement, which analyzed up to 80 pits per year at LANL in the Expanded Operations Alternative (DOE/EIS–0380, May 2008). Prior to making any decisions on producing a minimum of 30 pits per year at LANL and a minimum of 50 pits per year at SRS, NNSA will conduct further NEPA analyses as discussed below.

NNSA anticipates that it will prepare at least three documents including: A SA to the *Final Complex Transformation Supplemental Programmatic EIS* (Complex Transformation SPEIS); the site-specific EIS for the proposal to produce pits at SRS announced in this Notice; and site-specific documentation for the proposal to authorize expanding pit production beyond 20 pits per year at LANL.

NNSA is preparing a SA to the Complex Transformation SPEIS related to the proposed action for pit production. NNSA will use the SA to determine if there are significant changes in the proposed action which are substantial and relevant to environmental concerns or whether new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts are significant. The SA would inform the site-specific documentation for the proposed pit production activities at both SRS and LANL. Although pertinent regulations do not require public comment on a SA, NNSA has decided, in its discretion, that public comment in this instance would be helpful and will issue a draft SA.

If the SA identifies no new significant circumstances or information relevant to environmental concerns that effect NNSA's decisions concerning pit production at a programmatic level, NNSA would announce the determination from the SA to the Complex Transformation SPEIS at the same time it would announce an amended ROD. If NNSA determines that a supplement to the Complex Transformation SPEIS or a new EIS is required, NNSA will announce those decisions as appropriate.

NNSA also intends to conduct site-specific NEPA analysis for expanded pit production activities at LANL to determine if there are significant changes in the proposed action which are substantial and relevant to environmental concerns or whether new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts are significant. The type of site-specific analysis for producing a minimum of 30 pits per year at LANL will include a SA to the 2008 LANL Sitewide Environmental Impact Statement.

Depending on the results of the site-specific review at LANL, NNSA may announce an amended ROD or prepare additional NEPA documentation for the proposed action.

EIS Preparation and Schedule

NNSA expects to issue the draft EIS in 2020.

Signed in Washington, DC, this 31st day of May 2019, for the United States Department of Energy.

Lisa E. Gordon-Hagerty,

Under Secretary for Nuclear Security Administration, National Nuclear Security Administration.

[FR Doc. 2019–12003 Filed 6–7–19; 8:45 am]

BILLING CODE 6450–01–P

ENVIRONMENTAL PROTECTION AGENCY

[FRL–9995–08–Region 8]

Public Water System Supervision Program Revision for the State of Utah

AGENCY: Environmental Protection Agency (EPA).

ACTION: Notice.

SUMMARY: Public notice is hereby given that the state of Utah has revised its Public Water System Supervision (PWSS) Program by adopting federal regulations for the Revised Total Coliform Rule (RTCR) that correspond to the National Primary Drinking Water Regulations (NPDWR). The EPA has reviewed Utah's regulations and determined they are no less stringent than the federal regulations. The EPA is proposing to approve Utah's primacy revision for the RTCR.

This approval action does not extend to public water systems in Indian country. Please see **SUPPLEMENTARY INFORMATION**, Item B.

DATES: Any member of the public is invited to request a public hearing on this determination by July 10, 2019. Please see **SUPPLEMENTARY INFORMATION**, Item C, for details. Should no timely and appropriate request for a hearing be received, and the Regional Administrator (RA) does not elect to hold a hearing on his/her own motion, this determination shall become applicable July 10, 2019. If a public hearing is requested and granted, then this determination shall not become applicable until such time following the hearing as the RA issues an order affirming or rescinding this action.

ADDRESSES: Requests for a public hearing should be addressed to: Robert Clement, Drinking Water B Section, EPA Region 8, 1595 Wynkoop Street, Denver, CO 80202–1129.

All documents relating to this determination are available for inspection at: EPA Region 8, Drinking Water Section (5th Floor), 1595 Wynkoop Street, Denver, Colorado.

FOR FURTHER INFORMATION CONTACT: Robert Clement, Drinking Water B Section, EPA Region 8, 1595 Wynkoop Street, Denver, CO 80202–1129, phone 303–312–6653.

SUPPLEMENTARY INFORMATION: In accordance with the provisions of section 1413 of the Safe Drinking Water Act (SDWA), 42 U.S.C. 300g–2, and 40 CFR 142.13, public notice is hereby given that the state of Utah has revised its PWSS program by adopting federal regulations for the RTCR that correspond to the NPDWR in 40 CFR parts 141 and 142. The EPA has reviewed Utah's regulations and determined they are no less stringent than the federal regulations. The EPA is proposing to approve Utah's primacy revision for the RTCR.

This approval action does not extend to public water systems in Indian country as defined in 18 U.S.C. 1151. Please see **SUPPLEMENTARY INFORMATION**, Item B.

A. Why are revisions to state programs necessary?

States with primary PWSS enforcement authority must comply with the requirements of 40 CFR part 142 to maintain primacy. They must adopt regulations that are at least as

FOR FURTHER INFORMATION CONTACT: For further information about this Notice, please contact Mr. James R. Sanderson, Office of NEPA Policy and Compliance, U.S. Department of Energy, 1000 Independence Avenue SW, Washington, DC 20585–0119, email to: *NEPA-SRS@srs.gov.*

This Notice will be available on the internet at: *https://www.energy.gov/nepa/listings/notices-intent-noi.*

SUPPLEMENTARY INFORMATION:

Background

National security policies require DOE, through NNSA, to maintain the United States' nuclear weapons stockpile, as well as the nation's core competencies in nuclear weapons. NNSA, a semi-autonomous agency within the DOE, has the mission to maintain and enhance the safety, security, and effectiveness of the nuclear weapons stockpile.

Plutonium pits are critical components of every nuclear weapon, with nearly all current stockpile pits having been produced from 1978–1989. Today, the United States' capability to produce plutonium pits is limited. To produce pits with enhanced safety features to meet NNSA and DoD requirements, mitigate against the risk of plutonium aging, and respond to changes in deterrent requirements driven by growing threats from peer competitors, the Department of Defense (DoD) requires NNSA to produce no fewer than 80 plutonium pits per year by 2030, and to sustain the capacity for future (Life Extension Programs and follow-on) programs.

NNSA's pit production mission was emphasized as a national security imperative by the 2018 Nuclear Posture Review, issued in February 2018 by the Office of the Secretary of Defense and subsequent Congressional statements of the policy of the United States. The 2018 Nuclear Posture Review announced that the United States will pursue initiatives to ensure the necessary capability, capacity, and responsiveness of the nuclear weapons infrastructure and the needed skill of the workforce, including providing the enduring capability and capacity to produce no fewer than 80 pits per year by 2030. The 2018 Nuclear Posture Review concludes that the United States must have sufficient research, design, development, and production capacity to support the sustainment of its nuclear forces.

To that end, DoD Under Secretary of Defense for Acquisition and Sustainment Ellen M. Lord and Under Secretary for Nuclear Security and Administrator of the NNSA Lisa Gordon-Hagerty issued a Joint Statement on May 10, 2018, identifying their recommended alternative to meet the pit production requirement based on the completion of an Analysis of Alternatives, an Engineering Assessment and a Workforce Analysis. To achieve the nation's requirement of producing no fewer than 80 pits per year by 2030, NNSA is proposing to repurpose the MFFF at SRS to produce plutonium pits while also maximizing pit production activities at LANL. This two-pronged approach—with a minimum of 50 pits per year produced at SRS and a minimum of 30 pits per year at LANL—is proposed as the best way to manage the cost, schedule, and risk of such a vital undertaking. This approach improves the resiliency, flexibility, and redundancy of our Nuclear Security Enterprise by reducing reliance on a single production site.

Purpose and Need for Agency Action

The security policies of the United States require the maintenance of a safe, secure, and reliable nuclear weapons stockpile and the maintenance of core competencies to design, manufacture, and maintain nuclear weapons. NNSA will pursue initiatives to meet national security requirements and ensure the necessary capability, capacity, and responsiveness of the nuclear weapons infrastructure and the needed skill of the workforce, including providing the enduring capability and capacity to produce no fewer than 80 plutonium pits per year by 2030. This need follows the requirements identified by the 2018 Nuclear Posture Review and Congressional statement of the policy of the United States (Pub. L. 115–232).

Alternatives Considered

NNSA proposes to prepare an EIS for the proposed action to repurpose the MFFF to produce a minimum of 50 pits per year at SRS. NNSA intends to evaluate the following alternatives in the EIS: (1) Proposed action to repurpose MFFF to produce a minimum of 50 pits per year; and (2) No Action Alternative. If any other reasonable alternatives are identified during the scoping period, NNSA will also evaluate those alternatives in the EIS. The EIS will include an analysis of potential impacts to the environment and human health from the proposed action, and an evaluation of potential impacts of the No Action Alternative.

The proposed action to repurpose the MFFF to produce a minimum of 50 pits per year would include, but not be limited to: Reconfiguration (including disassembly and removal of equipment and utility commodities) of the MFFF; installation of equipment necessary for activities associated with pit production (disassembly/metal preparation, pit assembly, machining, aqueous processing, foundry operations, material characterization and analytical chemistry operations for certification); constructing and repurposing other facilities surrounding the MFFF for support activities (*e.g.,* waste handling, training, office space, roads, storage, and parking); security and nuclear safety upgrades to support pit production; providing reliable utilities and infrastructure required for pit production; and hiring and training necessary workforce to ensure the safe, secure, reliable, and responsive capability for pit production at SRS.

Site-Specific SRS EIS Process

The scoping process is intended to involve all interested agencies (Federal, State, county, and local), public interest groups, Native American Tribes, businesses, and members of the public. Interested parties are invited to participate in the EIS process, both to refine the preliminary alternatives and environmental issues to be analyzed in depth and to eliminate from detailed study those alternatives and environmental issues that are not reasonable or pertinent. Input from the scoping meeting will assist NNSA in formulating the proposed action, refining the alternatives, and defining the scope of EIS analyses.

Following the scoping period announced in this Notice, and after consideration of comments received during scoping, NNSA will prepare a draft EIS for the production of plutonium pits at SRS. NNSA will announce the availability of the draft EIS in the **Federal Register** and local media outlets. Comments received on the draft EIS will be considered and addressed in the Final EIS. NNSA will issue a record of decision (ROD) no sooner than 30 days after publication by the Environmental Protection Agency of a Notice of Availability of the Final EIS.

Relationship to Existing and Other NEPA Analyses

NNSA is responsible for management and implementation of the requirements of NEPA and the regulations and policies promulgated thereunder, including but not limited to the Council of Environmental Quality NEPA regulations (40 CFR parts1500–1508), the DOE NEPA implementing procedures (10 CFR part 1021), and NNSA Policy (NAP) 451.1.

Previously, NNSA prepared the Complex Transformation SPEIS to analyze the potential environmental

APPENDIX D

Contractor Disclosure Statements

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE *ENVIRONMENTAL IMPACT STATEMENT FOR PLUTONIUM PIT PRODUCTION AT SAVANNAH RIVER SITE IN SOUTH CAROLINA*

CEQ Regulations at 40 CFR 1506.5(c), which have been adopted by the DOE (10 CFR 1021), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial interest or other interest in the outcome of the project" for purposes of this disclosure is defined in the March 23, 1981 guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 8026-18038 at Question 17a and b.

"Financial or other interest in the outcome of the project" includes "any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)." 46 FR 18026-18038 at 18031.

In accordance with these requirements, the offeror and any proposed subcontractors hereby certify as follows: (check either (a) or (b) to assure consideration of your proposal).

(a) __X__ Offeror and any proposed subcontractor have no financial or other interest in the outcome of the project.

(b) _____ Offeror and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract.

Financial or Other Interests

1.
2.
3.

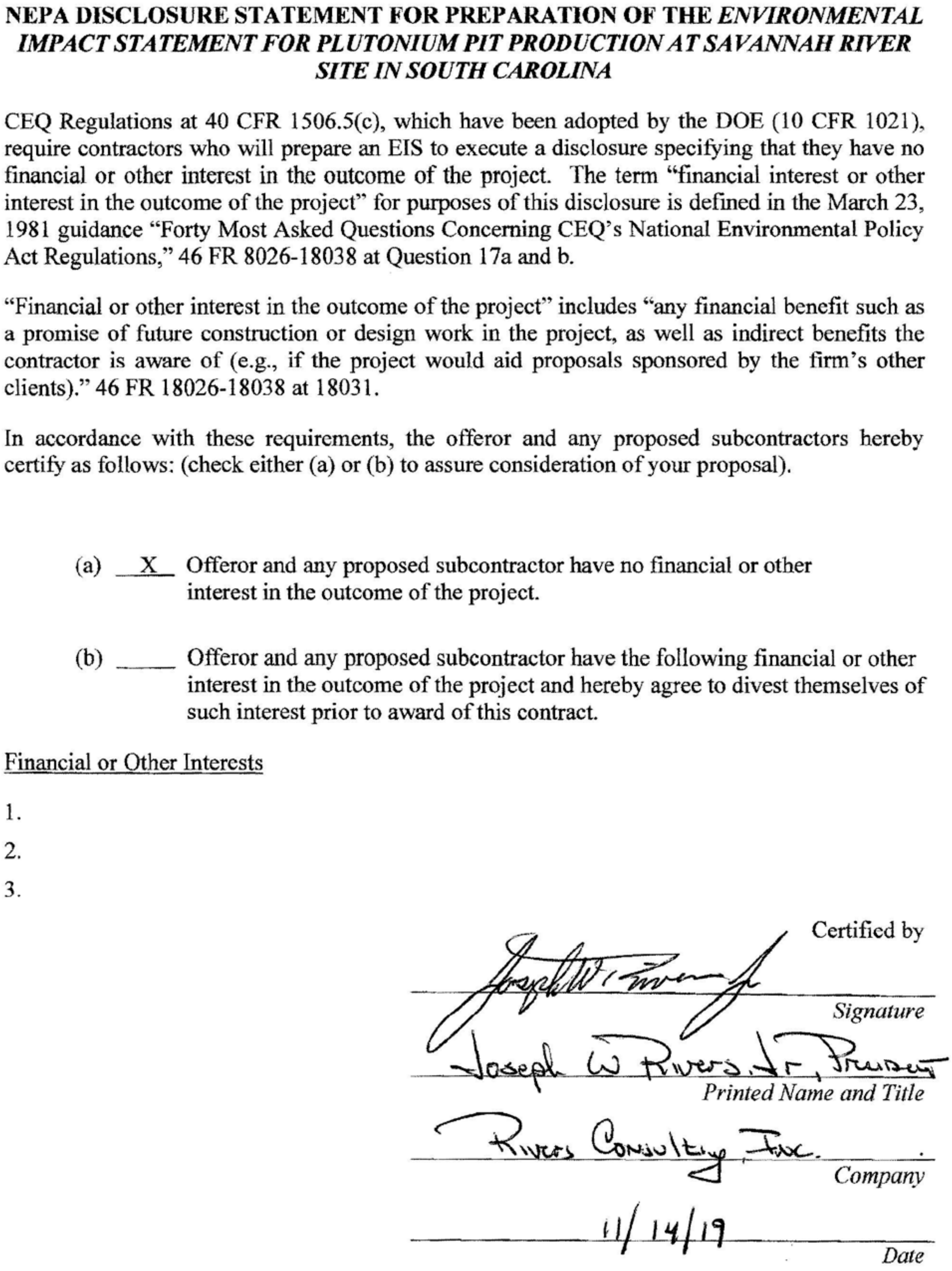
Certified by

Signature

Maher Itani, Director
Printed Name and Title

Tetra Tech, Inc.
Company

November 11, 2019
Date



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(b) _____ Offeror and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract.

Financial or Other Interests

1.
2.
3.

Certified by

Joseph W Rivers Jr
Signature

Joseph W Rivers, Jr, President
Printed Name and Title

Rivers Consulting, Inc.
Company

11/14/19
Date

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE *ENVIRONMENTAL IMPACT STATEMENT FOR PLUTONIUM PIT PRODUCTION AT SAVANNAH RIVER SITE IN SOUTH CAROLINA*

CEQ Regulations at 40 CFR 1506.5(c), which have been adopted by the DOE (10 CFR 1021), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial interest or other interest in the outcome of the project" for purposes of this disclosure is defined in the March 23, 1981 guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 8026-18038 at Question 17a and b.

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(b) _____ Offeror and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract.

Financial or Other Interests

None

Certified by

Abe Zeitoun
Signature

Dr. Abe Zeitoun, Senior Vice President
Printed Name and Title

SC&A
Company

November 11, 2019
Date

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE *ENVIRONMENTAL IMPACT STATEMENT FOR PLUTONIUM PIT PRODUCTION AT SAVANNAH RIVER SITE IN SOUTH CAROLINA*

CEQ Regulations at 40 CFR 1506.5(c), which have been adopted by the DOE (10 CFR 1021), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial interest or other interest in the outcome of the project" for purposes of this disclosure is defined in the March 23, 1981 guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 8026-18038 at Question 17a and b.

"Financial or other interest in the outcome of the project" includes "any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)." 46 FR 18026-18038 at 18031.

In accordance with these requirements, the offeror and any proposed subcontractors hereby certify as follows: (check either (a) or (b) to assure consideration of your proposal).

(a) __X__ Offeror and any proposed subcontractor have no financial or other interest in the outcome of the project.

(b) _____ Offeror and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract.

<u>Financial or Other Interests</u>

1.
2.
3.

Certified by

Donald G Trost

Digitally signed by Donald G Trost
Date: 2019.11.13 09:11:35 -08'00'

Signature

Donald G. Trost
OCI Officer, Executive Vice President
Printed Name and Title

TechSource, Inc
Company

November 13, 2019
Date