Construction and Demonstration of a Prototype Mobile Microreactor

Environmental Impact Statement

CONSTRUCTION AND DEMONSTRATION OF A PROTOTYPE MOBILE MICROREACTOR

ENVIRONMENTAL IMPACT STATEMENT

Draft | September 2021

This page left blank intentionally.

PRIVACY ADVISORY

This Environmental Impact Statement (EIS) is provided for public comment in accordance with the National Environmental Policy Act (NEPA), the President's Council on Environmental Quality NEPA Regulations (40 Code of Federal Regulations [CFR] 1500–1508).

The public commenting process provides an opportunity for public input on Department of Defense (DoD) decision making, allows the public to offer input on alternative ways for the DoD to accomplish what it is proposing, and solicits comments on the DoD's analysis of environmental effects.

Public commenting allows the DoD to make better informed decisions. Letters or other written or oral comments provided may be published in the EIS. As required by law, comments provided will be addressed in the EIS and made available to the public. Providing personal information is voluntary. Any personal information provided will be used only to identify a desire to make a statement during the public comment portion of any public meetings or hearings or to fulfill requests for copies of the EIS or associated documents. Private addresses will be compiled to develop a mailing list for those requesting digital copies of the EIS; however, only the names of the individuals making comments and specific comments will be disclosed. Personal home addresses and phone numbers will not be published in the document.

This page left blank intentionally.

COVER SHEET

Lead Agency: Department of Defense (DoD) acting through the Strategic Capabilities Office (SCO)

Cooperating Agency: Department of Energy (DOE)

Title: Draft Construction and Demonstration of a Prototype Mobile Microreactor Environmental Impact Statement (Draft EIS)

Location: Idaho

Comments: Submit written comments on the Draft EIS by one of the following methods.

Mail: Mobile Microreactor EIS Comment, c/o Leidos
2109 Air Park Rd SE, Suite 200
Albuquerque, NM 87106

E-mail: PELE_NEPA@sco.mil

Online: https://www.mobilemicroreactoreis.com

Information about this project and general information on the National Environmental Policy Act (NEPA) process is available at https://www.mobilemicroreactoreis.com. If additional information is needed, contact PELE_NEPA@sco.mil.

This document is available for viewing and download at https://www.mobilemicroreactoreis.com.

Abstract: This *Draft Construction and Demonstration of a Prototype Mobile Microreactor Environmental Impact Statement* (Draft EIS) evaluates the potential environmental impacts of the proposed construction and operation of a prototype mobile microreactor and the fabrication of fuel (a single mobile microreactor core).

The DoD consumes around 30 terawatt hours of electricity per year and more than 10 million gallons of fuel per day. Additionally, military operational projections predict that energy demand will continue to increase significantly over the next few years. Prioritizing climate change considerations in national security will require explorations of energy-generating resources that create a sustainable climate pathway. Energy delivery and management continues to be a critical defensive risk. The challenge is to develop more sustainable methods to provide reliable, abundant, and continuous energy. Inherent dangers, logistical complexities, and overwhelming costs of sustaining power demands at Forward Operating Bases and Remote Operating Bases using diesel generators continue to constrain operations and fundamental strategic planning. Additionally, technologies currently under development, such as unmanned aerial vehicles, new radar systems, new weapon systems, and the electrification of the non-tactical vehicle fleet, will require even greater energy demands. A Defense Science Board, commissioned by the DoD, recommended further engineering development and prototyping of very small modular reactors with an output less than 10 megawatts of electric power (MWe). Before this technology can be deployed, a prototype mobile microreactor must be tested to ensure it can meet DoD specifications and requirements.

The Proposed Action addresses this recommendation by the Defense Science Board and would include the construction and demonstration of a mobile microreactor that is capable of producing 1 to 5 MWe and meets the specific design goals and requirements identified by DoD/SCO that would be necessary for the practical deployment of the mobile microreactor. Two designs selected from a preliminary design competition are being considered; both are small, advanced gas-cooled reactors using high-assay low-enriched uranium (HALEU) tristructural isotopic (TRISO) fuel. The mobile microreactor would be fabricated at either BWXT Advanced Technologies, LLC or X-energy, LLC team facilities. Fuel would be

fabricated at BWXT facilities in Lynchburg, Virginia. Final assembly, fuel loading, and demonstration of the operability and mobility (proof-of-concept) of the mobile microreactor would be performed at the Idaho National Laboratory (INL) Site using DOE technical expertise and facilities at the Materials and Fuels Complex (MFC) and the Critical Infrastructure Test Range Complex (CITRC).

Demonstration testing would consist of startup testing, transportation between test locations, and testing at a second location at the INL Site. At the second testing location, the mobile microreactor system would be connected to a small, isolable electrical grid (microgrid) with diesel generators and load banks attached. The generators and load banks would apply realistic loads and supplies to the microgrid to test the mobile microreactor in a realistic setting. After demonstration testing, the mobile microreactor would be placed into temporary storage at the DOE facility. At some later time, it would undergo disposition. The mobile microreactor components would be disposed of at licensed disposal sites as appropriate for the waste type.

Preferred Alternative: The Proposed Action is the Preferred Alternative. Because a microgrid is required for the demonstration and testing of the mobile microreactor, no other alternatives or options were found to be practical to demonstrate operation of the mobile microreactor and mobility proof-of-concept. The No Action Alternative was also considered but does not meet the purpose and need.

Public Involvement: DOE issued a Notice of Intent to Prepare an Environmental Impact Statement in the Federal Register (85 Federal Register 12274) on March 2, 2020, to solicit public input on the scope and environmental issues to be addressed in this EIS. Comments received during the March 2 through April 1, 2020, scoping period were considered in the preparation of this Draft EIS. Comments on this Draft EIS will be accepted following publication of the U.S. Environmental Protection Agency Notice of Availability. Written comments can be submitted as noted above. Opportunities to provide oral comments will be provided at two public hearings to be held on Wednesday, October 20, 2021, from 3:00 p.m. to 5:00 p.m. and from 6:00 p.m. to 8:00 p.m. (all times in Mountain) at the Shoshone-Bannock Hotel and Event Center, 777 Bannock Trail, Fort Hall, Idaho 83203. These meetings will be livestreamed and recorded for later playback. The address for the livestream and a call-in phone number is available at https://www.mobilemicroreactoreis.com. The recording of the public hearing will be available at this same webpage after the meetings are held. In light of ongoing health concerns, these hearings could be subject to change or cancellation of the in-person portion due to evolving COVID-19 restrictions. Public notification would be made in the event of postponement or cancellation, including at https://www.mobilemicroreactoreis.com. Comments received during the comment period will be considered during the preparation of the Final EIS. Comments received after the close of the comment period will be considered to the extent practicable.

TABLE OF CONTENTS

List of Appendices

List of Tables

List of Figures

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHART

AC	alternating current
ALARA	as low as reasonably achievable
AMWTP	Advance Mixed Waste Treatment Project
ANL-W	Argonne National Laboratory – West
APE	area of potential effects
ATR	Advanced Test Reactor
BBS	breeding bird survey
BCC	Birds of Conservation Concern
BEIR	Biological Effects of Ionizing Radiation
BLM	Bureau of Land Management
BMP	best management practice
BWXT	BWXT Advanced Technologies
°C	degrees Celsius
CAA	Clean Air Act
CCA	Candidate Conservation Agreement
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CITRC	Critical Infrastructure Test Range Complex
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CONEX	container express (shipping container)
CWA	Clean Water Act
D&D	decontamination and decommissioning
DART	days away, restricted or on-the-job transfer
dBA	A-weighted decibels
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE-ID	Department of Energy-Idaho
DOE-NE	Department of Energy-Office of Nuclear Energy
DOME	Demonstration of Operational Microreactor Experiments
DOT	U.S. Department of Transportation
EA	Environmental Assessment
EBR-I	Experimental Breeder Reactor I
EBR-II	Experimental Breeder Reactor II
EIS	Environmental Impact Statement
EOL	end-of-life
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESER	Environmental Surveillance, Education, and Research
ESRP	Eastern Snake River Plain
°F	degrees Fahrenheit
FR	Federal Register
FY	fiscal year
GHG	greenhouse gas
GTCC	greater-than-Class-C
GTCC LLW EA	*Environmental Assessment for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste at Waste Control Specialists, Andrews County, Texas*
GTCC LLW EIS	*Final Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste*
GWP	global warming potential
HALEU	high-assay low-enriched uranium
HAP	hazardous air pollutant
HEPA	high-efficiency particulate air
HEU	highly enriched uranium
HEU FEIS	*Final Environmental Impact Statement for the Disposition of Highly Enriched Uranium*
HFEF	Hot Fuel Examination Facility
HLW	high-level radioactive waste
HTGR	high temperature gas-cooled reactor
I-##	U.S. Interstate (I-15, I-86, etc.)
ICRP	International Commission on Radiological Protection
IDA	International Dark-Sky Association
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
IPaC	Information for Planning and Consultation
IPDES	Idaho Pollutant Discharge Elimination System
ISCORS	Interagency Steering Committee on Radiation Standards
ISO	International Organization for Standardization
IWTS	Integrated Waste Tracking System
kg	kilograms

kV	kilovolt
kW	kilowatts
kWh	kilowatt-hours
LCF	latent cancer fatality
LEU	low-enriched uranium
LLW	low-level radioactive waste
LOS	level of service
LWR	light water reactor
MARVEL	Microreactor Applications Research, Validation and Evaluation
MBTA	Migratory Bird Treaty Act
MCL	maximum contaminant level
MEI	maximally exposed individual
MFC	Materials and Fuels Complex
MLLW	mixed low-level radioactive waste
MWe	megawatts of electrical power (megawatts-electric)
MWh	megawatt-hours
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Site
NO_2	nitrogen dioxide
NOI	Notice of Intent
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NRIC	National Reactor Innovation Center
O_3	ozone
ORNL	Oak Ridge National Laboratory
ORSA	Outdoor Radioactive Storage Area
OSHA	Occupational Safety and Health Administration
PAC	Protective Action Criteria
pCi/L	picocuries per liter
PEIS	Programmatic Environmental Impact Statement
PIE	post-irradiation examination
PM_{10}	particulate matter less than or equal to 10 microns in diameter
$PM_{2.5}$	particulate matter less than or equal to 2.5 microns in diameter
PSD	Prevention of Significant Deterioration
PTC	permit to construct
PUSCx	an excavated (x), palustrine (P) feature with an unconsolidated shore (US) that is seasonally flooded (C)
PyC	pyrocarbon
RCRA	Resource Conservation and Recovery Act
rem	roentgen equivalent man (a measure of radiation)
ROD	Record of Decision
ROI	region of influence
RSWF	Radioactive Scrap and Waste Facility
SCO	Office of the Secretary of Defense, Strategic Capabilities Office
SGCA	Sage-grouse Conservation Area
SGCN	Species of Greatest Conservation Need
SL-1	Stationary Low-Power Reactor Number One
SNF	spent nuclear fuel
SNF EIS	*Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Environmental Impact Statement*
SO_2	sulfur dioxide
SRPA	Snake River Plain Aquifer
TAP	toxic air pollutant
TRC	Total Recordable Cases
TREAT	Transient Reactor Test Facility
TRISO	tristructural isotropic
TRU	transuranic
UAV	unmanned aerial vehicle
U.S.	United States
U.S.C.	United States Code
US-20	U.S. Highway 20
US-26	U.S. Highway 26
USCB	U.S. Census Bureau
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VAC	volts alternating current
VOCs	volatile organic compounds
VP	Versa Pac
VRM	Visual Resources Management
VTR EIS	*Versatile Test Reactor Environmental Impact Statement*
WebTRAGIS	Web Transportation Routing Analysis Geographic Information System
WIPP	Waste Isolation Pilot Plant

CONVERSIONS

METRIC TO ENGLISH			ENGLISH TO METRIC		
Multiply	**by**	**To get**	**Multiply**	**by**	**To get**
Area					
Square meters	10.764	Square feet	Square feet	0.092903	Square meters
Square kilometers	247.1	Acres	Acres	0.0040469	Square kilometers
Square kilometers	0.3861	Square miles	Square miles	2.59	Square kilometers
Hectares	2.471	Acres	Acres	0.40469	Hectares
Concentration					
Kilograms/square meter	4.46	Tons/acre	Tons/acre	0.224	Kilograms/square meter
Milligrams/liter	1 [a]	Parts/million	Parts/million	1 [a]	Milligrams/liter
Micrograms/liter	1 [a]	Parts/billion	Parts/billion	1 [a]	Micrograms/liter
Micrograms/cubic meter	1 [a]	Parts/trillion	Parts/trillion	1 [a]	Micrograms/cubic meter
Density					
Grams/cubic centimeter	62.428	Pounds/cubic feet	Pounds/cubic feet	0.016018	Grams/cubic centimeter
Grams/cubic meter	0.0000624	Pounds/cubic feet	Pounds/cubic feet	16,018.5	Grams/cubic meter
Length					
Centimeters	0.3937	Inches	Inches	2.54	Centimeters
Meters	3.2808	Feet	Feet	0.3048	Meters
Kilometers	0.62137	Miles	Miles	1.6093	Kilometers
Radiation					
Sieverts	100	Rem	Rem	0.01	Sieverts
Temperature					
Absolute					
Degrees C + 17.78	1.8	Degrees F	Degrees F - 32	0.55556	Degrees C
Relative					
Degrees C	1.8	Degrees F	Degrees F	0.55556	Degrees C
Velocity/Rate					
Cubic meters/second	2118.9	Cubic feet/minute	Cubic feet/minute	0.00047195	Cubic meters/second
Grams/second	7.9366	Pounds/hour	Pounds/hour	0.126	Grams/second
Meters/second	2.237	Miles/hour	Miles/hour	0.44704	Meters/second
Volume					
Liters	0.26418	Gallons	Gallons	3.7854	Liters
Liters	0.035316	Cubic feet	Cubic feet	28.316	Liters
Liters	0.001308	Cubic yards	Cubic yards	764.54	Liters
Cubic meters	264.17	Gallons	Gallons	0.0037854	Cubic meters
Cubic meters	35.314	Cubic feet	Cubic feet	0.028317	Cubic meters
Cubic meters	1.3079	Cubic yards	Cubic yards	0.76456	Cubic meters
Cubic meters	0.0008107	Acre-feet	Acre-feet	1233.49	Cubic meters
Weight/Mass					
Grams	0.035274	Ounces	Ounces	28.35	Grams
Kilograms	2.2046	Pounds	Pounds	0.45359	Kilograms
Kilograms	0.0011023	Tons (short)	Tons (short)	907.18	Kilograms
Metric tons	1.1023	Tons (short)	Tons (short)	0.90718	Metric tons
ENGLISH TO ENGLISH					
Acre-feet	325,850.7	Gallons	Gallons	0.000003069	Acre-feet
Acres	43,560	Square feet	Square feet	0.000022957	Acres
Square miles	640	Acres	Acres	0.0015625	Square miles

a. This conversion is only valid for concentrations of contaminants (or other materials) in water.

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}

Summary

This page left blank intentionally.

SUMMARY

S.1 Introduction

The United States (U.S.) Department of Defense (DoD), Office of the Secretary of Defense, acting through the Strategic Capabilities Office (SCO), is the lead agency for this *Construction and Demonstration of a Prototype Mobile Microreactor Environmental Impact Statement* (EIS), and the U.S. Department of Energy (DOE) is a cooperating agency. This EIS has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended and the Council on Environmental Quality (CEQ) (40 Code of Federal Regulations [CFR] 1500 through 1508[1]). This EIS evaluates the implementation of Project Pele, including the fabrication of the microreactor components, fabrication of the fuel, transportation of the fuel and microreactor components to the Idaho National Laboratory (INL) Site, demonstration of the mobile microreactor concept, and temporary storage of the mobile microreactor at the completion of demonstration. Post-Project Pele activities evaluated include possible post-irradiation examination and disposition of the mobile microreactor.

The DoD is one of the largest users of energy in the world, consuming around 30 terawatt-hours of electricity per year and more than 10 million gallons of fuel per day (DoD SCO, 2021), and projections for future military operations predict energy demand will increase significantly in coming years. DoD installations need the capability to reduce their present reliance on local electric grids, which are highly vulnerable to prolonged outages from a variety of threats, such as natural disasters, cyber attacks, domestic terrorism, and grid failure from lack of maintenance and aging infrastructure. These scenarios are occurring with increasing frequency all over the world (e.g., natural disasters exacerbated by climate change, grid failure). This vulnerability places critical missions at unacceptably high risk of extended disruption.

Energy delivery and management continues to be a critical defensive risk for military operations. Inherent dangers, logistical complexities, and overwhelming costs of sustaining power demands at Forward Operating Bases,[2] Remote Operating Bases,[3] and Expeditionary Bases[4] continue to constrain operations and fundamental strategic planning. Backup power systems, using diesel generators, have limited on-site fuel storage, are undersized for many missions, are not prioritized to power critical electrical needs before noncritical needs, and are inadequate in duration and reliability. The modern battlefield has amplified the need for electrical power as well as the demand for fuel to provide mobility in the air and on the

[1] In July 2020, the CEQ comprehensively updated its NEPA regulations, which went into effect on September 14, 2020.However, the CEQ clarified that these regulations apply to all NEPA processes begun after the effective date, but gave agencies the discretion to apply them to ongoing NEPA processes (85 Federal Register [FR] 43304 (July 16, 2020). Development of this EIS was started prior to the effective date of the revised CEQ regulations, and SCO has elected to complete this EIS pursuant to the earlier CEQ regulations).

[2] Forward Operating Bases include both enduring locations with varying degrees of permissiveness, remoteness, and austerity, as well as semi-permanent contingency locations. Forward Operating Bases may be characterized by portable or semi-permanent shelters and are often established around existing airfields. These may include semi-permanent billeting, logistics facilities, and operating centers and may extend support to smaller, more remote locations, which could be characterized as patrol bases (DoD Defense Science Board, 2016).

[3] Remote Operating Bases are remote and austere military locations. Even though Remote Operating Bases are often permanent, many share the challenge of power insufficiency since they are far from established power grids. For example, providing adequate electrical power to Remote Operating Bases located in places such as Kwajalein, Guam, and remote Alaska, is costly and difficult (DoD Defense Science Board, 2016).

[4] Expeditionary Bases can rapidly aggregate or disaggregate in contingency locations that comprise any combination of remote or austere and permissive or non-permissive characteristics. Such bases are established and supported entirely with unit assets and are typically powered by tactical diesel generator sets. These expeditionary bases are intended to be mobile, while also serving as a hub for operational needs such as fuel, ammunition, food, water, communications, medical, and maintenance. They are capable of moving rapidly, often daily (DoD Defense Science Board, 2016).

ground. Technologies currently under development, such as new radar systems, new weapon systems, unmanned aerial vehicles (UAVs), and the electrification of the non-tactical vehicle fleet, will require even greater energy demands (DoD Defense Science Board, 2016).

Energy has increasingly become a source of vulnerability and a limitation on military freedom of action. Supplying liquid fuel to military forces is a significant challenge, as the commodity typically comprises a large portion of the mass transported to deployed locations. The logistics supply chain to sustain deliveries of energy to Forward Operating Bases, Remote Operating Bases, and Expeditionary Bases is an attractive target to an adversary and a burden on military capabilities to provide effective protection. Storage facilities for fuel enlarge the footprint and tactical signature of the facility, thus contributing to the vulnerability of the site and military and contractor personnel stationed there (DoD Defense Science Board, 2016).

The scale of the energy supply problem is affirmed by estimates that between 70 and 90 percent of the volume of goods delivered to Forward Operating Bases and expeditionary forces in Iraq and Afghanistan were accounted for by fuel and (to a lesser extent) water. The percentage of fuel used to support base operations (in comparison to mobile platforms) at five forward-deployed locations was estimated in 2008 to range from 13 to 78 percent. Estimates from Afghanistan show that "installation energy" (the energy consumed from on-site energy sources) made up approximately 40 to 60 percent of fuel demand in 2013 and 2014 (DoD Defense Science Board, 2016).

The fully burdened cost of any commodity, to include fuel or any form of energy, is very much scenario dependent. Costs of up to $400 per gallon of fuel have been reported for air-dropped fuel, though the cost of truck-delivered fuel during combat is more typically reported to be between $10 and $50 per gallon (DoD Defense Science Board, 2016).

On January 27, 2021, the President signed Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*. Executive Order 14008 prioritizes climate change considerations in national security and requires explorations of energy generating resources that create a sustainable climate pathway. The Executive Order requires that the United States organize and deploy the full capacity of its agencies to combat the climate crisis and implement a Government-wide approach that reduces climate pollution in every sector of the economy; increases resilience to the impacts of climate change; protects public health; conserves our lands, waters, and biodiversity; delivers environmental justice; and spurs well-paying union jobs and economic growth, especially through innovation, commercialization, and deployment of clean energy technologies and infrastructure. The Federal Government, consistent with applicable law, is required to take steps to ensure that Federal infrastructure investment reduces climate pollution and that Federal permitting decisions consider the effects of greenhouse gas emissions and climate change. In addition, the Federal Government must identify steps that can be taken, consistent with applicable law, to accelerate the deployment of clean energy and energy transmission projects in an environmentally stable manner.

The challenge is to develop more sustainable methods to provide reliable, abundant, and continuous energy. Recognizing this challenge, DoD commissioned the Defense Science Board to study alternative energy technologies for Forward Operating Bases, Remote Operating Bases, and expeditionary forces. The report prepared by the Defense Science Board (2016) noted that renewable sources of energy such as wind, tidal, solar, and similar energy sources can reduce the need for some fuel, but most renewable resources are limited by location, weather, time of year, storage capacity, available land area, and constructability. The intermittent character of many alternative energy sources requires energy storage technologies or redundant power supplies, and emerging technologies for improved energy storage do not appear able to keep pace with the growth of DoD's energy needs. These technologies and practices are useful to meet some current demands, and military adoption of renewable energy has occurred at domestic bases and in specific use cases in deployed locations—e.g., where a small source of power (a few watts) is needed to power sensors, UAVs, and warfighter power systems). For example, solar energy has shown the most promise to date, with successful demonstrations in remote outposts, for sensors and on UAVs. However, due to the intermittent supply and large footprint required, solar power does not offer the capability of conventional power production systems when significant amounts of on-demand power are needed. For the immediate future, diesel generators will continue to be the primary source of electrical power for U.S. military units (DoD Defense Science Board, 2016).

The Defense Science Board reviewed several nuclear reactor concepts that differ in size and technology from conventional commercial reactors and the small modular reactor concepts currently under development for commercial use. Some of these reactors, such as very small modular reactors with an output less than 10 megawatts of electrical power (MWe), may be transportable and deployable in Forward Operating Bases, Remote Operating Bases, and Expeditionary Bases and could eliminate the need for fuel otherwise dedicated to producing electrical power. Such nuclear energy power systems present an opportunity to "invert" the paradigm of military energy, where the extremities of U.S. military power could become the beneficiaries of reliable, abundant, and continuous energy, rather than the most energy-challenged segments (DoD Defense Science Board, 2016). In civilian applications, mobile microreactors could be transported to support disaster response work and provide temporary or long-term support to critical infrastructure like hospitals, as well as remote civilian or industrial locations where delivery of electricity and power is difficult (DoD, 2020).

S.2 Purpose and Need for Agency Action

The purpose of this action is to construct and demonstrate a prototype mobile microreactor. As described in EIS Section 1.1, *Introduction*, the Defense Science Board evaluated available energy technologies before concluding that electrical generating capability for Forward Operating Bases, Remote Operating Bases, and Expeditionary Bases can best be met by a less than 10 MWe microreactor system that can be safely and rapidly moved by road, rail, sea, or air for quick set up and shut down. The Defense Science Board recommended further engineering development and prototyping (DoD Defense Science Board, 2016).

Pursuant to the National Defense Authorization Act for Fiscal Year 2018 (Public Law 115–91, 131 Statute 1283 and 131 Statute 1857 Section 2831), as codified in 10 United States Code (U.S.C.) 2911 (*Energy policy of the Department of Defense*), the Secretary of Defense shall ''ensure the readiness of the armed forces for their military missions by pursuing energy security and energy resilience.'' Further, pursuant to the Consolidated Appropriations Act, 2020, Public Law 116–93, Division A, Title IV, and the Act's accompanying congressional explanatory statement, 165 Congressional Record H10613, H10886 (daily edition December 17, 2019), DoD and SCO received an appropriation for a prototype mobile microreactor.

In addition, Section 3 of Executive Order 13972 (January 5, 2021), *Promoting Small Modular Reactors for National Defense and Space Exploration*, called on the Secretary of Defense to establish and implement a plan to demonstrate the energy flexibility, capability, and cost effectiveness of a Nuclear Regulatory Commission (NRC)-licensed microreactor at a domestic military installation.

Before a mobile microreactor can be deployed, a prototype must be tested to ensure that it can meet regulatory requirements as well as DoD specifications and operational requirements.

S.3 Proposed Action

To meet the above described need, and after investigating alternatives for providing this electrical power-generating capability (DoD Defense Science Board, 2016), SCO, in partnership with DOE as a cooperating agency, proposes to construct and demonstrate an advanced prototype mobile microreactor (hereinafter referred to as the "mobile microreactor"). This project ("Project Pele") would construct and demonstrate a mobile microreactor that would be capable of producing 1 to 5 MWe and meet the specific design goals and requirements identified by SCO that would be necessary for the practical deployment of the mobile microreactor.[5] The mobile microreactor would be a small, advanced gas-cooled reactor using high-assay low-enriched uranium (HALEU)[6] tristructural isotropic (TRISO) fuel and air as the ultimate heat sink. TRISO fuel is encapsulated and has been demonstrated to be capable of withstanding temperatures up to 1,800 degrees Celsius (°C) (3,300 degrees Fahrenheit [°F]), allowing for a reactor design that relies primarily on simple passive features and inherent physics to ensure safety. All energy generated by the mobile microreactor that is not converted to electrical power would be transferred to the atmosphere (i.e., air would be the ultimate heat sink). Details of the proposed mobile microreactor and fuel are provided in EIS Chapter 2, Section 2.2, *Mobile Microreactor*.

On March 22, 2021, SCO announced two teams—led by BWXT Advanced Technologies, LLC (BWXT), Lynchburg, Virginia, and X-energy, LLC, Rockville (formerly Greenbelt), Maryland—would proceed with development of a final design for a mobile microreactor under Project Pele (DoD SCO, 2021). This announcement followed a preliminary design competition announced by SCO in April 2019 in which three companies were awarded agreements to develop preliminary designs. The two teams selected from the preliminary design competition continue design development independently. After a final design review in early 2022 and completion of this EIS under NEPA,[7] one of the two companies may be selected to build and demonstrate a mobile microreactor.

The joint effort between SCO and DOE, established by interagency agreement, would make use of DOE expertise, material, laboratories, and authority to construct and demonstrate this mobile microreactor. DOE would provide SCO regulatory oversight and expertise on technical, safety, environmental, and health requirements applicable to the construction and demonstration of the mobile microreactor. DoD has received authorization from DOE pursuant to its authority under the Atomic Energy Act (42 U.S.C. 2121(b), 2140) and National Security Decision Directive 282, September 30, 1987, for the acquisition and operation of a prototype reactor. The NRC, consistent with its role as an independent safety and security regulator, is participating in this project to provide SCO with accurate, current information on the NRC's regulations and licensing processes in connection with construction and demonstration of a mobile microreactor. Consistent with the non-commercial nature of the project, the prototype mobile microreactor may proceed under authorization by the Secretary of Energy.

Mobile microreactor fuel loading, final assembly, and demonstration would be performed at the INL Site using DOE technical expertise and facilities at the Materials and Fuels Complex (MFC) and Critical Infrastructure Test Range Complex (CITRC) (**Figure S-1**). The mobile microreactor would be fabricated at facilities owned and operated by, or subcontracted to, either BWXT Advanced Technologies or X-energy. Reactor fuel would be produced from DOE stockpiles of highly enriched uranium (HEU) located at DOE's Y-12 plant in Oak Ridge, Tennessee, that would be converted to an oxide form at the Nuclear Fuel Services (a subsidiary of BWXT) facility in Erwin, Tennessee, and downblended to HALEU and fabricated into TRISO fuel at the BWXT facility in Lynchburg, Virginia. The BWXT-Nuclear Fuel Services Erwin, Tennessee, and BWXT Lynchburg, Virginia, facilities are the only private U.S. facilities licensed to possess and process HEU.

---

[5] The Notice of Intent to Prepare an Environmental Impact Statement for Construction and Demonstration of a Prototype Advanced Mobile Nuclear Microreactor (85 FR 12274) described a Proposed Action that would construct and demonstrate a prototype mobile microreactor that would be capable of producing 1 to 10 MWe. The proposals submitted in response to the SCO solicitation for reactor concepts for the prototype mobile microreactor (DoD SCO, 2020) were for 5 MWe microreactors. Therefore, this EIS evaluates microreactors up to 5 MWe.

[6] HALEU is uranium in which the concentration of the isotope uranium-235 has been increased (enriched) to over 5 percent, but less than 20 percent. Highly enriched uranium (HEU) is uranium in which the concentration of the isotope of uranium-235 has been increased to 20 percent or higher.

[7] NEPA requires that the environmental analysis (in this case an EIS) be performed at the earliest reasonable time to ensure that agencies consider environmental impacts in their planning and decisions. For Project Pele, the NEPA process has been initiated prior to the final design selection.

The BWXT Lynchburg, Virginia, facility is the only domestic supplier of research reactor fuel elements (BWXT, 2021a; BWXT, 2021b). Therefore, these facilities have the unique capabilities to fabricate the microreactor fuel.

S.4 Public Involvement

The Notice of Intent (NOI) to prepare this EIS was published in the Federal Register (FR) on March 2, 2020 (85 FR 12274). The public scoping period started with publication of the NOI in the Federal Register. Initially, SCO provided a 30-day comment period (March 2 through April 1, 2020), but extended the comment period to April 30, 2020. Due to DoD travel restrictions and the public health concerns associated with the coronavirus (COVID-19) pandemic, SCO held a virtual scoping meeting instead of an in-person event as originally planned.

During the scoping period, 86 comment documents were received; 33 were requests to be added to the mailing list only, and 18 others did not include any comments on the scope of the EIS but rather expressed general support for the project or for a certain location for its development.

S.5 Decisions to Be Supported

This EIS provides the decision-maker with important information regarding potential environmental impacts for use in the decision-making process. In addition to environmental information, SCO will consider other factors (e.g., strategic objectives, feasibility, cost, schedule, safety, and security) when making its decision. The primary decision to be made regarding Project Pele is whether to:

- Fabricate and demonstrate a mobile microreactor at the INL Site.

If the decision is made to fabricate and demonstrate a prototype mobile microreactor at the INL Site, SCO may also make a decision on any of the options listed below:

- Conduct mobile microreactor core fueling and final assembly at MFC's Hot Fuel Examination Facility (HFEF) or the Transient Reactor Test Facility (TREAT) located about 0.5 mile northwest of MFC.
- Conduct mobile microreactor startup testing at MFC's National Reactor Innovation Center (NRIC) Demonstration of Operational Microreactor Experiments (DOME)[8] or CITRC.
- Temporarily store the mobile microreactor at MFC's Radioactive Scrap and Waste Facility (RSWF) or Outdoor Radioactive Storage Area (ORSA).

The mobile microreactor design determination by SCO will precede the decisions supported by this EIS. However, the analysis of impacts is applicable to (i.e., bounds) whichever of the two candidate mobile microreactor designs is selected.

S.6 Alternatives Analyzed

S.6.1 No Action Alternative

Under the No Action Alternative, a mobile microreactor would not be constructed, fuel would not be fabricated by BWXT, and the mobile microreactor would not be demonstrated at the INL Site.

[8] The DOME was formerly known as the Experimental Breeder Reactor-II (EBR-II) test bed.

Figure S-1. Idaho National Laboratory Site

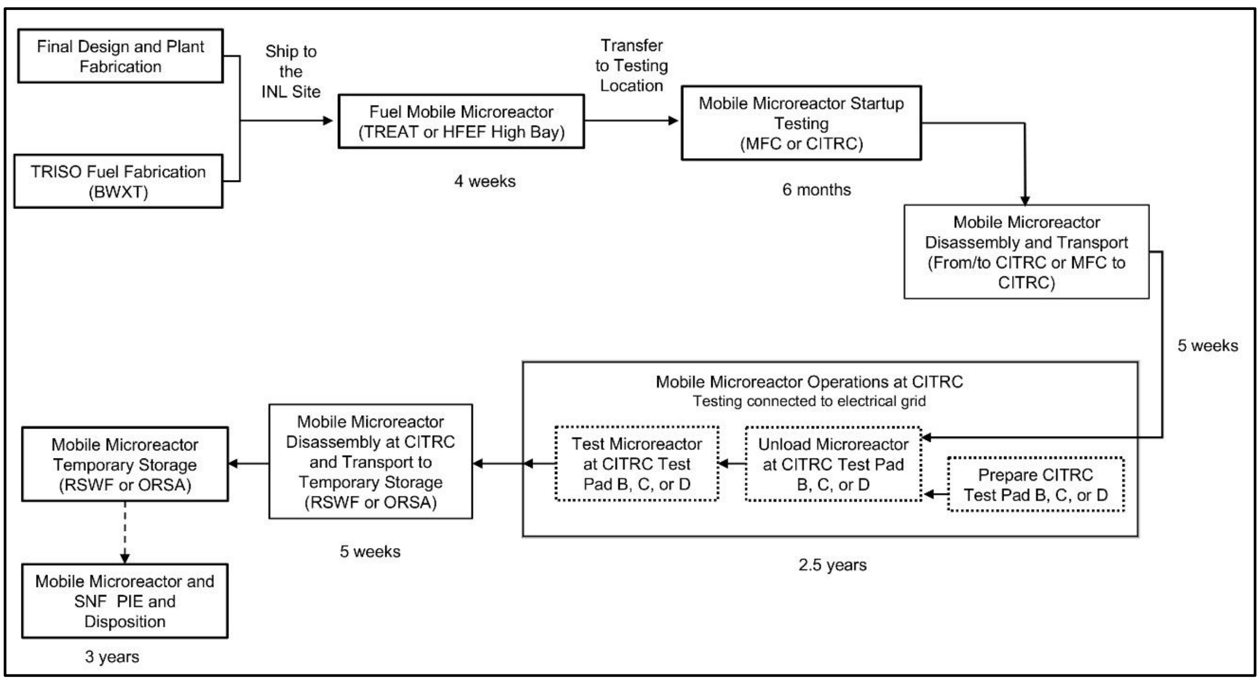
S.6.2 Proposed Action Alternative

Introduction to Fabrication and Demonstration of the Mobile Microreactor

The goal of Project Pele is to construct and demonstrate a mobile microreactor that would be capable of producing 1 to 5 MWe. This alternative consists of four separate activities:

- Microreactor fabrication
- Fuel fabrication
- Transport of the mobile microreactor from fabrication sites to the INL Site
- Mobile microreactor demonstration

The mobile microreactor will consist of mobile microreactor modules that would be manufactured at a commercial facility (either BWXT Advanced Technologies or X-energy team facilities). Fuel fabrication would be performed at BWXT facilities using existing stockpiles of HEU and depleted uranium from DOE's Y-12 facility at the Oak Ridge Reservation. Mobile microreactor final assembly and demonstration would be performed at the INL Site using DOE technical expertise and facilities at MFC and CITRC. Activities required to complete the Proposed Action are shown in **Figure S-2** with estimated durations of the demonstration phases.



Key: BWXT = BWX Technologies; CITRC = Critical Infrastructure Test Range Complex; HFEF = Hot Fuel Examination Facility; INL = Idaho National Laboratory; MFC = Materials and Fuels Complex: ORSA = Outdoor Radioactive Storage Area; PIE = post-irradiation examination; RSWF = Radioactive Scrap and Waste Facility; SNF = spent nuclear fuel; TREAT = Transient Reactor Test Facility; TRISO = tristructural isotropic

Note: Once shipped to the INL Site, all activities occur at the INL Site except for disposition to off-site spent fuel and waste disposal sites. The 2.5 years for Mobile Microreactor Operations at CITRC is the operational period for demonstration testing; site preparation of the CITRC test area could take an additional 6 months.

Figure S-2. Project Pele Flowchart

S.6.2.1 Mobile Microreactor Component Fabrication

Detailed descriptions of the two mobile microreactor designs are not available, as both are in the early design stage. They are the same in basic design and function. The two mobile microreactor designs under consideration for Project Pele are high-temperature gas-cooled reactors (HTGRs) using HALEU TRISO fuel

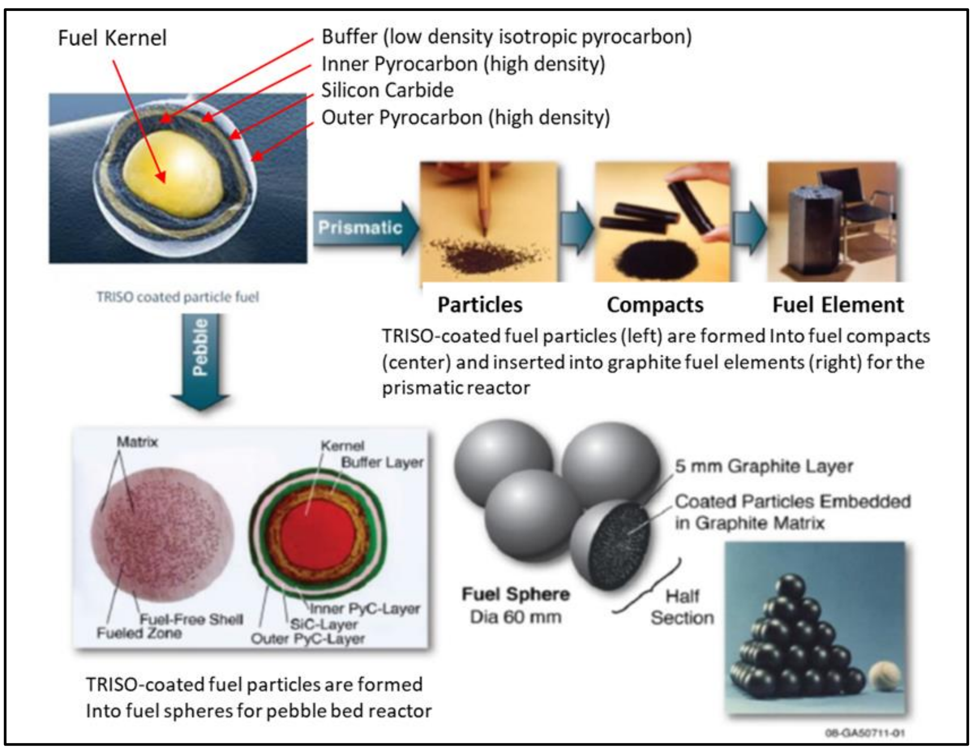
(DoD SCO, 2021). Both operate at a power level of 5 MWe or less. Power conversion would use a gas-driven turbine generator in the secondary coolant system to generate electrical power.

Each of the mobile microreactor designs would consist of three modules: microreactor, power conversion, and control modules. Each module would be contained within an International Organization for Standardization (ISO)-compliant container express (CONEX) container. The CONEX containers are about 8 feet by 8 feet by 20 feet. The microreactor CONEX container would hold the microreactor module: the mobile microreactor and primary cooling loop. A power conversion CONEX container would hold the power conversion module: a turbine generator, which converts the mobile microreactor thermal energy to electrical power that would be supplied to an electrical grid. The control CONEX container would hold the control module: instruments and equipment to monitor and control the microreactor and power conversion system operation. Ancillary (support) equipment needed for final assembly of the modules (cables, pipes, hoses, and connectors, etc.) would be packaged and shipped in another (fourth) CONEX container.

The three mobile microreactor modules would be manufactured at a commercial facility (BWXT Advanced Technologies or X-energy team facilities). These fabrication activities are expected to be within the scope of normal activities associated with the facility, and no reactor fuel would be present during construction. Once the modules are completed and loaded into the CONEX containers, they would be transported to the INL Site for microreactor fueling, assembly, and testing.

S.6.2.2 Mobile Microreactor Fuel Fabrication

Both mobile microreactor designs would be powered by up to 400 kilograms (kg) of HALEU TRISO fuel (**Figure S-3**).



Source: adapted from (Kitcher, 2020)

Key: mm = millimeter; PyC = pyrocarbon; SiC = silicon carbide; TRISO = tristructural isotropic

Figure S-3. TRISO Fuel

HEU would be supplied by the National Nuclear Security Administration (NNSA) and transferred to Nuclear Fuel Services (a subsidiary of BWXT) in Erwin, Tennessee, for conversion to an oxide form. The oxide form would be shipped from there to BWXT in Lynchburg, Virginia, for downblending to HALEU and fabrication into TRISO fuel for Project Pele. The downblending material would be shipped from the same NNSA facility to the BWXT Lynchburg, facility.

S.6.2.3 Transport of Reactor and Fuel to the INL Site

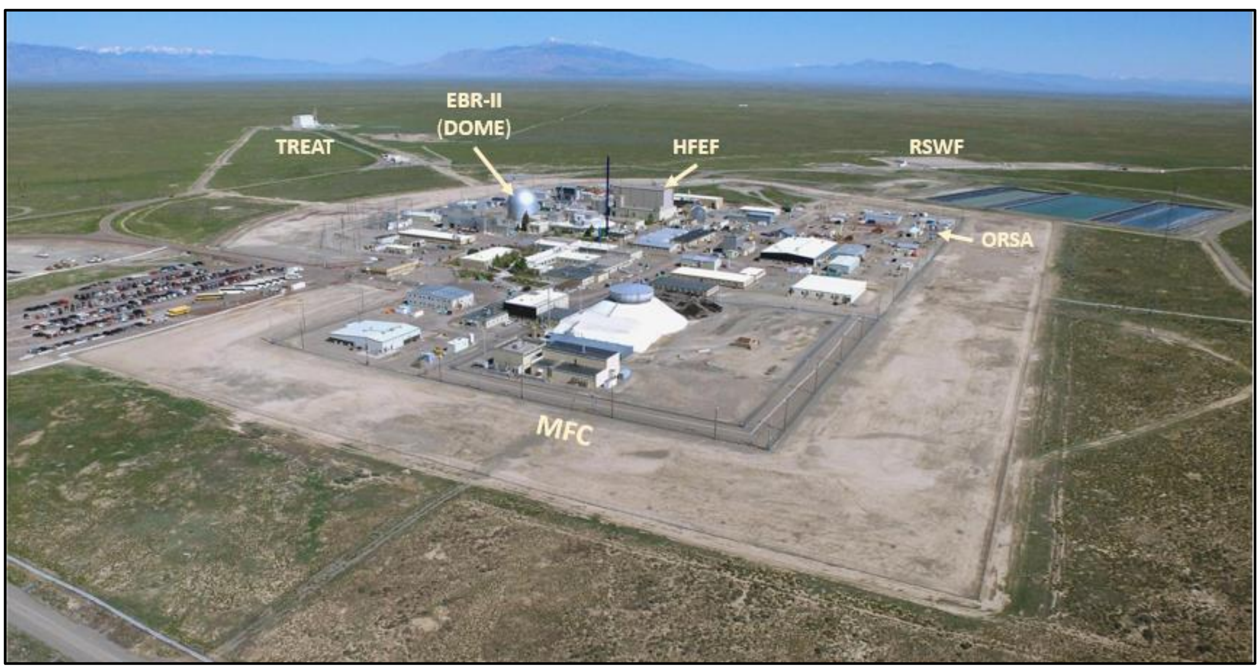
The unfueled mobile microreactor system would be shipped in four CONEX containers, from either X-energy or BWXT Advanced Technologies team facilities, to the INL Site. The fuel for the mobile microreactor would be shipped from BWXT's TRISO fuel manufacturing plant in Lynchburg, Virginia, to the INL Site. TRISO fuel would be shipped from BWXT Lynchburg to MFC at the INL Site in shipping containers that meet NRC and U.S. Department of Transportation (DOT) requirements for the shipment of radiological material. Shipping the mobile microreactor fuel from the BWXT facility to the INL Site could require up to 10 truck shipments (INL, 2021a).

S.6.2.4 Demonstration Activities at the INL Site

Project Pele would involve demonstration that the mobile microreactor could produce reliable electric power onto an electrical grid that is separate from the public utility grid[9] and that the mobile microreactor can be disassembled and moved. These activities are to be performed at the CITRC and MFC facilities on the INL Site. At the end of an approximately 3-year demonstration, current plans are that the mobile microreactor would be shut down and placed into a safe storage mode at the INL Site.

Fuel Mobile Microreactor at MFC

The mobile microreactor would arrive at the INL Site for installation at MFC without reactor fuel. The possible locations to perform the fueling of the mobile microreactor are TREAT or HFEF. **Figure S-4** shows the locations of the facilities at MFC that could be used to fuel the mobile microreactor.



Key: DOME = Demonstration of Operational Microreactor Experiments (formerly the EBR-II [Experimental Breeder Reactor-II] test bed); HFEF = Hot Fuel Examination Facility; MFC = Materials and Fuels Complex; ORSA = Outdoor Radioactive Storage Area; RSWF = Radioactive Scrap Waste Facility; TREAT = Transient Reactor Test Facility

Figure S-4. Project Pele MFC Facilities

[9] The demonstration does not include putting power onto a public utility's electrical grid.

The fuel loading would utilize the 60-ton crane at TREAT or the 30-ton crane in the truck lock at HFEF. Regardless of the facility chosen to fuel the microreactor, the microreactor module and the CONEX container housing it would be opened, the facility crane may be used to manipulate the microreactor and CONEX container, fuel would be added to the microreactor, and the microreactor and the CONEX container would be closed. The microreactor module then would be transferred to the initial startup testing location.

Mobile Microreactor Startup Testing

Final assembly of the mobile microreactor modules would occur at the site of the initial startup testing. The initial startup testing could be performed at the DOME at MFC (see **Figure S-4**). Improvements to the DOME are planned in support of other programs at the INL Site. These improvements to the DOME, while not a part of Project Pele,[10] are necessary for the DOME to be able to support the initial startup testing phase of the mobile microreactor demonstration. Should these improvements not be made in time to support the Project Pele schedule, final assembly and startup testing would be performed at CITRC.

Final assembly entails connecting the mobile microreactor modules. The modules within the CONEX containers would be attached via cables, conduit, and pipes transported with the mobile microreactor to the INL Site. At this phase of the demonstration, any power generated by the mobile microreactor would be transferred to load banks installed at the startup testing site; the mobile microreactor would not be connected to an electrical distribution grid. Load banks accurately mimic the operational or "real" load that a power source will see in actual application.

The microreactor module (in its CONEX container) would be placed in the DOME. Within the DOME, neutron and gamma radiation shielding materials would be used to limit the production of activation products and doses outside the DOME during operation. The remaining three CONEX containers (power conversion module, control module, and ancillary equipment) would be placed outside the DOME. At the DOME, the cables, conduits, and pipes would be routed through existing containment dome entry points and penetrations.

If startup tested at CITRC, the mobile microreactor would be set up as described in Section S.6.2.4, *Demonstration Activities at the INL Site*, *Mobile Microreactor Operations at CITRC*, including construction of a concrete pad and installation of shielding.

Regardless of the setup location, startup testing would be performed to verify that the mobile microreactor would perform as designed. Startup would be in accordance with DOE Order 425.1D Change 2 (DOE, 2019a), *Verification of Readiness to Start Up or Restart Nuclear Facilities*. The mobile microreactor would be operated to confirm that it can operate to DOE nuclear reactor safety basis requirements and all applicable DOE orders and standards as required.

The startup and initial testing phase is anticipated to take 6 months to complete.

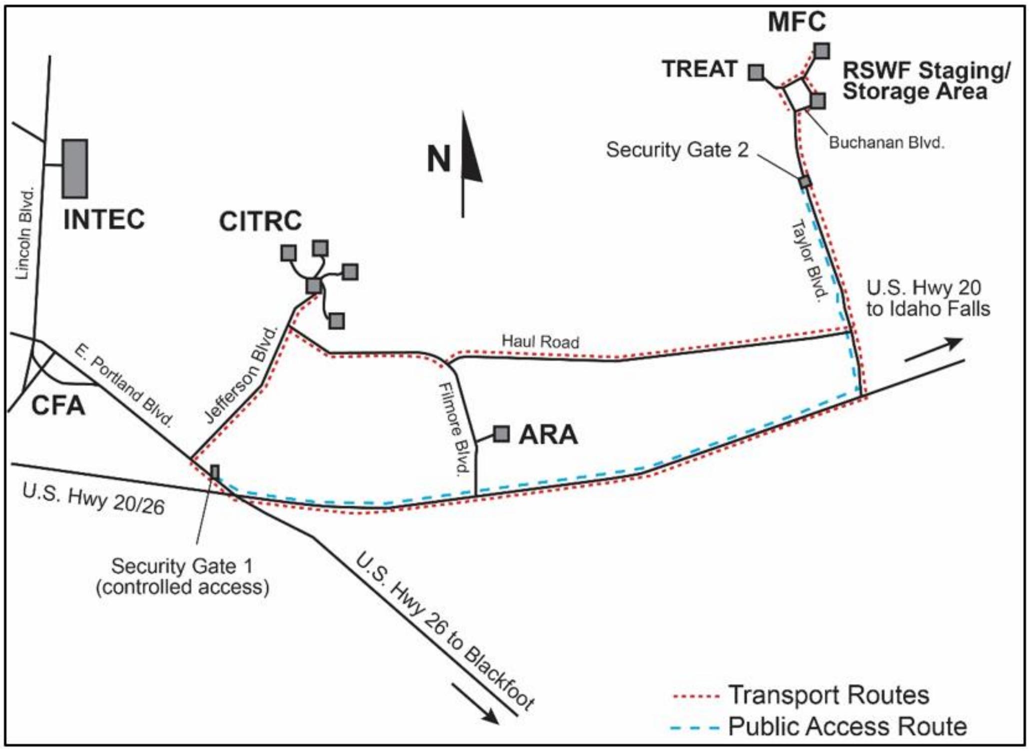
Disassembly and Transport

Disassembly and transport would occur between the startup testing and the operational testing phases at CITRC regardless of where startup testing would be performed. The disassembly and transport would provide proof-of-concept of the required mobility of the mobile microreactor.

The mobile microreactor would be disassembled at the startup testing site with minimal temporary laydown requirements (for the collection of conduit, piping, etc.). The mobile microreactor would be placed in a safe shutdown mode in which decay heat (from radiation) would be removed via the passive heat removal systems. The mobile microreactor modules would be separated from each other and loaded

[10] Modifications to the DOME proposed by DOE under the National Reactor Innovation Center (NRIC) program at INL are not dependent on any actions taken in support of Project Pele.

onto semi-trailers for transport. Cables that can be reused that are not specific to DOME application would be packaged and reused at the second testing location. Cables that cannot be reused would be disposed of. The haul road[11] or U.S. Highway 20 (US-20) would be used to transport the mobile microreactor (see **Figure S-5**). If US-20 is used, the road would be shut down during non-peak hours, to enable safe and unhindered transport of the mobile microreactor between the two locations.[12]



Key: ARA = Auxiliary Reactor Area; ATR = Advanced Test Reactor; CFA = Central Facilities Area; CITRC = Critical Infrastructure Test Range Complex; Hwy = Highway; INTEC = Idaho Nuclear Technology and Engineering Center; MFC = Materials and Fuels Complex; RSWF = Radioactive Scrap and Waste Facility; RWMC = Radioactive Waste Management Complex; TREAT = Transient Reactor Test Facility

Figure S-5. Transportation Routes Between MFC and CITRC

If startup testing is performed at the DOME, site restoration would entail the removal of shielding and returning the site to its original configuration. Site restoration would not be necessary at this point if the startup testing is performed at CITRC. The mobile microreactor would be returned to the same test pad, and the existing radiation shielding would be used for the next phase of the mobile microreactor demonstration.

This phase is anticipated to take around 5 weeks to complete.

Mobile Microreactor Operations at CITRC

CITRC is part of the INL Site's 61-mile 138-kilovolt (kV) power loop electric test bed and supports critical infrastructure research and testing. CITRC includes a configurable and controllable substation and a 13.8-kV distribution network. The CITRC infrastructure includes four user locations on a distribution network that can operate alone or together to support larger operations at any of multiple test voltage levels. Each user location allows connection to 13.8-kV power to supply a separate source of noninterrupted power to support test operations. Fiber optic cables route to a centralized command and

[11] Haul road is a term for roads designed for heavy or bulk transfer of materials by haul trucks.

[12] The portion of US-20 that would be used is entirely within the INL Site. With the closure of this portion of US-20 during the transport of the mobile microreactor, DOT and NRC off-site transportation regulations are not applicable (49 CFR 171.1 (d) (4)).

control shelter allowing communications between any combination of user locations and between the user locations and the command shelter (DOE-ID, 2019b).

Four test pads are located at CITRC within the CITRC distribution grid (Pads A, B, C, and D). Some testing connects multiple test pads using the CITRC electrical distribution infrastructure. These graveled or paved test pads furnish areas to place test equipment (e.g., transformers, circuit breakers, switches). Test pads also serve as parking areas for personnel performing setup and testing. (DOE-ID, 2019b)

Preparation of the CITRC site would be performed over the course of up to 6 months prior to the arrival of the mobile microreactor at the site. Preparation would involve construction of a 200-foot by 200-foot concrete pad about 8 inches thick to create a level surface for the CONEX containers.

Upon arrival at the test pad area for Pad B, C, or D at CITRC, the mobile microreactor would be offloaded from the transports to the concrete pad at the test pad area and the mobile microreactor modules reconnected (**Figure S-6**). The temporary shielding, consisting of concrete T-walls, steel-reinforced concrete roof panels, concrete wall blocks, steel bladders for water shielding, and HESCO® bags, would be installed. The completed shielding structure would be about 5,000 square feet and up to 30 feet tall around the microreactor and power conversion modules. No other construction is anticipated. In addition, the power conversion module would be connected to the test bed equipment. A limited version of the startup tests performed at the DOME (or CITRC) would be performed to verify that no modules were damaged during transport.

Figure S-6. Mobile Microreactor Located at CITRC Test Pad D Area

At CITRC, the mobile microreactor system would be integrated into a specific engineered test microgrid[13] utilizing the CITRC power distribution system (which is controlled and managed by INL) for interconnection, monitoring, and typical utility power needs. Diesel generators and load banks would be attached to the microgrid. The generators and load banks would apply realistic loads and supplies to the microgrid to test the mobile microreactor in a realistic setting. Additional pads would be used to house the load banks and diesel generators to simulate a microgrid (i.e., electrical power loads for the mobile microreactor) during testing. The design could require a mobile office trailer that would contain a restroom, potable water, donning/doffing facilities, equipment storage, charging stations, etc.

At-power testing performed at power levels from low power to full-rated power and, according to test procedures yet to be developed, would verify the ability of the mobile microreactor to operate at its rated power level for an extended period under normal, off-normal (but expected), and upset (not expected but anticipated) conditions. Transient tests performed would demonstrate mobile microreactor features, not push it to damage conditions. Transient testing would demonstrate upset conditions that would last at most a couple of days but more likely hours. Under normal circumstances, TRISO fuel would not be removed from the mobile microreactor, but if an issue occurs during testing, material may need to be extracted and taken to MFC for testing.

The mobile microreactor operations phase at CITRC is anticipated to take around 2.5 years to complete, although this phase could be slightly longer or shorter based on the progress of the test program.

Disassembly and Transport from CITRC to Temporary Storage

Disassembly and transport from CITRC to temporary storage would be similar to disassembly and transport from MFC to CITRC. Therefore, the project description information provided above for disassembly and transport from MFC to CITRC can be used to describe this phase of the project.

Temporary Storage at the INL Site

After operational testing, the mobile microreactor would be placed in temporary storage, awaiting eventual disposition. There are two options for temporary storage of the mobile microreactor system (within their CONEX containers) at the INL Site: the RSWF receiving area (facility number MFC-771) and ORSA (MFC-797) (see **Figure S-4**).

ORSA is an outdoor storage area for radioactive material. Material stored in this area must be stored in an ISO-standard container. The area already has a fence, but temporary storage of the mobile microreactor would require minor upgrades in fencing and instrumentation.

RSWF is an outdoor storage facility for storage and staging. Use of this storage area for temporary storage of the mobile microreactor would not require any construction.

A reinforced concrete pad and shed would be constructed at the temporary storage location.

There is no defined duration for this phase. Temporary storage of at least portions of the mobile microreactor would continue until an off-site spent nuclear fuel disposal facility or geologic repository is available to accept the mobile microreactor spent nuclear fuel.

Post-Irradiation Examination and Disposition

After the mobile microreactor's useful life is complete and after a period of temporary storage, all the materials would be disposed of. The mobile microreactor components would be disposed of through the appropriate waste streams. It is anticipated that the mobile microreactor would be deconstructed and

[13] A typically small isolated electrical transmission and distribution system able to function independently from any larger grid.

parts, fuel, or both would be removed to aggregate like-class wastes.[14] After deconstruction, irradiated materials would be stored with other similar DOE-irradiated materials and experiments at MFC, most likely in the HFEF or the RSWF, in accordance with DOE's *Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE, 1995a), Record of Decision (DOE, 1995b), supplemental analyses, and the amended Record of Decision (DOE, 1996a). Ultimate disposal of the irradiated materials that have been declared waste would occur along with similar DOE-owned irradiated materials and experiments currently at MFC.

Although not specifically part of Project Pele, and while no decision has been made to pursue any post-irradiation examination (PIE) activity, further evaluation through PIE of components and fuel could provide the means to gather information about the fuel's performance. If a determination to pursue PIE of mobile microreactor fuels and components is made, the mobile microreactor would need to be defueled and deconstructed at the INL Site and fuel and components transferred to a facility with hot cells[15] for PIE. Even if a decision is made that no PIE would be performed on the mobile microreactor, it would be defueled and deconstructed to facilitate disposal of the mobile microreactor components. The INL Site has existing facilities for the handling of spent fuel, such as the Irradiated Fuels Storage Facility (facility number CPP-603), the Fluorinel Dissolution Process and Fuel Storage facility (CPP-666), the Fuel Processing Restoration Facility (CPP-691), the Remote Analytical Laboratory (CPP-684), the Material Security and Consolidation Facility (CPP-651), TREAT (MFC-720), the Fuel Conditioning Facility (MFC-765), and HFEF (MFC-785). Additionally, the DOME or a temporary hot cell facility near MFC could be used. The specific facility for any defueling activity has not been identified nor have any procedures or plans been developed for such an activity. These are activities routinely performed at the INL Site, and the laboratory has developed generalized procedures that would be tailored to the defueling of the mobile microreactor. Selection of the facility and plan development may not be done until a decision has been made regarding what fuels and components would be selected for PIE and may depend on facility availability, costs associated with the use of each facility,[16] and the microreactor design ultimately selected for Project Pele.

Any spent fuel designated for disposal would be packaged in standard casks and transferred to a storage location on the INL Site (several locations such as the Idaho Nuclear Technology and Engineering Center [INTEC] or RSWF would be capable of storing the spent fuel) pending shipment to an interim storage facility or geologic repository.

If PIE were to be performed on the mobile microreactor materials of interest, HFEF at MFC would most likely be used in conjunction with additional facilities that may be used for small-scale samples, e.g., analytical chemistry. These materials would include the mobile microreactor fuel and potentially some mobile microreactor components. The determination of the components that could be of interest for PIE would not be made until after the demonstration testing has progressed for some time and possibly after it has been completed.

The HFEF hot cells would not require modifications to perform PIE. HFEF operations to support the Project Pele mission are within the scope of activities currently performed at HFEF.

[14] It is anticipated that the reactor vessel and two of the CONEX containers would be disposed of as low-level radioactive waste. The remaining two CONEX containers and components within would be nonradioactive waste and disposed of in the appropriate waste stream (hazardous, nonhazardous, etc.).

[15] Hot cells are structures used for the examination of highly radioactive material and include concrete walls and multilayered leaded-glass windows several feet thick. Remote manipulators allow operators to perform a range of tasks on test specimens within the hot cell while protecting themselves from radiation exposure.

[16] The facility modifications needed to perform defueling vary from facility to facility.

The disposition and PIE (if performed) would be performed in parallel and would take around 3 years to complete.

S.7 Alternatives Considered but Dismissed from Detailed Analysis

SCO evaluated a range of reasonable alternatives for the Proposed Action in this EIS, as well as a No Action Alternative that serves as a basis for comparison with the action alternatives. The following site features were identified as necessary to accomplish the Proposed Action and were used as screening criteria to identify candidate locations (INL, 2021a):

- A characterized site that has been previously used for nuclear activities that has sufficient infrastructure to support nuclear operations.
- Access to an electrical grid and a grid independent from the commercial grid capable of performing research.
- A site that has options for transportation and handling of the mobile microreactor equipment and an irradiated reactor
- An established control zone with security and emergency response trained in nuclear operations to facilitate emergency planning for reactors with safety features not previously demonstrated.
- Adjacent nuclear facilities available for examination and characterization of radioactive components and materials (e.g., hot cells).
- Sufficient space for transportation and operational testing and evaluation of the mobility of the prototype microreactor or its components within the boundaries of the site, including both indoor and outdoor testing facilities.
- A site that is or can be subject to DOE authority or control.
- Current experience in operating nuclear reactors.

As stated in the NOI to prepare the EIS (85 FR 12274), a review of DOE laboratories identified two as candidates for demonstration of the mobile microreactor: the INL Site and the Oak Ridge National Laboratory (ORNL).

The ORNL site met almost all the siting criteria, but, most significantly, ORNL does not have an independent electrical distribution system that can be isolated from the commercial power grid. The demonstration requires an independent, isolable electrical distribution system. The program for demonstration of the mobile microreactor is intended to demonstrate its operation under a wide variety of operational conditions. Demonstration of all these capabilities in a controlled environment requires the ability to receive power from an existing electric grid, as well as dispatch mobile microreactor–generated power to an isolated and locally controlled distribution system. Specifically, testing requirements include criteria that assess load following capabilities, including but not limited to variations in capacity and rate-of-change, output voltage (600 to 69,000 volts alternating current [VAC]), and paralleling as part of an asset used singly or in combination with other generators. Therefore, ORNL was not considered for further analysis.

Once the INL Site was determined to meet the requirements for the demonstration of the mobile microreactor, several indoor and outdoor sites at the INL Site were identified as potential locations for mobile microreactor demonstration activities. Site selection at INL (INL, 2021b) tiered off previous site selection efforts for the NRIC (INL, 2020a). CITRC Test Pads A, B, C, and D and a location on Test Area North were considered, along with the sites considered for the NRIC. This brought the total number of sites evaluated to 37: 5 indoor sites and 32 outdoor sites.

Outdoor sites that were considered were located on or adjacent to several INL facilities (ATR, CFA, CITRC, INTEC, MFC, Naval Reactors Facility, and Test Area North) or at more undeveloped locations on the INL Site. Of these sites, only the CITRC test pad areas met all the siting criteria. Most candidate sites were eliminated for a failure to meet the criteria of being a previously impacted site of a minimum of 0.25 acre. For those that met this criteria, the failure to meet electrical connection criteria or location criteria (not more than 5 miles from a hazardous site) resulted in their elimination from consideration.

The following five sites were considered for an indoor location for testing of the mobile microreactor:

- Fuel Processing Restoration Facility (CPP-691) located at INTEC
- DOME located at MFC
- Zero Power Physics Reactor located at MFC
- CITRC Control System Research Facility (PBF-612)
- CITRC Communications Research Facility (PBF-613)

In addition to the general siting criteria, the following distinguishing requirements for the mobile microreactor were considered in the evaluation of indoor locations:

- Must provide egress from the demonstration site large enough to accommodate CONEX containers plus shielding
- Must be able to keep the temperature inside the demonstration site facility below 115°F (46.1°C)
- Must enable connection of the microreactor module to support modules
- Must provide a demonstration site facility with a floor loading capacity of 42 tons, minimum
- Must enable movement of the shielded microreactor in and out of the facility
- Must enable lifts of 10 tons maximum to move piping within the facility, if applicable

Of the five facilities considered, only the DOME met all acceptance criteria.

S.8 Preferred Alternative

The Proposed Action is the Preferred Alternative. The mobile microreactor would be fabricated at either BWXT Advanced Technologies or X-energy team facilities, fuel would be converted to an oxide at BWXT's Nuclear Fuel Services, Inc facilities in Erwin, Tennessee, and fabricated at the BWXT facility in Lynchburg, Virginia. Both fuel and the mobile microreactor would be transported to the INL Site, where facilities at MFC and CITRC would be used to demonstrate operation of the mobile microreactor and mobility proof-of-concept.

S.9 Summary of Environmental Consequences

S.9.1 Comparison of Alternatives

Table S-1 summarizes potential environmental consequences for the Proposed Action at the INL Site. All activities at the fuel fabrication sites are addressed in existing NEPA documentation; environmental impacts associated with the fuel fabrication activities of Project Pele would be bound by the impacts previously identified. Microreactor fabrication is a typical industrial activity to be performed at existing facilities that operate under applicable permits and regulations. Fabrication of the mobile microreactor (over a period of less than 2 years) would be a small part of the activities at these facilities. Under the No Action Alternative, there would be no increase in environmental impacts at the INL Site and the fuel and reactor fabrication sites beyond the existing conditions described in Chapter 3, *Affected Environment*.

Table S-1. Summary of Project Pele Environmental Consequences

Resource Area	***Impacts Summary***
Land Use and Aesthetics (Chapter 4, Section 4.1)	
Land Use	There would be minor impacts on land use from the disturbance of less than 2 (up to about 1.6) acres during construction activities at the CITRC test location. Less than an additional 0.1 acre would be disturbed at the temporary storage site. No additional land would be disturbed during operations.
Aesthetics	Localized and temporary visual impacts could result from construction equipment (e.g., cranes), but only in areas within the line of sight of CITRC and the temporary storage location during construction. Construction and other related activities at CITRC would be limited to daylight hours with very limited or nonexistent nighttime or weekend work and thus would not contribute to any local or regional night sky impacts. New facilities associated with mobile microreactor demonstration would be designed to minimize, to the extent practicable, new sources of light pollution. Impacts on the Craters of the Moon National Monument and Preserve (an International Dark-Sky Park) would not be expected from exterior lighting required for the mobile microreactor demonstration at CITRC.
Geology and Soils (Chapter 4, Section 4.2)	
	Area disturbed would be less than 2 acres. Volume of excavated materials would be about 4,250 cubic yards. Rock/gravel needed would be 3,200 cubic yards. The total quantities of geologic and soil materials needed during construction would represent small percentages of regionally plentiful resources and are unlikely to adversely impact geology and soil resources. At the conclusion of testing, any soil determined to be LLW would be removed and the area returned to a state allowing unrestricted access and use.
Water Resources (Chapter 4, Section 4.3)	
Surface Water	No effluent would be discharged across the previously graded ground surface, and no surface water would be used. No activities are expected to add to or change the constituents in the stormwater discharge during construction. Sanitary wastewater from the construction and operational workforce would be handled by existing on-site systems.
Groundwater	No effluent would be discharged directly to groundwater, and thus, the Proposed Action would not adversely affect groundwater quality. The Proposed Action would use 260,500 gallons of groundwater over the approximately 6 years of mobile microreactor demonstration and potential PIE activities.
Air Quality (Chapter 4, Section 4.4)	
	None of the proposed operations would produce substantial air emissions. The combined annual emissions from all sources would be well below annual indicator thresholds. Therefore, annual emissions from the proposed project would not result in adverse impacts to air quality. The mobile and/or intermittent operation of project emission sources would result in dispersed concentrations of air pollutants at locations outside the INL Site. The transport of these emissions to the nearest boundary of the Craters of the Moon National Monument and Preserve would produce substantial dispersion and would result in negligible concentrations of air pollutants within this pristine Class I area. PM_{10} emissions from the project also would negligibly impact the nearest PM_{10} nonattainment or maintenance area to the INL Site, which is the Fort Hall Indian Reservation PM_{10} nonattainment area in northeastern Power County and northwestern Bannock County.
Biological Resources (Chapter 4, Section 4.5)	
	The Proposed Action could disturb 28 vegetated acres across Pads B, C, or D at CITRC. Appropriate mitigations (such as sagebrush replacement, invasive species management, and the INL Revegetation Assessment program) would be enforced. As described in Section 4.10, *Human Health – Normal Operations*, radiological emissions from the Proposed Action would not substantially contribute to impacts on human health or biological resources. If an unforeseen

Table S-1. Summary of Project Pele Environmental Consequences (Continued)

Resource Area	*Impacts Summary*
	hypothetical accident were to occur, radiological exposure could affect biological resources. Some plant and wildlife species may be more sensitive than others. In general, exposure to radiation may lead to increased mutation rates, reduced growth rates, changes in pollen production and seed viability, as well as abnormal development.
Cultural and Paleontological Resources (Chapter 4, Section 4.6)	
	The proposed project is expected to have no effect on ethnographic, significant cultural, and paleontological resources from construction and land disturbance.
Infrastructure (Chapter 4, Section 4.7)	
	The Proposed Action would use 140 megawatt-hours of electricity, with the majority (100 megawatt-hours) of this associated with any PIE activities, 34,000 pounds of propane, and 210,500 gallons of water for staff and operational use plus another 50,000 gallons of water for the water bladders used for neutron shielding. Additionally, small quantities of diesel fuel (72,000 gallons) and gasoline (9,000 gallons) would be used.
Noise and Vibration (Chapter 4, Section 4.8)	
	The noise generated from operation would be consistent with other existing industrial activities and equipment at the INL Site and the potential concurrent noise would be similar to existing levels at the INL Site. Due to the distance, estimated noise levels at the INL Site boundary (5.9 miles from CITRC) and closest receptor (6.5 miles) would not be perceptible and would be consistent with ambient levels. Ground-borne vibration due to construction and operational activities are expected to be below the threshold of human perception at off-site locations.
Waste Management and Spent Nuclear Fuel Management (Chapter 4, Section 4.9)	
	Small amounts of waste and spent nuclear fuel would be generated as a result of the proposed project. All waste would be packaged on-site and would be disposed of off-site or stored at approved INL Site facilities. **Low-Level Waste** 247.1 cubic meters 533.4 meters 50 connections (units) **Mixed Low-Level Waste** 3.2 cubic meters **Cold Waste** 2,379.7 cubic meters 92.9 meters **Tru or GTCC-Like Waste** Small quantities (less than 3.4 cubic meters) **Spent Nuclear Fuel** Small quantities (less than 3.4 cubic meters)
Human Health – Normal Operations (Chapter 4, Section 4.10)	
	The annual dose to individuals in the INL Site areas from natural background radiation is about 380 millirem per year (Section 3.10.1, *Radiation Exposure and Risk*). The estimated population dose from natural background to the approximately 257,000 persons within 50 miles of the proposed operations is about 98,000 person-rem. The dose from demonstration of the microreactor to both the maximally exposed individual and the total population would be an insignificant fraction of this dose (equivalent to less than 15 minutes of exposure to natural background radiation and much less than the dose received on a flight from New York to Los Angeles). No latent cancer fatalities (LCF) would be expected to result from these doses. *Operations (annual radiological impacts)*: Off-site population within 50 miles

Table S-1. Summary of Project Pele Environmental Consequences (Continued)

Resource Area	*Impacts Summary*
	Dose: less than 0.001 person-rem LCFs: 0 (less than 1 x 10^{-6}) (i.e., less than 0.000001) Maximally exposed individual Dose: less than 0.01 millirem LCF risk: less than 1 × 10^{-8} (i.e., less than 0.00000001) Worker population Dose: 3 person-rem LCFs: 0 (calculated: 2 × 10^{-3}) (i.e., 0.002) Industrial accidents: less than 1 injury with no fatalities expected.
Human Health – Facility Accidents (Annual Impacts) (Chapter 4, Section 4.11)	
	Because of the protective characteristics of the TRISO fuel particles, only a very, very small fraction of the radioactive materials would be released from the fuel under operating or accident conditions and temperatures. As a result, radiological impacts to the public from any accident would be a small fraction of an individual's annual natural background radiation dose rate of about 0.38 rem per year. The largest impacts to receptors would be associated with different accidents. Both the off-site population and non-involved worker dose shown would be associated with an operational accident at CITRC. The maximally exposed individual dose would be associated with an inadvertent criticality accident (i.e., accidental uncontrolled nuclear fission chain reaction) during transport of the mobile microreactor between locations on the INL Site. Projected radiological impacts from the accident with the largest consequences are: Off-site population within 50 miles Accident probability: less than one in 10,000 per year Collective Population Dose: 12 person-rem In contrast, the projected population dose from natural background is about 98,000 person-rem. (approximately 0.380 rem per year [Section 3.10.1] x 257,000 people or 98,000 person-rem) LCFs: 0 (0.007) Maximally exposed individual Accident probability: less than one in 10,000 per year Dose: 0.031 rem (natural background 0.38 rem per year) LCF risk: 2 × 10^{-5} (i.e., 0.00002) Non-involved worker Accident probability: less than one in 10,000 per year Dose: 0.52 rem LCF risk: 3 × 10^{-4} (i.e., 0.0003)
Human Health – Transportation Impacts (Chapter 4, Section 4.12)	
	The transportation of radioactive material (fuel) and waste likely would result in no additional fatalities as a result of radiation, either from incident-free operation or postulated transportation accidents. No potential traffic fatalities would be expected over the duration of activities. The nonradiological accident risks (the potential for fatalities as a direct result of traffic accidents) are greater than the radiological accident risks.
Traffic (Chapter 4, Section 4.13)	
	The impacts on traffic from the Proposed Action are anticipated to be negligible to minor.

Table S-1. Summary of Project Pele Environmental Consequences (Continued)

Resource Area	*Impacts Summary*
Socioeconomics (Chapter 4, Section 4.14)	
	The increase in jobs and income from construction and operations would have a small and short-term beneficial impact on the local and regional economy. The population influx associated with an in-migrating workforce and their families is considered relatively small and would have no major adverse impacts on the region in terms of population, employment, income levels, housing, or community services.
Environmental Justice (Chapter 4, Section 4.15)	
	No disproportionately high and adverse impacts on minority or low-income populations are expected. Increased health risks to minority or low-income individuals or populations exposed to radiation would be negligible.

Key: CITRC = Critical Infrastructure Test Range Complex; HALEU = high-assay low-enriched uranium; INL = Idaho National Laboratory; LCF = latent cancer fatality; LLW = low-level radioactive waste; PIE = post-irradiation examination; PM_{10} = particulate matter less than or equal to 10 microns in diameter; rem = roentgen equivalent man (a measure of radiation); TRISO = tristructural isotropic

S.9.2 Cumulative Impacts

CEQ regulations define cumulative impacts as effects on the environment that result from implementing any of the alternatives when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions (40 CFR 1508.7). Cumulative impacts were assessed by combining the effects of activities at the INL Site for the Proposed Action assessed in this EIS with the effects of other past, present, and reasonably foreseeable future actions. Many of these actions occur at different times and locations and may not be truly additive, but the effects were combined irrespective of the time and location of the impact, to encompass any uncertainties in the projected activities and their effects. This approach produces a conservative estimate of cumulative impacts for the activities considered. **Table S-2** presents a summary and comparison of cumulative impacts at the INL Site.

Table S-2. Summary of Cumulative Impacts

Resource Area	*Cumulative Impacts*
Land Use and Aesthetics	Activities evaluated under the Proposed Action would disturb less than 2 acres of primarily previously disturbed land, or less than 0.01 percent of the 45,400 acres of currently developed land at the INL Site and less than 0.001 percent of the 569,600 acres of land available at the INL Site, and would represent a negligible contribution to cumulative impacts on land use impacts. Because construction would disturb less than 2 acres, would be located at CITRC in a developed area, and would be geographically separated from most of the other activities at the INL Site, the Proposed Action would represent a negligible contribution to cumulative impacts on aesthetics impacts.
Geology and Soils	Based on the information presented above for Land Use, the amount of soil in predominately previously disturbed areas by the Proposed Action would be a small percentage of the total soil disturbed at the INL Site. The amount of geologic and soils materials used by the Proposed Action would be at most 3,200 cubic yards or less than 1 percent of the 1,230,000 cubic yards used by other activities at the INL Site and would represent a negligible contribution to cumulative impact.
Water Resources	Under the Proposed Action, no effluent would be discharged across the previously graded ground surface, and no surface water would be used. No effluent would be discharged directly to groundwater, and thus the Proposed Action would not contribute to cumulative impacts on groundwater quality. The 260,500 gallons of groundwater

Table S-2. Summary of Cumulative Impacts (Continued)

Resource Area	***Cumulative Impacts***
	required over the approximately 6 years of mobile microreactor demonstration and potential PIE activities would represent a negligible contribution to cumulative impacts on groundwater.
Air Quality	The minor increase in off-site air pollutant concentrations produced from construction and operation, in combination with emissions from other past, present, and reasonably foreseeable future actions, would result in air pollutant concentrations that would not exceed the state and national ambient air quality standards. Emissions from construction and operations activities would not substantially contribute to cumulative air quality impacts.
Biological Resources	Cumulative impacts on biological resources would not be substantial because ground disturbance and land clearing for the Proposed Action would be less than 1 percent of habitat at the INL Site; other past, present, and reasonably foreseeable future actions would occur at different locations and times; and appropriate best management practices (such as sagebrush replacement and invasive species management) would be enforced.
Cultural and Paleontological Resources	The Proposed Action is expected to have no effect to sites and buildings that are listed, eligible for, or unevaluated for eligibility for the NRHP and paleontological resources. Therefore, the Proposed Action would not contribute to cumulative impacts to eligible cultural and paleontological resources.
Infrastructure	Annual electricity use for the Proposed Action would be approximately 30 megawatt-hours of electricity, which represents a small fraction of the projected cumulative site activities usage of up to 471,000 megawatt-hours and of the site capacity of 481,800 megawatt-hours. Operation of the Proposed Action would use about 260,500 gallons of water, which represents a small fraction of the 872 million gallons cumulative infrastructure use and an even smaller fraction of the 11.4 billion gallons total site capacity. Therefore, operation activities would not substantially contribute to cumulative water use impacts.
Noise	The closest off-site receptor for the Proposed Action is a small development of homes in Atomic City that is about 6.5 miles away. Given the large distance, cumulative noise from construction or operation of projects at CITRC and other locations within the INL Site would be indistinguishable from background at the closest off-site noise-sensitive receptor.
Waste Management and Spent Nuclear Fuel Management	The waste management infrastructure at the INL Site was developed such that it would be able to accommodate the quantities of waste generated by the Proposed Action. Therefore, cumulative waste generation would be within site capacities. There are existing off-site DOE and commercial waste management facilities with sufficient capacities for the treatment and disposal needs associated with the relatively small volumes of LLW and MLLW wastes that would be generated by the Proposed Action. Therefore, substantial cumulative impacts on off-site LLW and MLLW treatment and disposal facilities would not be expected. The PIE activities, which may occur if a decision is made to examine the fuel for research and development purposes, could generate a small amount of TRU/GTCC-like waste (from the examination of a single fuel pin). A determination would be made of whether the waste qualifies as defense TRU waste or is GTCC-like waste. The Waste Isolation Pilot Plant (WIPP) is currently the only disposal option for defense TRU waste. WIPP's Land Withdrawal Act total TRU waste volume limit is 175,564 cubic meters. As of April 3, 2021, 70,115 cubic meters of TRU waste were disposed of at the WIPP facility. TRU waste volume estimates, such as those provided in NEPA documents, cannot be used to determine compliance with the WIPP Land Withdrawal Act TRU

Table S-2. Summary of Cumulative Impacts (Continued)

Resource Area	***Cumulative Impacts***
	waste volume capacity limit. These wastes and waste from other actions will be incorporated, as appropriate, into future *Annual Transuranic Waste Inventory Report* TRU waste inventory estimates. Currently, there is not a disposal facility for GTCC-like waste. DOE evaluated potential environmental impacts of alternatives for the disposal of 12,000 cubic meters of GTCC LLW and DOE GTCC-like waste in the *Final Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste* (GTCC LLW EIS) (DOE, 2016a) and the *Environmental Assessment for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste at Waste Control Specialists, Andrews County, Texas* (DOE, 2018a). As of September 2021, DOE has not announced a decision on a disposal location for GTCC and GTCC-like waste. If the Proposed Action waste is determined to be GTCC-like waste, additional NEPA analysis may be required. This waste was not part of the inventory evaluated in the GTCC LLW EIS because the Proposed Action was established after the 2016 GTCC LLW EIS was issued. Existing or new facilities would safely store GTCC-like waste at the INL Site in accordance with applicable requirements until a disposal capability is available. The small amount of spent nuclear fuel (up to 400 kilograms and less than 3.4 cubic meters) would be managed with existing spent nuclear fuel at the INL Site, pending ultimate off-site disposal.
Human Health – Normal Operations	The cumulative population dose from all current and reasonably foreseeable activities would be 0.11 person-rem per year with no expected LCFs (calculated value of 8×10^{-5}) (i.e., 0.00008). Operation of the Proposed Action would result in a total population dose of less than 0.001 person-rem per year with no expected LCFs. The Proposed Action would not substantially contribute to human health impacts. The cumulative MEI dose from all current and reasonably foreseeable activities would be 1.9 millirem per year with an associated LCF risk of 1×10^{-6} (i.e., 0.000001). Operation of the Proposed Action would result in a total MEI dose of less than 0.01 millirem per year with essentially no associated LCF risk. The Proposed Action would not substantially contribute to cumulative human health impacts. The cumulative worker dose would be 230 person-rem per year with no expected LCFs (calculated value of 0.1). Operation of the Proposed Action would result in a total worker dose of 3 person-rem per year with no expected LCFs (calculated value of 0.002).
Transportation	Transportation of fuel and nuclear waste associated with the Proposed Action would result in transportation worker doses of about 1 rem and public doses of about 2 rem. These doses would be an imperceptible increase in the cumulative radiological dose to transportation workers (430,000 person rem) and the public (441,000 person-rem).
Traffic	The impacts on traffic from construction and operation activities are anticipated to be negligible to minor. As such, they would not substantially contribute to cumulative traffic impacts.
Socioeconomics	The 40 to 50 workers (not all of whom would be additions to the current work force) associated with the Proposed Action would negligibly add to the cumulative labor force (estimated to be nearly 160,000) from current and reasonably foreseeable actions.
Environmental Justice	There would be no high and adverse human health or environmental impacts on any population within the region of influence because of the proposed project. Impacts on minority and low-income populations would be comparable to those on the population as a whole and would be negligible.
Global Commons – Greenhouse Gas Emissions	The proposed project would emit 1,300 metric tons of CO_2e over a period of about 6 years and would imperceptibly add to U.S. and global greenhouse gas (GHG) emissions, which were estimated to be 6.6 billion metric tons of CO_2e and 36.4 billion

Table S-2. Summary of Cumulative Impacts (Continued)

Resource Area	Cumulative Impacts
	metric tons of CO_2e, respectively in 2019. GHG emitted from the proposed project would equate to a negligible percentage of U.S. and global GHG emissions and would not substantially contribute to future climate change.

Key: CITRC = Critical Infrastructure Test Range Complex; CO_2e = carbon dioxide equivalent; DOE = U.S. Department of Energy; EIS = Environmental Impact Statement; GHG = greenhouse gas; GTCC = greater-than-Class-C; INL = Idaho National Laboratory; LCF = latent cancer fatality; LLW = low-level radioactive waste; MEI = maximally exposed individual; MLLW = mixed low-level radioactive waste; NEPA = National Environmental Policy Act; NRHP = National Register of Historic Places; rem = roentgen equivalent man (a measure of radiation); TRU = transuranic; WIPP = Waste Isolation Pilot Plant

This page left blank intentionally.

Chapter 1
Introduction and Purpose and Need

This page left blank intentionally.

1 INTRODUCTION AND PURPOSE AND NEED

1.1 Introduction

The United States (U.S.) Department of Defense (DoD), Office of the Secretary of Defense, acting through the Strategic Capabilities Office (SCO), is the lead agency for this *Construction and Demonstration of a Prototype Mobile Microreactor Environmental Impact Statement* (EIS), and the U.S. Department of Energy (DOE) is a cooperating agency.

The DoD is one of the largest users of energy in the world, consuming around 30 terawatt-hours of electricity per year and more than 10 million gallons of fuel per day (DoD SCO, 2021) and projections for future military operations predict energy demand will increase significantly in coming years. DoD installations need the capability to reduce their present reliance on local electric grids, which are highly vulnerable to prolonged outages from a variety of threats such as natural disasters, cyber attacks, terrorism, and grid failure from lack of maintenance and aging infrastructure. These scenarios are occurring with increasing frequency all over the world (e.g., natural disasters exacerbated by climate change, grid failure). This vulnerability places critical missions at unacceptably high risk of extended disruption.

Energy delivery and management continues to be a critical defensive risk for military operations. Inherent dangers, logistical complexities, and overwhelming costs of sustaining power demands at Forward Operating Bases,[17] Remote Operating Bases,[18] and Expeditionary Bases[19] continue to constrain operations and fundamental strategic planning. Backup power systems, using diesel generators, have limited on-site fuel storage, are undersized for many missions, are not prioritized to power critical electrical needs before noncritical ones, and are inadequate in duration and reliability.

The modern battlefield has amplified the need for electrical power as well as the demand for fuel to provide mobility in the air and on the ground. Technologies currently under development such as new radar systems, new weapon systems, unmanned aerial vehicles (UAVs), and the electrification of the non-tactical vehicle fleet, will require even greater energy demands (DoD Defense Science Board, 2016).

Energy has increasingly become a source of vulnerability and a limitation on military freedom of action. Supplying liquid fuel to military forces is a significant challenge, as the commodity typically comprises a large portion of the mass transported to deployed locations. The logistics supply chain to sustain deliveries of energy to Forward Operating Bases, Remote Operating Bases, and Expeditionary Bases is an attractive target to an adversary and a burden on military capabilities to provide effective protection. Storage facilities for fuel enlarge the footprint and tactical signature of the facility, thus contributing to

[17] Forward Operating Bases include both enduring locations with varying degrees of permissiveness, remoteness, and austerity, as well as semipermanent contingency locations. Forward Operating Bases may be characterized by portable or semi-permanent shelters and are often established around existing airfields. These may include semi-permanent billeting, logistics facilities, operating centers, and may extend support to smaller, more remote locations, which could be characterized as patrol bases (DoD Defense Science Board, 2016).

[18] Remote Operating Bases are remote and austere military locations. Even though Remote Operating Bases are often permanent, many share the challenge of power insufficiency since they are far from established power grids. For example, Remote Operating Bases located in places such as Kwajalein, Guam, and remote Alaska, are costly and difficult to provide with adequate electrical power (DoD Defense Science Board, 2016).

[19] Expeditionary Bases can rapidly aggregate or disaggregate in contingency locations that comprise any combination of remote or austere and permissive or non-permissive characteristics. Such bases are established and supported entirely with unit assets and are typically powered by tactical diesel generator sets. These expeditionary bases are intended to be mobile, while also serving as a hub for operational needs such as fuel, ammunition, food, water, communications, medical, and maintenance. They are capable of moving rapidly, often daily (DoD Defense Science Board, 2016).

the vulnerability of the site and military and contractor personnel stationed there (DoD Defense Science Board, 2016).

The scale of the energy supply problem is affirmed by estimates that, in Iraq and Afghanistan, between 70 and 90 percent of the volume of goods delivered to forward bases and expeditionary forces were accounted for by fuel and (to a lesser extent) water. The percentage of fuel used to support base operations (in comparison to mobile platforms) at five forward-deployed locations was estimated in 2008 to range from 13 to 78 percent. Estimates from Afghanistan show that "installation energy" (the energy consumed from on-site energy sources) made up approximately 40 to 60 percent of fuel demand in 2013 and 2014 (DoD Defense Science Board, 2016).

The fully burdened cost of any commodity, to include fuel or any form of energy, is very much scenario dependent. Costs of up to $400 per gallon of fuel have been reported for air-dropped fuel, though the cost of truck-delivered fuel during combat is more typically reported to be between $10 and $50 per gallon (DoD Defense Science Board, 2016).

On January 27, 2021, the President signed Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*. Executive Order 14008 prioritizes climate change considerations in national security and requires explorations of energy generating resources that create a sustainable climate pathway. The executive order requires that the United States organize and deploy the full capacity of its agencies to combat the climate crisis and implement a Government-wide approach that reduces climate pollution in every sector of the economy; increases resilience to the impacts of climate change; protects public health; conserves our lands, waters, and biodiversity; delivers environmental justice; and spurs well-paying union jobs and economic growth, especially through innovation, commercialization, and deployment of clean energy technologies and infrastructure. The Federal Government, consistent with applicable law, is required to take steps to ensure that Federal infrastructure investment reduces climate pollution and that Federal permitting decisions consider the effects of greenhouse gas emissions and climate change. In addition, the Federal Government must identify steps that can be taken, consistent with applicable law, to accelerate the deployment of clean energy and energy transmission projects in an environmentally stable manner.

The challenge is to develop more sustainable methods to provide reliable, abundant, and continuous energy. Recognizing this challenge, DoD commissioned the Defense Science Board to study alternative energy technologies for Forward Operating Bases, Remote Operating Bases, and expeditionary forces. The report prepared by the Defense Science Board (2016) noted that renewable sources of energy such as wind, tidal, solar and similar energy sources can reduce the need for some fuel, but most renewable resources are limited by location, weather, time of year, storage capacity, available land area, and constructability. The intermittent character of many alternative energy sources requires energy storage technologies or redundant power supplies, and emerging technologies for improved energy storage do not appear able to keep pace with the growth of DoD's energy needs. These technologies and practices are useful to meet some current demands, and military adoption of renewable energy has occurred at domestic bases and in specific use cases in deployed locations (e.g., where a small source of power [few watts] is needed to power sensors, UAVs, and warfighter power systems). For example, solar energy has shown the most promise to date, with successful demonstrations in remote outposts, for sensors and on UAVs, but due to the intermittent supply and large footprint required, solar power does not offer the capability of conventional power production systems when significant amounts of on-demand power are needed. Therefore, for the immediate future, diesel generators will continue to be the primary source of electrical power for U.S. military units (DoD Defense Science Board, 2016).

The Defense Science Board reviewed several nuclear reactor concepts that differ in size and technology from conventional commercial reactors and the small modular reactor concepts currently under development for commercial use. Some of these reactors, very small modular reactors with an output less than 10 megawatts of electrical power (MWe), may be transportable and deployable in Forward Operating Bases, Remote Operating Bases, and Expeditionary Bases and could eliminate the need for fuel otherwise dedicated to producing electrical power. Such nuclear energy power systems present an opportunity to "invert" the paradigm of military energy, where the extremities of U.S. military power could be the beneficiaries of reliable, abundant, and continuous energy, instead of the most energy-challenged segments (DoD Defense Science Board, 2016). In civilian applications, mobile microreactors could be transported to support disaster response work and provide temporary or long-term support to critical infrastructure like hospitals, as well as remote civilian or industrial locations where delivery of electricity and power is difficult (DoD, 2020).

1.2 Purpose and Need for Agency Action

The purpose of this action is to construct and demonstrate a prototype mobile microreactor. As described in Section 1.1, Introduction, the Defense Science Board evaluated available energy technologies before concluding that electrical generating capability for Forward Operating Bases, Remote Operating Bases, and Expeditionary Bases can best be met by a less than 10 MWe microreactor system that can be safely and rapidly moved by road, rail, sea, or air for quick set up and shut down. The Defense Science Board recommended further engineering development and prototyping (DoD Defense Science Board, 2016).

Pursuant to the National Defense Authorization Act for Fiscal Year 2018 (Public Law 115–91, 131 Statute 1283 and 131 Statute 1857 Section 2831), as codified in Title 10 United States Code (U.S.C.) 2911 (*Energy policy of the Department of Defense*), the "Secretary of Defense shall ensure the readiness of the armed forces for their military missions by pursuing energy security and energy resilience." Further, pursuant to the Consolidated Appropriations Act, 2020, Public Law 116–93, Division A, Title IV, and the Act's accompanying congressional explanatory statement, 165 Congressional Record H10613, H10886 (daily edition December 17, 2019), the DoD and the SCO received an appropriation for a prototype mobile microreactor. In addition, Section 3 of Executive Order 13972 (January 5, 2021), *Promoting Small Modular Reactors for National Defense and Space Exploration*, calls on the Secretary of Defense to establish and implement a plan to demonstrate the energy flexibility, capability, and cost effectiveness of a Nuclear Regulatory Commission (NRC)-licensed microreactor at a domestic military installation.

Before a mobile microreactor could be deployed, a prototype must be built and tested to ensure that it can meet regulatory requirements as well as DoD specifications and operational requirements.

1.3 Proposed Action and Scope of this EIS

To meet the above described need, and after investigating alternatives for providing this electrical power-generating capability (DoD Defense Science Board, 2016), SCO, in partnership with DOE as a cooperating agency, proposes to construct and demonstrate an advanced prototype mobile microreactor (hereinafter referred to as the "mobile microreactor"). This project ("Project Pele") would construct and demonstrate a mobile microreactor that would be capable of producing 1 to 5 MWe and meet the specific design goals and requirements identified by SCO that would be necessary for the practical deployment of the mobile microreactor.[20] The mobile microreactor would be a small, advanced gas-cooled reactor using high-assay

[20] The Notice of Intent to Prepare an Environmental Impact Statement for Construction and Demonstration of a Prototype Advanced Mobile Nuclear Microreactor (85 Federal Register 12274) described a Proposed Action that would construct and demonstrate a prototype microreactor that would be capable of producing 1 to 10 MWe. The proposals submitted in response

low-enriched uranium (HALEU) tristructural isotropic (TRISO) fuel and air as the ultimate heat sink. TRISO fuel is encapsulated and has been demonstrated to be capable of withstanding temperatures up to 1,800 degrees Celsius (°C) (3,300 degrees Fahrenheit [°F]), allowing for a reactor design that relies primarily on simple passive features and inherent physics to ensure safety. All energy generated by the mobile microreactor that is not converted to electrical power would be transferred to the atmosphere (i.e., air would be the ultimate heat sink). Details of the proposed mobile microreactor and fuel are provided in Chapter 2, Section 2.2, *Mobile Microreactor*.

On March 22, 2021, SCO announced two teams—led by BWXT Advanced Technologies, LLC (BWXT), Lynchburg, Virginia, and X-energy, LLC, Rockville (formerly Greenbelt), Maryland—would proceed with development of a final design for a mobile microreactor under Project Pele (DoD SCO, 2021). This announcement followed a preliminary design competition announced by SCO in April 2019 in which three companies were awarded agreements to develop preliminary designs. The two teams selected from the preliminary design competition continue design development independently. After a final design review in early 2022 and completion of this EIS under the National Environmental Policy Act of 1969 as amended (NEPA),[21] one of the two companies may be selected to build and demonstrate a mobile microreactor.

The joint effort between SCO and DOE, established by interagency agreement, would make use of DOE expertise, material, laboratories, and authority to construct and demonstrate this mobile microreactor. DOE would provide SCO regulatory oversight and expertise on technical, safety, environmental, and health requirements applicable to the construction and demonstration of the mobile microreactor. DoD has received authorization from the DOE pursuant to its authority under the Atomic Energy Act (42 U.S.C. 2121(b), 2140) and National Security Decision Directive 282, September 30, 1987, for the acquisition and operation of a prototype reactor. The NRC, consistent with its role as an independent safety and security regulator, is participating in this project to provide SCO with accurate, current information on the NRC's regulations and licensing processes in connection with construction and demonstration of a mobile microreactor. Consistent with the non-commercial nature of the project, the prototype mobile microreactor may proceed under authorization by the Secretary of Energy and does not require an NRC license.

Mobile microreactor fuel loading, final assembly, and demonstration would be performed at the Idaho National Laboratory (INL) Site using DOE technical expertise and facilities at the Materials and Fuels Complex (MFC) and Critical Infrastructure Test Range Complex (CITRC) (see **Figure 2.3-1** in Chapter 2). The mobile microreactor would be fabricated at facilities owned and operated by, or subcontracted to, either BWXT Advanced Technologies or X-energy. Reactor fuel would be produced from DOE stockpiles of highly enriched uranium (HEU) located at DOE's Y-12 plant in Oak Ridge, Tennessee, that would be converted to oxide at the Nuclear Fuel Services (a subsidiary of BWXT) facility in Erwin, Tennessee, and downblended to HALEU and fabricated into TRISO fuel at the BWXT facility in Lynchburg, Virginia. The Nuclear Fuel Services Erwin, Tennessee, and BWXT Lynchburg, Virginia, facilities are the only private U.S. facilities licensed to possess and process HEU. The BWXT Lynchburg, Virginia, facility is the only domestic supplier of research reactor fuel elements (BWXT, 2021a; BWXT, 2021b). Therefore, these facilities have the unique capabilities to fabricate the microreactor fuel.

to the SCO solicitation for reactor concepts for the mobile microreactor prototype (DoD SCO, 2020) were for 5 MWe microreactors. Therefore, this EIS evaluates microreactors up to 5 megawatt electric.

[21] NEPA requires that the environmental analysis (in this case an EIS) be performed at the earliest reasonable time to ensure that agencies consider environmental impacts in their planning and decisions. For Project Pele, the NEPA process was initiated prior to the final design selection.

This EIS has been prepared in accordance with NEPA and the Council on Environmental Quality (CEQ) (40 Code of Federal Regulations [CFR] 1500 through 1508[22]). This EIS evaluates various phases for implementation of Project Pele, including fuel and microreactor fabrication; the final assembly and fueling of the mobile microreactor; initiation of microreactor criticality[23] and startup testing; transportation of the mobile microreactor from the startup location to an operational demonstration location; operational demonstration of the mobile microreactor; safe shutdown to a standby mode and transportation to a location for storage; and temporary storage of the mobile microreactor. Post-Project Pele activities evaluated include possible post-irradiation examination and disposition. Details of the activities evaluated in this EIS are provided in Chapter 2, Section 2.3, *Proposed Action Alternative*.

1.4 Decisions to be Supported

This EIS provides the decision-maker with important information regarding potential environmental impacts for use in the decision-making process. In addition to environmental information, SCO will consider other factors (e.g., strategic objectives, feasibility, cost, schedule, safety, and security) when making its decision. The primary decision to be made regarding Project Pele is whether to:

- Fabricate and demonstrate a mobile microreactor at the INL Site.

SCO's primary decision will be announced in a Record of Decision (ROD) that will be issued no sooner than 30 days after the U.S. Environmental Protection Agency (EPA) Notice of Availability of the Final EIS is published in the Federal Register. If the decision is made to fabricate and demonstrate a mobile microreactor at the INL Site, SCO may also make a decision on any of the options listed below:

- Conduct mobile microreactor core fueling and final assembly at the Hot Fuel Examination Facility (HFEF) or the Transient Reactor Test Facility (TREAT) located about 0.5 mile northwest of MFC;
- Conduct mobile microreactor startup testing at MFC's National Reactor Innovation Center (NRIC) Demonstration of Operational Microreactor Experiments (DOME)[24] or at CITRC; and
- Temporarily store the mobile microreactor at MFC's Radioactive Scrap and Waste Facility (RSWF) or Outdoor Radioactive Storage Area (ORSA).

SCO may also delay making decisions on these options or may decide that selection of a particular option is not necessary because any of the options are reasonable and similar in environmental impact. If needed, later decisions could be announced in a ROD or RODs published in the Federal Register.

The mobile microreactor design determination by SCO will precede the decisions supported by this EIS. However, the analysis of impacts is applicable to (i.e., bounds) whichever of the two candidate mobile microreactor designs is selected.

1.5 Related NEPA Documents

There are no DoD NEPA documents related to the scope of Project Pele, but DOE and NRC have prepared NEPA documents related to the scope of Project Pele. This section describes the applicable general DOE

[22] In July 2020, the Council on Environmental Quality (CEQ) comprehensively updated its National Environmental Policy Act (NEPA) regulations, which went into effect on September 14, 2020.However, the CEQ clarified that these regulations apply to all NEPA processes begun after the effective date, but gave agencies the discretion to apply them to ongoing NEPA processes (85 FR 43304 (July 16, 2020). This EIS was started prior to the effective date of the revised CEQ regulations, and SCO has elected to complete this EIS pursuant to the earlier CEQ regulations.

[23] Criticality is the normal operating condition of a reactor, in which nuclear fuel sustains a fission chain reaction. A reactor achieves criticality (and is said to be critical) when each fission event releases a sufficient number of neutrons to sustain an ongoing series of reactions (https://www.nrc.gov/reading-rm/basic-ref/glossary/criticality.html).

[24] The DOME is formerly known as the Experimental Breeder Reactor II (EBR-II) test bed.

waste management NEPA documents first, followed by INL NEPA documents, and then fuel production NEPA documents.

General DOE Waste Management NEPA Documents

Collectively, the five NEPA documents listed below evaluated waste management activities that affect many DOE sites and programs. Facilities discussed in these five NEPA documents could be used for managing waste generated by Project Pele:

- ***Final Waste Management Programmatic Environmental Impact Statement for Managing, Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*** **(DOE/EIS-0200)** (DOE, 1997a);
- ***Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement Eddy County, near Carlsbad, New Mexico*** **(DOE/EIS-0026-S-2)** (DOE, 1997b);
- ***Final Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste*** **(DOE/EIS-0375)** ("GTCC LLW EIS") (DOE, 2016a);
- ***Environmental Assessment for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste at Waste Control Specialists, Andrews County, Texas*** **(DOE/EA-2082)** ("GTCC LLW EA") (DOE, 2018a); and
- ***Final Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada*** **(DOE/EIS-0426)** (DOE, 2013a).

Following the analysis in the *Final Waste Management Programmatic Environmental Impact Statement for Managing, Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE, 1997a), DOE issued its programmatic decision selecting the alternatives for disposal of low-level and mixed low-level radioactive waste (LLW and MLLW) at regional disposal facilities. DOE's decision included continuing the use of on-site disposal for certain sites (including at the INL Site) where practicable (64 FR 69241). The Nevada Test Site (now the Nevada National Security Site [NNSS]) was one of the identified regional disposal sites. DOE's decision also allows disposal at commercial facilities. DOE also announced its decision that each DOE site would prepare its own transuranic (TRU) waste for disposal at the Waste Isolation Pilot Plant (WIPP) facility (63 FR 3629).

The *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement Eddy County, near Carlsbad, New Mexico* (DOE, 1997b) was prepared to assess the potential environmental impacts of continuing the phased development of WIPP as a geologic repository for the safe disposal of TRU waste generated by defense related activities. Following that analysis, DOE announced its decision to dispose of defense TRU waste at WIPP following preparation of waste to meet WIPP's waste acceptance criteria (63 FR 3624). Any defense TRU waste generated by Project Pele would be disposed of at WIPP.

Currently, there is not a disposal facility for GTCC LLW and DOE GTCC-like waste. In the GTCC LLW EIS (DOE, 2016a) and GTCC LLW EA (DOE, 2018a), DOE evaluated potential environmental impacts of alternatives for the disposal of GTCC LLW and DOE GTCC-like waste. As of August 2021, DOE has not announced a decision on a disposal location for GTCC LLW and GTCC-like waste. If Project Pele waste is determined to be GTCC-like waste, additional NEPA analysis may be required. Project Pele waste was not part of the inventory evaluated in the GTCC LLW EIS and the GTCC LLW EA because Project Pele was established after those NEPA documents were issued.

The *Final Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in* *the State of Nevada* (DOE, 2013a) analyzed the potential environmental impacts of alternatives for continued management and operation of NNSS, including its Environmental Management Mission, which includes operation of on-site LLW disposal facilities. In its ROD (December 30, 2014), the National Nuclear Security Administration (NNSA) selected the Expanded Operations Alternative for the LLW disposal portion of its Environmental Management Mission (79 FR 78421). The NNSS LLW disposal facility is one of DOE's regional facilities that accepts waste from off-site generators. LLW generated by Project Pele could be disposed of at NNSS.

Idaho National Laboratory NEPA Documents

***Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Environmental Impact Statement* (DOE/EIS-0203)** ("SNF EIS") (DOE, 1995a) – The SNF EIS analyzed, at a programmatic level, the potential environmental consequences over a 40-year period of alternatives related to the transportation, receipt, processing, and storage of spent nuclear fuel (SNF) under the responsibility of DOE. It also addressed the site-wide actions anticipated to occur at the INL Site (known then as the Idaho National Engineering Laboratory) for waste and SNF management. In the first ROD (60 FR 28680), DOE decided to manage its SNF by type (fuel cladding and matrix material) at the Hanford Site, the INL Site, and the Savannah River Site. Under that decision, the fuel type distribution would be as follows:

- Hanford production reactor fuel would remain at the Hanford Site.
- Aluminum-clad fuel would be consolidated at the Savannah River Site.
- Non-aluminum-clad fuels (including Naval SNF) would be consolidated at the INL Site.

In an amended ROD (64 FR 23825), DOE announced a decision to use a multipurpose canister or comparable system for the loading and storage of DOE-owned SNF at the INL Site and transportation of this SNF for ultimate disposition outside the state of Idaho. Many of the issues addressed in the SNF EIS are similar to the issues addressed in this EIS, including SNF management and management of other wastes at the INL Site.

***Environmental Assessment for the Resumption of Transient Testing of Nuclear Fuels and Materials at the Idaho National Laboratory, Idaho* (DOE/EA-1954)** (DOE-ID, 2014a) – The EA for the resumption of transient testing of nuclear fuels and materials at the INL Site evaluated DOE activities associated with its proposal to resume testing of nuclear fuels and materials under transient high-power test conditions at TREAT located about 0.5 mile northwest of MFC. The EA resulted in a Finding of No Significant Impact (FONSI). That NEPA document is relevant because TREAT could be used for fueling and final assembly of the mobile microreactor.

***Final Environmental Assessment for Expanding Capabilities at the Power Grid Test Bed at Idaho National Laboratory* (DOE/EA-2097)** (DOE-ID, 2019a) – This action included (1) installing a new 138-kilovolt (kV) overhead power line from the INL Site's Central Facilities Area (CFA) through CITRC to MFC, (2) increasing the size of the fenced area at the Scoville substation, (3) enlarging old and establishing new test pads for expanded testing, and (4) expanding authorized uses of the haul road. The EA resulted in a FONSI. That EA is relevant because it discusses CITRC, the Power Grid Test Bed, and the haul road, all of which could be used by Project Pele.

***Final Environmental Assessment for the Microreactor Applications Research, Validation and Evaluation (MARVEL) Project at Idaho National Laboratory* (DOE/EA-2146)** (DOE-ID, 2021a) – The purpose of the MARVEL project is to construct and operate a 100-kilowatt (kW) thermal (about 20-kW electric) microreactor application test platform at TREAT that will offer experimental capabilities for performing research and development on various operational features of microreactors and improving integration of microreactors to end-user applications, such as off-grid electricity generation and supplying heat for industrial processes (process heat). The EA is relevant because, like Project Pele, MARVEL is a microreactor to be assembled and operated at the INL Site.

DOE-ID NEPA Categorical Exclusion Determination, Experimental Breeder Reactor (EBR)-II Modifications to Support National Reactor Innovation Center (NRIC) **(DOE-ID-INL-20-219)** (DOE-ID, 2021b) – To support the MFC and NRIC missions, INL needs to maintain effective nuclear Research, Development, Demonstration and Deployment (RDD&D) capabilities at MFC and to improve the availability of RDD&D facilities to meet customer demand. To meet these needs, INL is developing advanced reactor demonstration capabilities at the location of the former EBR-II test bed at MFC (currently referred to as the DOME). The proposed action associated with the categorical exclusion determination includes refurbishing the DOME. Modifications are being made to the containment dome, mechanical systems, water supply and pump house, ventilation, stack and air monitor, gas supplies, electrical, instrumentation and control systems, fire protection, security, and the yard area. This categorical exclusion is relevant because Project Pele may use the DOME for the mobile microreactor initial startup testing.

Fuel Production NEPA Documents

Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement **(DOE/EIS-0240)** ("HEU EIS") (DOE, 1996b) – The HEU EIS evaluated the impacts of blending HEU to low-enriched uranium (LEU) to eliminate the risk of diversion for nuclear proliferation, and, where practical, to reuse the resulting LEU in peaceful, beneficial ways that recover its commercial value. The HEU EIS, and subsequent ROD and supplemental analysis, evaluated and authorized blending of surplus HEU in DOE's inventory at the Y-12 Plant. It also analyzes the transportation of necessary materials from their likely places of origin to the potential blending sites and from blending sites to the likely or representative destinations for nuclear fuel fabrication, including the BWXT facilities in Lynchburg, Virginia, and Erwin, Tennessee.

Environmental Assessment Related to the Renewal of NRC License No. SNM-42 for BWX Technologies, Inc. (NRC, 2005) – The NRC completed an EA and FONSI in 2005 for renewing Materials License SNM-42 for BWXT, Lynchburg, Virginia. Materials License SNM-42 authorizes BWXT to possess nuclear materials, manufacture nuclear fuel components, fabricate research and university reactor components, fabricate compact reactor fuel elements, perform research on spent fuel performance, and handle the resultant waste streams, including recovery of scrap uranium. The EA is relevant because TRISO fuel production at the BWXT Lynchburg, Virginia, facility would be performed within the operating envelope of Materials License SNM-42 and within the impacts described in the EA.

Final Environmental Assessment for the Proposed Renewal of U.S. Nuclear Regulatory Commission License No. SNM–124 for Nuclear Fuel Services, Inc. (NRC, 2011a) – The NRC completed an EA and FONSI in 2011 for renewing Materials License SNM-142 for Nuclear Fuel Services (a subsidiary of BWXT), in Erwin, Tennessee. Under the conditions of a special nuclear materials license (SNM-124), Nuclear Fuel Services operates a nuclear fuel fabrication facility. The license authorizes Nuclear Fuel Services to receive, possess, store, use, and ship special nuclear material enriched up to 100 percent. The EA is relevant because HEU processing at the Nuclear Fuel Services' Erwin, Tennessee, facility would be performed within the operating envelope of Materials License SNM-142 and within the impacts described in the EA.

1.6 Public Involvement

The Notice of Intent (NOI) to prepare this EIS was published in the Federal Register on March 2, 2020 (85 FR 12274) and is provided in Appendix A, *Federal Register Notices*. The public scoping period started with publication of the NOI in the Federal Register. Initially, SCO provided a 30-day comment period (March 2 through April 1, 2020); SCO extended the comment period to April 30, 2020. Due to DoD travel restrictions and the public health concerns associated with the coronavirus (COVID-19) pandemic, SCO held a virtual scoping meeting, instead of an in-person event as originally planned.

During the scoping period, 86 comment documents were received; 33 were requests to be added to the mailing list only, and 18 others did not include any comments on the scope of the EIS but expressed general support for the project or for a certain location for its development.

Table 1.6-1 summarizes the comments received during the public scoping period. General statements of support, opposition, or alternative preferences; comments outside the scope of the project; or comments pertaining to issues already decided by law, regulation, or policy are not included. A complete record of all letters, including names of individuals, agencies, and organizations that submitted a comment are kept in the administrative record. Any comments received after the April 30, 2020, closing date were not included in this scoping comment summary, but comments received after the closing date were considered during development of the EIS.

DoD is offering opportunities for public review and comment, including public hearings, on this Draft EIS. Public involvement opportunities and public hearing information will be announced in newspapers in communities near potentially affected areas and in other communications with stakeholders. Comments received during the public review and comment period will be evaluated in preparing the Final EIS. Comments received after the close of the public comment period will be considered to the extent practicable.

Table 1.6-1. Scoping Comment Summary

Comment	***Response***
Include analysis to fully assess all potential impacts from the Proposed Action, No Action Alternative, and alternatives involving use of renewable energy to replace diesel-fueled generators, or alternative sites for Project development.	Per NEPA requirements, this EIS assesses the direct, indirect, and cumulative effects of the Proposed Action on a variety of resources including, but not limited, to socioeconomics, water resources, human health, biological resources, air quality, traffic, cultural resources, and aesthetics within the affected area. The direct effects of an action are those "caused by the action and occur at the same time and place" (40 CFR 1508.8(a)). The indirect effects of an action are those "caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable" (40 CFR 1508.8(b)). For example, "[i]ndirect effects may include... effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems." Cumulative effects are the impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions (40 CFR 1508.7). As described in Section 1.2, *Purpose and Need for Agency Action*, DoD commissioned the Defense Science Board to study alternative energy technologies for Forward Operating Bases, Remote Operating Bases, and expeditionary forces. The report prepared by the Defense Science Board (2016) noted that alternative energy technologies such as wind, tidal, solar, and similar

Table 1.6-1. Scoping Comment Summary (Continued)

Comment	***Response***
	intermittent energy sources are unlikely to consistently meet current or future energy demands for Forward Operating Bases, Remote Operating Bases, and expeditionary forces, apart from very limited and highly specialized applications. Therefore, the Defense Science Board recommended further engineering development and prototyping of very small modular reactors with an output less than 10 megawatts of electrical power (MWe). Section 2.5 of the Draft EIS describes "Alternatives Considered and Dismissed from Detailed Analysis." This section describes why the INL Site was analyzed and why other sites were eliminated from further consideration.
Requesting that analysis is comprehensive in considering the full extent of radioactivity that could be released if the microreactor is destroyed, as well as from exposure during normal transportation, operation, and waste storage and disposal. Concern that the analysis of cumulative effect of project impacts in combination with other past, present, and future radiation releases is comprehensive.	This EIS assesses individual and cumulative impacts of the Proposed Action in accordance with NEPA regulations and guidance from the CEQ. The analysis includes a comprehensive assessment of potential impacts that could be created during all phases of the project, from initial construction through decommissioning of the project and disposal of materials. Impacts from potential radioactivity releases during normal operation, reactor accidents, intentional destructive acts, transportation, and waste management are analyzed, along with cumulative impacts.
Concern that present standards are outdated and not adequate to protect workers, their families, and residents near project sites. Concern that DOE operations are not adequately monitored and the incidents are not reported promptly.	This EIS was prepared by SCO, which is an agency of the DoD. All analyses conducted for this EIS were independently prepared and have been rigorously reviewed. As described in Chapter 4 and summarized in Chapter 2, Section 2.7, *Summary of Environmental Consequences*, emissions from project activities are expected to be very small, well below regulatory standards, and a small fraction of health-based limits. Publicly available annual reports document the extensive monitoring conducted on and around the INL Site. Incidents are promptly reported and corrective actions taken as needed.
Concern that operations or accidents could result in impacts to plant and wildlife species in the area near the Proposed Action site.	As described in Chapter 4 and summarized in Chapter 2, Section 2.7, *Summary of Environmental Consequences*, the Proposed Action could disturb 28 vegetated acres at either Pad B, C, or D at CITRC. Appropriate mitigations such as sagebrush replacement, invasive species management, and the INL Revegetation Assessment Program would be enforced. As described in Section 4.10, *Human Health – Normal Operations*, radiological emissions from the Proposed Action would not substantially contribute to impacts on human health, and therefore, as discussed in Section 4.5, *Biological*

Table 1.6-1. Scoping Comment Summary (Continued)

Comment	Response
	Resources, would not substantially contribute to impacts on biological resources. The USFWS and Idaho Department of Fish and Game have been consulted in relation to the assessment of impacts to any Federal and state-listed species near the selected site for development of the Proposed Action. All parties, including Federal and state wildlife agencies, have the opportunity to comment on the analysis of potential impacts in this Draft EIS.
Concern that project impacts could affect the Craters of the Moon National Monument and Preserve if located at INL, and that the Shoshone-Bannock Tribe as a sovereign nation should have decision-making authority for projects on their historical Tribal Lands.	Potential impacts on Craters of the Moon National Monument and Preserve are described in Chapter 4, Section 4.1, *Land Use and Aesthetics*. SCO has incorporated the environmental analysis and proposals of potentially affected Federal and state agencies with jurisdiction by law or special expertise, to the maximum extent possible consistent with its responsibility as lead agency. SCO acknowledges its obligation under Federal law and DoD policy to consult with Native American Tribal governments, including Tribes historically or culturally affiliated with impacted lands. SCO will continue to consult with impacted Tribal government throughout the EIS process.
Work with Shoshone-Bannock Tribe to fully vet and understand project impacts on Tribal cultural resources, environmental justice, biological resources, water resources, and air quality, especially from potential contaminants that could be emitted during construction, operation, and waste processing, storage and transportation. Analysis of effects on cultural resources should include effects on ability of Tribal members to continue to hunt and gather in their traditional range, for subsistence, gathering medicinal plants, and to support a spiritual and religious connection to the land, which in turn can affect health and wellbeing. The Tribe recommends use of a risk assessment model discussed in the paper "Using Eco-Cultural Dependency Webs in Risk Assessment and Characterization of Risks to Tribal Health and Cultures." (S.G. Harris and B.L. Harper. 2000. Environmental Science & Pollution Research Special Issue 2: 91-100), and that DoD work with the Tribe in developing risk exposure scenarios that include cultural risks, which should be an on-going effort for conducting similar risk assessments elsewhere once the microreactors become ready for use, nationally and internationally.	This EIS assesses individual and cumulative impacts of the Proposed Action in accordance with NEPA regulations and guidance from the CEQ. Potential environmental justice impacts are described in Chapter 4, Section 4.15, and potential cultural resources impacts are described in Chapter 4, Section 4.6. SCO acknowledges its obligation under Federal law and DoD policy to consult with Native American Tribal governments, including Tribes historically or culturally affiliated with impacted lands, and is committed to those consultations for the Proposed Action, in recognition that it may have the potential to affect protected Tribal rights, land, or resources. DOE has similar responsibilities for consultations regarding the INL Site. SCO and DOE will continue to consult with the Shoshone-Bannock government throughout the EIS process.

Table 1.6-1. Scoping Comment Summary (Continued)

Comment	***Response***
Ensure analysis addresses impacts to water resources from microreactor operations, safety concerns from seismic activity for underground test sites, and to adequacy and cost of provision of emergency services in communities near the site of the Proposed Action.	The impacts to water resources from project operations, both for water use and potential for contamination from releases, is included in the Water Resources environmental consequences section of this EIS (see Section 4.3). No underground testing is anticipated. Accidents caused by seismic activity are considered in Section 4.11, *Human Health – Facility Accidents*. Impacts on emergency services near the INL Site are considered in Section 4.14, *Socioeconomics*. Costs are outside the scope of this EIS.

Source: Modified from *Final Public Scoping Report for the Prototype Advanced Mobile Nuclear Microreactor Project Environmental Impact Statement* (NewFields Government Services, LLS, 2020)

Key: CEQ = Council on Environmental Quality; CFR = Code of Federal Regulations; DoD = Department of Defense; DOE = Department of Energy; EIS = Environmental Impact Statement; INL = Idaho National Laboratory; NEPA = National Environmental Policy Act; SCO = Office of the Secretary of Defense, Strategic Capabilities Office; USFWS = U.S. Fish and Wildlife Service

Chapter 2
Description of Alternatives

This page left blank intentionally.

2 DESCRIPTION OF ALTERNATIVES

This chapter describes the reasonable alternatives considered for the construction and demonstration of a mobile microreactor. In its NOI to prepare an EIS, the SCO identified both the INL Site and ORNL as potential sites. Subsequent analyses have indicated that the ORNL site is not suitable for the proposed activities (see Section 2.5, *Alternatives Considered but not Analyzed in Detail*). As required by CEQ regulations 40 CFR 1502.14(d), this EIS includes a No Action Alternative, which serves as a baseline for comparison for the Proposed Action alternative.

2.1 Mobile Microreactor Siting

2.1.1 Siting Requirements for the Mobile Microreactor

The following site features were identified as necessary to accomplish the Proposed Action and were used as screening criteria to identify candidate locations (INL, 2021a):

- **Nuclear Site with Sufficient Support Infrastructure –** For prototype construction and demonstration, the mobile microreactor would use preexisting facilities. No new permanent nuclear facilities would be constructed using program funds. A reasonable demonstration site alternative must have previously been used for nuclear activities and have sufficient infrastructure to support nuclear operations, including the planned disposition of the mobile microreactor after operation and demonstration.
- **Independent Electrical Grid Access –** Testing the operational performance and effectiveness of the mobile microreactor (and subsystems) requires the ability to receive power from an existing electric grid, as well as dispatch microreactor-generated power to an isolated and locally controlled distribution system. Specifically, testing requirements include criteria that assess load following capabilities, including, but not limited to, variations in capacity and rate-of-change, output voltage (600 to 69,000 volts alternating current [VAC]), and paralleling as part of a field-deployed asset used singly or in combination with other generators. Given the necessity for operational flexibility, SCO, working with subject matter experts and project stakeholders, further clarified supporting grid-related and test site requirements as follows:
  - Electrical distribution system that can be or is isolated from a commercial grid and capable of independent and locally controlled dispatch and operations. The mobile microreactor would be operated under DOE authorization and would not be subject to an NRC license. The DOE authorization does not allow power to be placed on a commercial electrical grid.
  - A system comprised of existing supporting infrastructure that reduces or eliminates the need for new construction, including, but not limited to, the power distribution network, test locations with dedicated test pads and services (e.g., communications) supporting the placement and operation of additional power generation and consumption assets, and existing roads and unobstructed access to each respective test location.
  - Test bed communications and data systems (e.g., Supervisory Controls and Data Acquisition) that allows operators to observe, manage, and manipulate test line configurations, and record test-bed operating parameters.
  - The capability to interface with multiple electrical power sources and assets, such as the mobile microreactor and diesel generators.
  - A power distribution system capable of regulating and supplying electrical power from the mobile microreactor to medium- and low-voltage loads located on test pads.
  - Controlled perimeter, access, and physical security.

   - Availability of electrical-system trained and readily available engineering, crafts, and trade support (including linemen) during testing.
- **Transportation and Handling Options –** Transportation and handling options are needed that can accommodate receiving equipment as well as the movement of an irradiated reactor within the controlled test boundary.
- **Established Control Zone –** During mobile microreactor demonstration, to facilitate emergency planning and response for reactors with safety features not previously demonstrated, the mobile microreactor must be in a physically controlled environment.
   - Security and emergency response, with sufficient training to safely respond should it be required, must be in place.
   - An established control zone must be available for operational security.
- **Adjacent Post-Irradiation Examination (PIE) Facilities –** After operations, components of the mobile microreactor may be subject to PIE to evaluate material condition and design performance. The site must have facilities available for examination and characterization of radioactive components and materials (e.g., hot cells, analytical chemistry).
- **Sufficient Testing Space –** Sufficient space for transportation and operational testing and evaluation of the mobility of the mobile microreactor or its components within the boundaries of the site, including both indoor and outdoor testing facilities. The roads used for transportation must meet the following requirements:
   - Have sufficient road width and characteristics (e.g., turn radius, load rating) to support a semi-trailer loaded with the mobile microreactor;
   - Be entirely contained within site boundaries such that force protection can be maintained; and
   - Must not utilize public roads for shipment to the outdoor location because the transportation of this mobile microreactor has not been evaluated by the U.S. Department of Transportation (DOT) or the NRC.
- **Site Subject to DOE Authority or Control –** The mobile microreactor would be operated under DOE authorization and must be operated on a site subject to DOE authority or control.
- **Current Nuclear Reactor Operational Experience –** Demonstration of the mobile microreactor would require expertise in the operation of advanced or experimental nuclear reactors (i.e., Nuclear Safety Basis, fueling, shipping, disposition, etc.). Current operational experience with these types of nuclear reactors would ensure that trained staff are on-site for essential technical analysis and safe operations.

Mobile Microreactor Siting Options

As published in the NOI to prepare an Environmental Impact Statement for Construction and Demonstration of a Prototype Advanced Mobile Nuclear Microreactor (85 FR 12274), and after considering the capabilities and facilities at multiple DOE sites, two DOE National Laboratories were considered as candidates for demonstration of the mobile microreactor: the INL Site and ORNL. Both sites were identified because they possess the human resources (technical staff, including scientists, engineers and operational and support staff), with the requisite experience to operate a demonstration reactor like the mobile microreactor, as well as the staff and programs needed for mobile microreactor site safety and security. These laboratories currently operate the Advanced Test Reactor (ATR) and TREAT (both at the INL Site) and High Flux Isotope Reactor (at ORNL). Both sites also have the requisite PIE facilities essential to the success of Project Pele. The INL Site has HFEF and several other facilities. ORNL has PIE facilities associated with its High Flux Isotope Reactor as well as hot cells within the Irradiated Fuels Examination Laboratory (Building 3525) and the Irradiated Material Examination and Testing Facility (Building 3025E).

At ORNL, several sites were identified as possible locations for the initial fueling and initial testing of the mobile microreactor. Longer-term demonstration at the ORNL site was also considered. While the ORNL siting option was strongly considered, subsequent analyses have indicated that the ORNL site would not be suitable for the proposed activities due to lack of an independent power grid (see Section 2.5, *Alternatives Considered but not Analyzed in Detail*).

At the INL Site, several possible locations were identified for initial fueling and initial testing of the mobile microreactor, with locations within MFC offering the most reasonable accommodations. Longer term demonstration of the mobile microreactor requires connection to an electrical test grid, which is available at the CITRC test pads. Hence, the only reasonable option for longer term demonstration at the INL Site is CITRC. This location is also in a well-characterized, previously disturbed, low-population area, which would be expected to result in low environmental impacts.

2.2 Mobile Microreactor

Two designs, one from BWXT Advanced Technologies and one from X-energy, are under consideration for Project Pele. The analysis in this EIS is intended to bound the environmental impacts of the construction and demonstration of the mobile microreactor regardless of which design is ultimately selected for use in Project Pele. Where specific parameters either have not been defined or are known to differ between these two designs, this EIS uses a bounding design and uses the parameters associated with this bounding design to assess the potential environmental impacts.

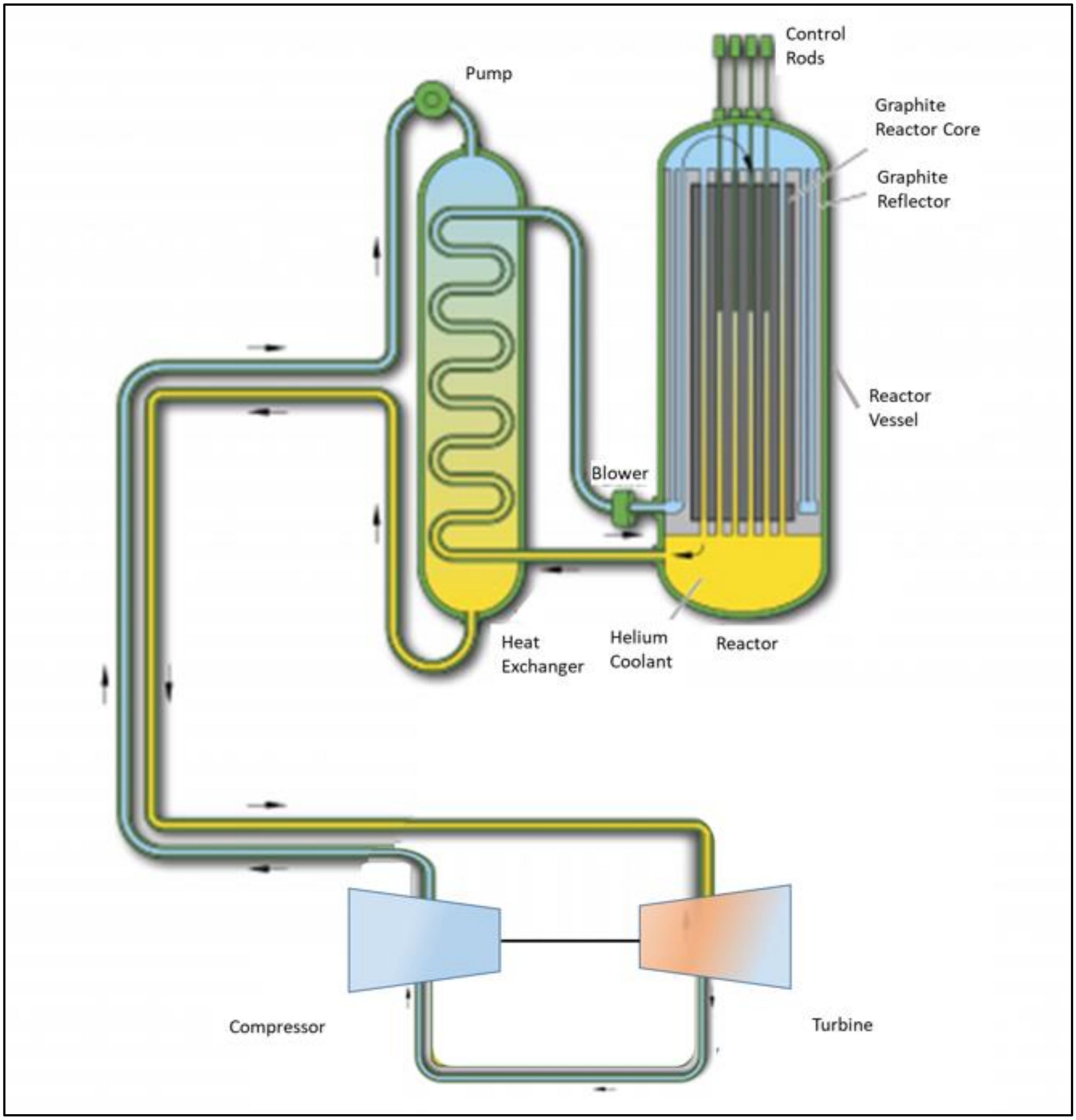
2.2.1 The Mobile Microreactor: A High Temperature Gas-Cooled Reactor

The mobile microreactor would be a High Temperature Gas-Cooled Reactor (HTGR), conceptually similar to the much higher power commercial HTGR shown in **Figure 2.2-1**. Neither mobile microreactor design under consideration for Project Pele has been finalized; the characteristics of each design may evolve as the designs progress.[25] The descriptions provided in this paragraph are of a generic higher power commercial HTGR design, and specifics of the design could vary for the mobile microreactor. Gas-cooled reactors are similar to U.S. commercial nuclear plants in that they are thermal[26] nuclear reactors. The neutrons generated during fission of the fuel (uranium-235) reactor are slowed down through collisions with a moderator. A commercial HTGR operates at pressures of about 1,000 pounds per square inch and at temperatures above 750° C (approaching 1,000° C for very high temperature HTGRs). These parameters could vary with the much smaller mobile microreactor. Most HTGR designs have two coolant systems, a primary coolant system and a secondary coolant system. (Designs using only a primary coolant system with a gas turbine in the primary coolant are also possible.) The coolant systems use an inert gas, typically helium, to transfer heat from the reactor core (via the primary coolant system) to the power conversion system (from the primary coolant via the secondary coolant system). The transfer of energy from the primary coolant to the secondary coolant is through an intermediate heat exchanger that may be either inside or outside of the reactor vessel. Commercial HTGRs are graphite-moderated. In **Figure 2.2-1**, reactivity control is provided by control rods inserted from the top of the reactor vessel. Control drums, containing both neutron reflecting material (beryllium is one of the candidate materials for the mobile microreactor) and neutron absorbers (typically a form of boron) can also be used. By rotating the

[25] Additionally, some aspects of the mobile microreactor design could be proprietary and some design information may not be publicly disclosed for security reasons.

[26] Thermal neutrons are neutrons that are less energetic than neutrons generated during fission (generally, less than 1 electron volt and travelling at speeds of less than 5 kilometers per second), having been slowed by collisions with other materials such as water or graphite.

drum, either the reflecting material (increasing power) or the absorbing material (reducing power) would be facing the reactor.



Source: adapted from (INL, undated)

Figure 2.2-1. High Temperature Gas-Cooled Reactor

The DoD SCO solicitation for concepts for the mobile microreactor (DoD SCO, 2020) identified the technical objectives for the mobile microreactor, listed in **Table 2.2-1**. A proposed technical solution is expected to exceed some objectives while not fully meeting others. The uniqueness of the mobile microreactor of Project Pele is in the ability of the mobile microreactor packages to be transported by ship, rail, train, or plane.

Table 2.2-1. Technical Requirements and Objectives of a Mobile Microreactor

Technical Requirement	*Technical Objective*
Life	Able to generate threshold power (1 to 10 MWe of electric power generation[a]) for more than 3 years without refueling.
Wrap-Up	Time for planned shutdown, cool down, disconnect, prepared transport, and safe transport: less than 7 days.
Startup	Time from arrival of unit to reaching full electric power operations: less than 72 hours.
Size	All components should fit in ISO 688 certified 20- or 40-foot CONEX containers. Government's preference is to use 20-foot standard CONEX container.[b]
Operation	Semi-autonomous operation (i.e., does not require manned control by operators to ensure safe operation). Minimal manning to monitor overall mobile microreactor and power plant system health. Minimal routine preventative maintenance and repair required.

Key: CONEX = container express (shipping container); ISO = International Organization for Standardization; MWe = megawatts-electric

Notes:

[a] The technical objective for designs submitted for consideration in Project Pele was 1 to 10 MWe. Designs still under consideration are 5 MWe or less.

[b] Both designs still under consideration would house the major components of the mobile microreactor in up to four 20-foot CONEX containers of either standard (8.5 feet) or high cube (9.5 feet) height.

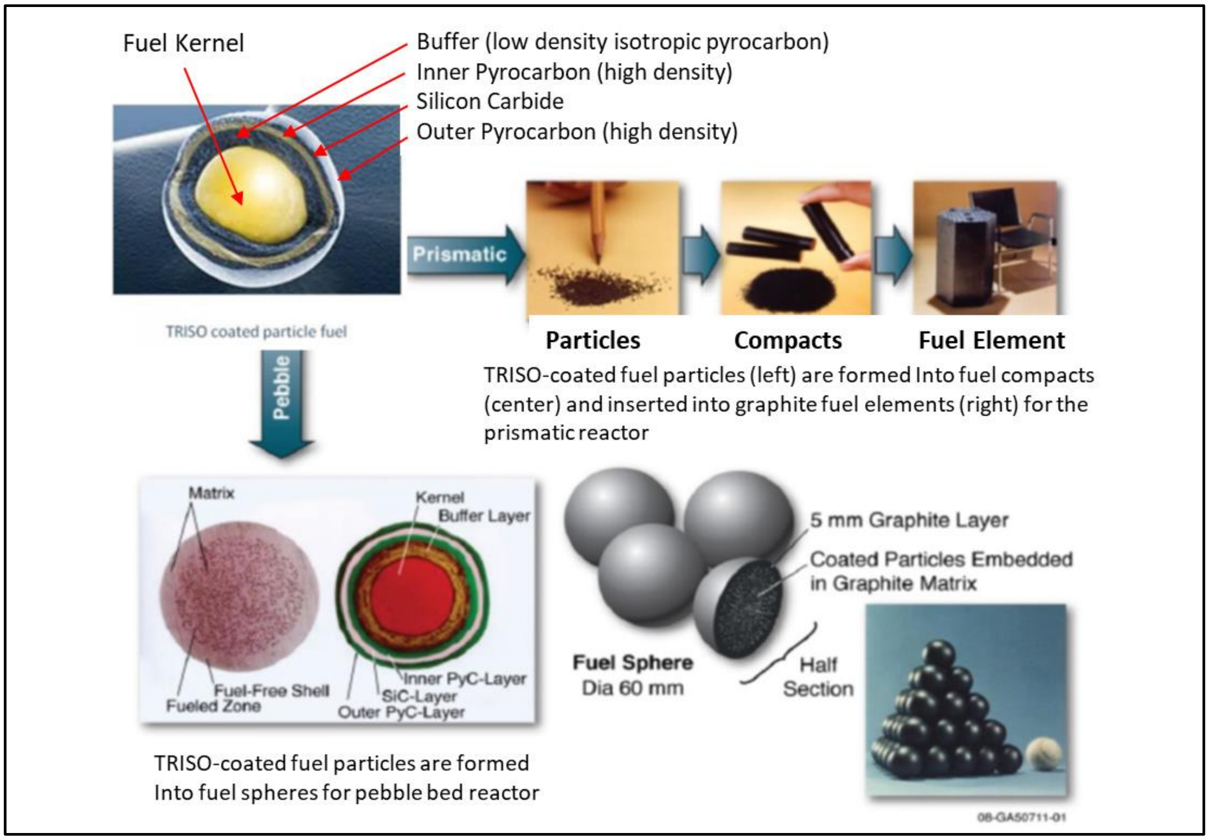
The following paragraphs describe different aspects of the proposed mobile microreactor. Where information specific to the two designs under consideration is not available, requirements from the DoD SCO solicitation for mobile microreactor concepts is provided (DoD SCO, 2020).

Fuel

SCO is requiring that the mobile microreactor be fueled with TRISO fuel. TRISO fuel was first developed in the United States and United Kingdom in the 1960s with uranium dioxide fuel. The DOE Office of Nuclear Energy Next Generation Nuclear Plant program has been sponsoring the development, testing, and manufacturing of TRISO fuel for more than a decade. In 2002, DOE established the Advanced Gas Reactor Fuel Development Program to establish a U.S. capability to fabricate high-quality TRISO fuel and demonstrate its performance. BWXT has manufactured and certified TRISO-coated kernels and fuel compacts in production-scale quantities.

Each TRISO particle is made up of a uranium oxycarbide (a mixture of uranium dioxide and uranium carbide) fuel kernel encapsulated by three layers of carbon- and ceramic-based (silicon carbide) material. Each particle acts as its own containment system because of its triple-coated layers. This allows them to retain fission products. The particles are incredibly small (about the size of a poppy seed) and very robust. TRISO fuels are structurally more resistant to neutron irradiation, corrosion, oxidation, and high temperatures (the factors that most impact fuel performance) than traditional reactor fuels.

The TRISO particles can be fabricated into cylindrical pellets (compacts) or billiard ball-sized spheres called "pebbles" for use in HTGRs (**Figure 2.2-2**). The exact form of the fuel proposed for the X-energy and BWXT fuel designs has not been finalized. Both pellets and spheres containing thousands of TRISO poppy seed-sized particles are possibilities.



Source: adapted from (Kitcher, 2020)

Key: mm = millimeter; PyC = pyrocarbon; SiC = silicon carbide; TRISO = tristructural isotropic

Figure 2.2-2. TRISO-Coated Fuel Particle Transition to Fuel Element

TRISO fuel has been tested in conditions that exceed the predicted worst-case accident conditions (peak accident temperatures) for HTGRs and showed no to minimal damage of the particles with full fission-product retention.

Core

The mobile microreactor core[27] (located within the reactor vessel, see **Figure 2.2-1**) and associated control system(s) are to be designed to maintain safety under all conditions, including transitional conditions throughout transport. All structural materials are to meet, or be capable through a short-term development plan to meet, applicable American Society for Testing and Materials standard and/or American Society of Mechanical Engineers code wherever practical. Core design should ensure minimization of release of fission products in any off-normal event.

A neutron startup source (a neutron-generating isotope) would be necessary to provide a stable and reliable neutron source to startup the mobile microreactor (fresh fuel would be incapable of providing sufficient neutrons for startup). Calibration sources (sources with known radioactive properties) would be required to demonstrate sensor functionality and accuracy. It is expected that sources would be handled by INL personnel.

[27] A reactor core is the part of a nuclear reactor containing the fuel (in this case the TRISO fuel) that generates energy (heat), materials to moderate (slow down) the neutrons emitted during fission and control the rate of fission (control the power level and shut down the reaction), and structural components.

Reactor

The reactor is that part of the mobile microreactor that includes the reactor vessel and all material and components within the vessel, including the core (see **Figure 2.2-1**), where nuclear fission is initiated and sustained to generate power. The mobile microreactor designs under consideration are capable of generation of no more than 5 MWe. The mobile microreactor design includes features to promote safety at all times, simplicity over complexity, passive heat rejection upon shutdown to achieve safety under all circumstances, and a normal condition of negative reactivity[28] throughout the mobile microreactor in the event of loss of power. The mobile microreactor itself, save for some minor final assembly (e.g., connecting the modules of the mobile microreactor), would not need to be assembled on-site. The mobile microreactor should be able to startup and produce electrical power using no off-site power (minimal off-site power supplies would be allowed during transportation). Mobile microreactor technology, engineering, and operations are to demonstrate minimization of added proliferation risk.

Power Conversion System

The power conversion system is the part of the mobile microreactor that converts the thermal energy produced in the reactor into electrical energy (from the heat exchanger through the compressor/turbine shown in **Figure 2.2-1**). The mobile microreactor should have the capability to output 4160 VAC volt 3-phase electrical power at both 60 and 50 hertz. No specialized connections shall be needed for connection to the electrical grid. Heat rejection should require as little ancillary equipment and systems as necessary and should focus on convective heat transfer to ambient conditions, conduction heat transfer to surroundings, or a combination of both. The benefit of this heat removal system is that it functions in a passive state and relies upon inherent temperature gradients to reject heat. Use of this passive heat rejection mode ensures that low-level fission and decay heat can be rejected by allowing the heat from the mobile microreactor vessel to transfer outward to the point where a passive natural circulation loop rejects the heat to exterior air, which is ultimately exhausted out of the stack. The ability to generate process steam, used for heating, cooling, or pressure control, etc., in addition to the required electrical output may be provided in the mobile microreactor conversion system design.

Safety

The mobile microreactor is to be designed with the concept of ensuring safety throughout the proposed operating and handling regimes, as well as being resilient to potential accidents or upsets, whether they are caused by internal hazards (such as human errors, equipment failures, or fires) or external hazards (such as seismic events, vehicle impacts, or wind loading). Consistent with DOE guidance for safety in design and the program end goal of safe, reliable, and robust power generation, the designs implement features that reduce or eliminate hazards, with a bias toward preventative design features as opposed to mitigative, and a preference for passive systems over active systems. This general approach creates a design that is very reliable, is resilient to upset conditions, and drastically reduces risk. The key safety functions can be summarized as:

- Reactivity control – controls the power level of the mobile microreactor;
- Adequate cooling – provides fission and decay heat removal to limit core coolant and fuel temperatures;
- Protection of engineered fission-product boundaries – limits the release of radionuclides during normal and accident conditions; and

[28] *negative reactivity* –as power increases, the rate of neutron generation slows, indicating a move toward a power decrease, thus limiting the power increase

- Shielding – protects workers and the public from exposure to radiation resulting from mobile microreactor operations and transport.

These safety functions are generally relevant for safe mobile microreactor operations and transport and are described in more detail in Chapter 4, *Environmental Consequences*, Section 4.11, *Human Health – Facility Accidents*.

With respect to plant dynamics and passive safety (internal hazards), the system is expected to be a design that relies primarily on simple passive features and inherent physics to ensure safety and be capable of both automatic shutdowns as well as redundant and immediate failsafe shutdowns with passive cooling upon loss of power. With respect to external hazards (earthquakes, tsunami), the mobile microreactor will be able to meet the *DOE Standard for Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities* (DOE-STD-1020) (DOE, 2016b) for protection against external events and natural phenomena, such as earthquakes, tornadoes, hurricanes, floods, and tsunamis.

Components and Structures (Balance of Plant, Shipping Container), Supply Chain, Manufacturing

Design of non-fuel components, structures, and balance of plant systems should be of high technology readiness level materials and manufacturing techniques and should avoid first-of-a-kind supply chain development. The ability to meet NRC requirements and licensing should be considered in component design and selection. If development is needed, a description of the path toward qualification and licensing shall be provided to the highest level of detail possible.

Instrumentation and Controls

Instrumentation and controls shall be consistent with the objective for this system to have minimal operator interaction required, while also providing for monitoring to confirm normal conditions, off-normal conditions, and upset conditions.

Security and Associated Cyber Protections

The system shall be designed with hardening against cyber and electromagnetic pulse attacks.

Assembly/Disassembly of Hardware

The entire mobile microreactor system shall be designed to be assembled at the site and operational within 72 hours. Shutdown, cool down, disconnect, and removal for transport should occur in less than 7 days.

Transportation (Packaging System for Transport)

The two designs being considered for the mobile microreactor would be transported in as many as four 20-foot International Organization for Standardization (ISO)-compliant container express (CONEX) containers, either the standard height, width, and length or the high cube design (a foot taller than the standard size). Three of the CONEX containers would hold the microreactor module (i.e., the microreactor and primary coolant system), the power conversion module, and the control module (i.e., instrumentation and control for the microreactor module and power control module), respectively. The fourth container may contain assorted materials, including the cables, wires, pipes, and connectors needed to connect the mobile microreactor modules. Additional shielding requirements may be needed during the transport process.

2.2.2 Proposed Mobile Microreactor Concepts Selected by SCO for Further Design

The two mobile microreactor designs[29] under consideration for Project Pele are HTGRs using TRISO fuel (DoD SCO, 2021). Both use similar reactor fuel concepts as the Modular HTGR that has undergone extensive national and international review, except that the power levels for the mobile microreactor would be orders of magnitude less than the Modular HTGR power levels and physically much smaller. Both would use HALEU fuel.[30] Power conversion for both concepts would use a gas-driven turbine generator in the secondary coolant system to generate electrical power.

Both designs for the mobile microreactor would consist of a microreactor module, a power conversion module, and a control module. Each module would be contained within a CONEX container. The CONEX containers are about 8 feet by 8 feet by 20 feet.[31] The microreactor module consists of the mobile microreactor and primary cooling loop. A power conversion module consists of a turbine generator, which converts the mobile microreactor thermal energy to electrical power that would be supplied to an electrical grid when deployed. A control module would consist of the instruments and equipment to monitor and control reactor and power conversion system operation. A fourth CONEX container could be used to house ancillary equipment (pipes, cables, connectors, etc.).

Since it is still early in the design phase of the two mobile microreactor concepts, detailed design descriptions are not available. The fundamental characteristics of the two concepts are sufficiently understood that is possible to proceed with environmental analyses under NEPA using assumptions that would bound design features of the mobile microreactor and the potential impacts from the construction and demonstration of the mobile microreactor.

Both mobile microreactors would use the TRISO fuel using HALEU described in Section 2.2, *Mobile Microreactor*. Both would operate at a power level of no more than 5 MWe and would use similar power conversion systems. Demonstration of the mobile microreactor's operation (i.e., the testing procedures) is not dependent upon the design. The same demonstration tests performed for the same durations would be conducted. The safety features of the mobile microreactor designs may differ in their details, but the operation and effectiveness of the systems are expected to be similar.

X-energy and BWXT Advanced Technologies Mobile Microreactor Concept Descriptions

The X-energy proposed mobile microreactor, its Mobile Nuclear Power Plant, would employ a TRISO-fueled reactor coupled to a high reliability power conversion system—each is contained in separate ISO-compliant containers to achieve maximum siting flexibility, limit hardware activation, and improve maintainability. The mobile microreactor would utilize HALEU fuel to generate 1 to 5 MWe. The design incorporates several features that contribute to overall safety: (1) reactor core characteristics that ensure mobile microreactor shutdown if core temperatures exceed operating ranges; (2) passive cooling of the core that does not require the operation of any mechanical device (e.g., pump, blower); and (3) limitation of the maximum core temperature to a safe range even under off-nominal or accident conditions. The use of HALEU TRISO fuel further adds to the safety of the system, as the ceramic layers provide radionuclide retention and have been tested and verified to temperatures almost double those that would

[29] This EIS is not a decision document for the selection of a mobile microreactor design, including the selection of the fuel type. The two candidate designs are those remaining from the design selection process discussed in Chapter 1, Section 1.3, *Proposed Action and the Scope of this EIS*. No restrictions were placed on the reactor design or fuel type during the selection process. The analysis in this EIS is intended to cover whichever design is selected for use in Project Pele.

[30] HALEU is uranium that has been enriched in the uranium-235 isotope (the uranium isotope that produces the power in a fission reactor) to levels above that in fuels used in current commercial nuclear power plants but below 20 percent.

[31] Additional material including the necessary pipes, cable, and wires needed to connect the three modules may be transported in other containers.

be experienced by the X-energy mobile microreactor during normal operation and higher than those expected during accident conditions.

The BWXT Advanced Technologies system includes an HTGR design that uses HALEU TRISO fuel and relies primarily on simple passive features and inherent physics to ensure safety. The mobile microreactor is capable of passive cooling and uses air as the ultimate heat sink; all excess heat generated by the mobile microreactor is transferred to the atmosphere without the need for any active components (e.g., pumps, blowers). The mobile microreactor would be coupled with a power conversion system that generates approximately 1 to 5 MWe using an open Brayton gas cycle. The need for manual control of the systems is minimized as both the mobile microreactor and power conversion systems are managed by an advanced control system capable of semi-autonomous operation and safe shut down of the system with no manual intervention.

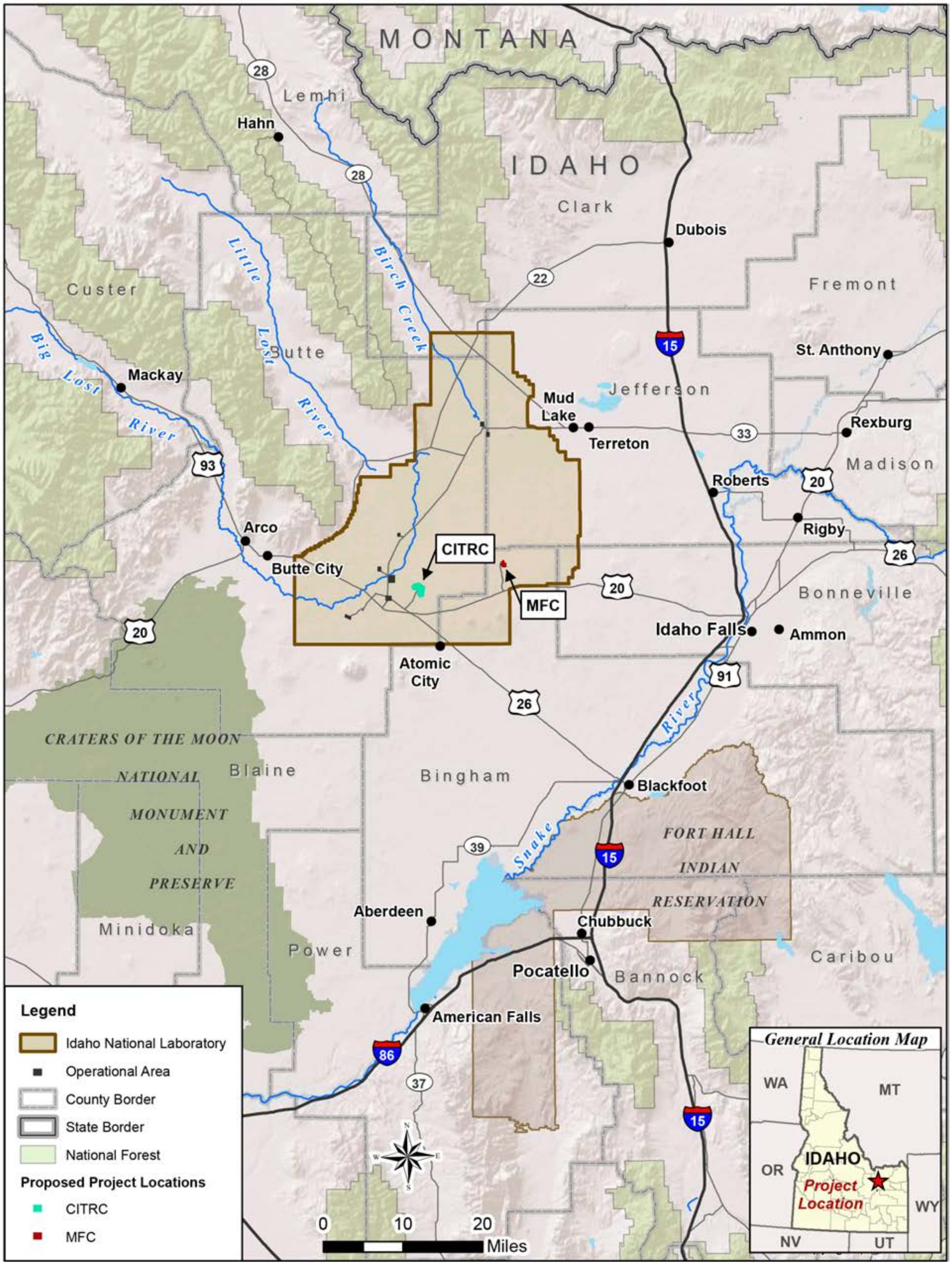
2.3 Proposed Action Alternative

This section describes the activities associated with the mobile microreactor construction and demonstration (Project Pele) and identifies the facilities planned for use during the demonstration at the INL Site. Additional information that supports the impact analyses presented in Chapter 4, *Environmental Consequences*, is provided in Appendix B, *Environmental Resources*, of this EIS.

The goal of Project Pele is to construct and demonstrate a mobile microreactor that would be capable of producing 1 to 5 MWe and meets the specific design goals and requirements identified by SCO (**Table 2.2-1**) that would be necessary for the practical deployment of the mobile microreactor. The mobile microreactor is expected to be a small, advanced gas-cooled reactor using HALEU TRISO fuel. All energy generated by the mobile microreactor that is not converted to electrical power would be transferred to the atmosphere (i.e., air would be the ultimate heat sink). Mobile microreactor demonstration would be performed at the INL Site using DOE technical expertise and facilities at MFC and CITRC (see **Figure 2.3-1**).

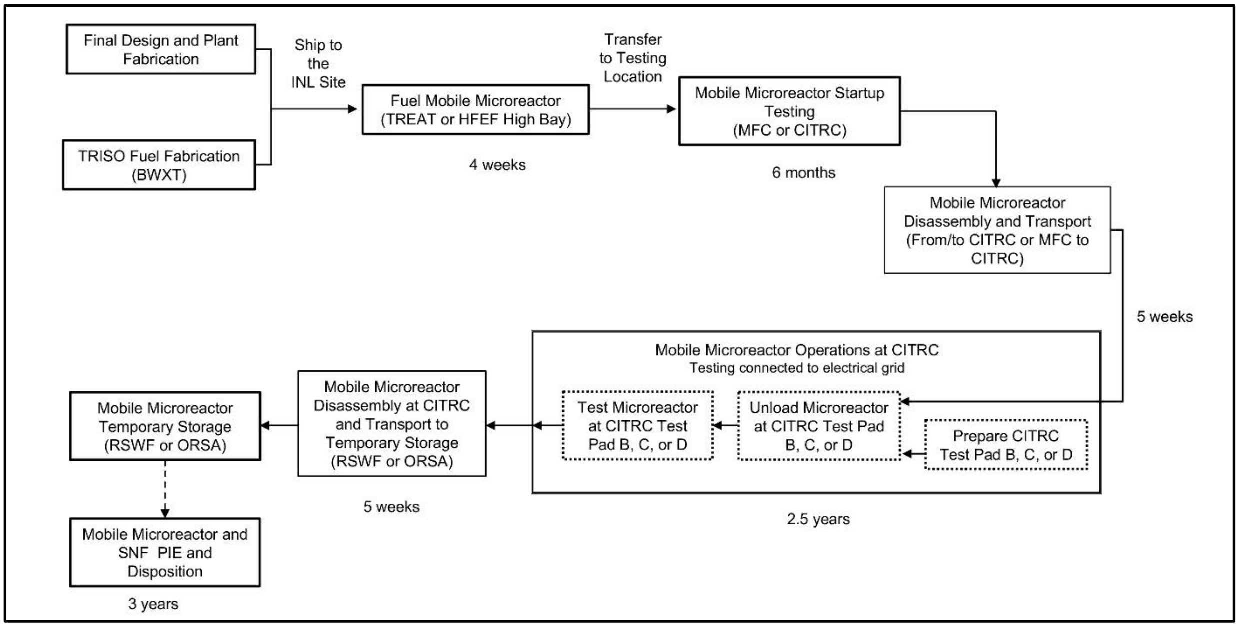
Several activities required to complete the Proposed Action alternative are shown in **Figure 2.3-2** with estimated durations of the demonstration activities. These include activities at non-DOE facilities, such as the fabrication and procurement of fuel from BWXT in Lynchburg, Virginia, fabrication of the mobile microreactor components, and transportation of fuel and mobile microreactor components from the fabrication locations to the INL Site test area. Final assembly and demonstration activities, including receipt of the fuel and components at a test area, assembly of the components into a mobile microreactor, mobile microreactor fuel loading, and completing proof-of-concept testing, would be conducted at DOE facilities at the INL Site. Proof-of-concept testing would consist of startup testing, transportation, and testing at a second location at the INL Site. At the second testing location, the mobile microreactor system would be connected to a test microgrid[32] system, with diesel generators and load banks attached, and integrated into an electric power distribution system. The generators and load banks would apply realistic loads and supplies to the microgrid to test the mobile microreactor in a realistic setting. After demonstration testing is complete, the mobile microreactor would be placed into temporary storage at the DOE facility. At some later time, the mobile microreactor would undergo disposition. The mobile microreactor components would be disposed of at licensed disposal sites as appropriate for the waste type (INL, 2021a).

[32] A microgrid is typically a small isolated electrical distribution system able to function independently from any larger grid. At CITRC, test microgrids are integrated into the CITRC electric power distribution system that is managed and operated by INL.



Key: CITRC = Critical Infrastructure Test Range Complex; MFC = Materials and Fuels Complex

Figure 2.3-1. INL Site General Location Map



Key: BWXT = BWX Technologies; CITRC = Critical Infrastructure Test Range Complex; HFEF = Hot Fuel Examination Facility; INL = Idaho National Laboratory; MFC = Materials and Fuels Complex; ORSA = Outdoor Radioactive Storage Area; PIE = post-irradiation examination; RSWF = Radioactive Scrap and Waste Facility; TREAT = Transient Reactor Test Facility; TRISO = tristructural isotropic

Note: Once shipped to the INL Site, all activities occur at the INL Site except for disposition to off-site spent fuel and waste disposal sites. The 2.5 years for Mobile Microreactor Operations at CITRC is the operational period for demonstration testing; site preparation of the CITRC test area could take an additional 6 months.

Figure 2.3-2. Project Pele Flowchart

Since the mobile microreactor would not be at the end of its useful life, additional testing could be performed using this mobile microreactor. No activities beyond what has been described here have been proposed. While such activities may occur, they have not been fully developed and are not covered in this EIS, as the testing is not fully scoped and therefore would be speculative. If additional tests are eventually determined to be useful and the mobile microreactor were to be used in such testing, those testing efforts would need to be covered in separate NEPA documentation.

The following sections describe the specifics of the Proposed Action. The information is organized as follows: microreactor fabrication, transport of mobile microreactor components and fuel to the INL Site, and demonstration of the mobile microreactor at the INL Site. Demonstration activities at the INL Site would entail the following phases: (1) Phase 1: Fuel Mobile Microreactor (TREAT or HFEF); (2) Phase 2: Mobile Microreactor Startup Testing (MFC or CITRC); (3) Phase 3: Mobile Microreactor Disassembly and Transport (at CITRC or from MFC to CITRC); (4) Phase 4: Mobile Microreactor Operations at CITRC, (5) Phase 5: Mobile Microreactor Disassembly at CITRC and Transport to Temporary Storage (RSWF or ORSA); (6) Phase 6: Mobile Microreactor Temporary Storage (RSWF or ORSA); and (7) Phase 7: Mobile Microreactor and Spent Nuclear Fuel Post Irradiation Examination and Disposition (**Figure 2.3-2**). Unless otherwise noted, INL provided the information in these sections (INL, 2021a).

2.3.1 Mobile Microreactor Fabrication

Mobile Microreactor Component Fabrication

The mobile microreactor modules (microreactor, power conversion, and control modules) comprising the mobile microreactor system would be manufactured at commercial (BWXT Advanced Technologies team member or X-energy team member) locations. These fabrication activities are expected to be within the normal activities associated with the fabrication sites and no reactor fuel would be present during construction. The three modules would each be contained in separate CONEX containers. Ancillary equipment needed for final assembly of the modules (cables, pipes, and hoses, connectors, etc.) would be packaged and shipped in a fourth CONEX container. Once the modules are completed and loaded into the CONEX containers, the containers would be transported to the INL Site for fueling, assembly, and testing of the mobile microreactor.

Mobile Microreactor Fuel Fabrication

Each of the mobile microreactor designs would be powered by HALEU TRISO fuel. The mobile microreactor would be fueled with up to 400 kilograms (kg) of HALEU encapsulated in TRISO particles embedded with up to 400,000 TRISO fuel compacts (see **Figure 2.2-2**).

HEU[33] would be supplied by the NNSA and transferred to Nuclear Fuel Services (a subsidiary of BWXT) in Erwin, Tennessee, for conversion l to an oxide form. The HEU oxide would be shipped from there to BWXT in Lynchburg, Virginia, for downblending to HALEU and fabrication into TRISO fuel for Project Pele. The downblending material would be shipped from the same NNSA facility to the BWXT Lynchburg facility.

Both of the BWXT facilities are NRC licensed. Activities at the BWXT facilities are covered by previous NEPA documentation.

In 1996, the DOE issued the *Disposition of Surplus Highly Enriched Uranium* Final Environmental Impact Statement (DOE/EIS-0240) (the HEU FEIS) (DOE, 1996b). The HEU FEIS evaluated the impacts of blending HEU to LEU to eliminate the risk of diversion for nuclear proliferation, and, where practical, to reuse the resulting LEU in peaceful, beneficial ways that recover its commercial value. The HEU EIS, and subsequent ROD and supplemental analysis, evaluated and authorized blending of surplus HEU in DOE's inventory at the Y-12 Plant. It also analyzes the transportation of necessary materials from their likely places of origin to the potential blending sites, and from blending sites to the likely or representative destinations for nuclear fuel fabrication, including the BWXT facilities in Lynchburg, Virginia, and Erwin, Tennessee.

The fabrication of the TRISO fuel are activities covered under existing NEPA documentation for the Nuclear Fuel Services and BWXT Lynchburg site. NEPA documentation for Nuclear Fuel Services is the *Final Environmental Assessment for the Proposed Renewal of U.S. Nuclear Regulatory Commission License No. SNM–124 for Nuclear Fuel Services, Inc.* (NRC, 2011a) NEPA documentation for the site in Lynchburg includes the *Environmental Report for Renewal of License SNM-42* (BWXT, Nuclear Products Division, 2004) and the *Environmental Assessment Related to the Renewal of NRC License No. SNM-42 for BWX Technologies, Inc.* (NRC, 2005).

A maximum of five shipments of the HEU would be required for the shipment from NNSA's Y-12 facility at Oak Ridge, Tennessee, to the BWXT facility in Erwin, Tennessee, in NNSA Office of Secure Transportation's Secure Transportation Assets. An additional five shipments of the material used to downblend the HEU could be required. HALEU would be shipped from Erwin to BWXT in Lynchburg, Virginia, in a maximum of five shipments by commercial carriers. These shipping containers would be DOT-approved shipping containers for the shipment of enriched fuel.

2.3.2 Transport of Mobile Microreactor and Fuel to the INL Site

The un-fueled mobile microreactor system would be shipped in four CONEX containers from either the X-energy team facilities or the BWXT Advanced Technologies team facilities to the INL Site. The TRISO fuel for the mobile microreactor would be shipped from BWXT's fuel manufacturing plant in Lynchburg, Virginia, to the INL Site. TRISO fuel would be shipped from BWXT Lynchburg to MFC at the INL Site in shipping containers that meet NRC and DOT requirements for the shipment of radiological material.

[33] Highly enriched uranium (HEU) is uranium in which the concentration of the isotope of uranium-235 has been increased to 20% or higher.

Shipping the mobile microreactor fuel from the BWXT facility to the INL Site could require up to 10 truck shipments (INL, 2021a).

2.3.3 Demonstration Activities at the INL Site

Project Pele (**Figure 2.3-1**) would involve demonstration that the proposed mobile microreactor could produce reliable electric power onto an electrical grid that is separate from a public utility grid[34] and that the mobile microreactor can be disassembled and moved. These activities are to be performed at the CITRC and MFC facilities on the INL Site. At the end of an approximately 3-year demonstration, current plans are that the mobile microreactor would be shut down and placed into a safe storage mode at the INL Site. **Figure 2.3-3** shows the locations of the facilities at MFC that could be utilized for Project Pele.

Key: DOME = Demonstration of Operational Microreactor Experiments (formerly known as the EBR-II [Experimental Breeder Reactor II] test bed); HFEF = Hot Fuel Examination Facility; MFC = Materials and Fuels Complex; ORSA = Outdoor Radioactive Storage Area; RSWF = Radioactive Scrap Waste Facility; TREAT = Transient Reactor Test Facility

Figure 2.3-3. Project Pele MFC Facilities

2.3.3.1 Fuel Mobile Microreactor at MFC

The mobile microreactor would arrive at the INL Site for installation at MFC without reactor fuel. The possible locations to perform the fueling[35] of the mobile microreactor are TREAT or HFEF.

The fuel loading at TREAT would utilize the facility's 60-ton crane and at HFEF the 30-ton crane in the facility truck lock (see **Figure 2.3-4** and **Figure 2.3-5**). Regardless of the facility chosen to fuel the microreactor, the microreactor module and the CONEX container that houses it would be opened, the

[34] The demonstration does not include putting power onto a public utility's electrical grid.
[35] The fuel may be held for a short period of time before fueling operations begin.

facility crane may be used to manipulate the microreactor module and CONEX container, fuel would be added to the mobile microreactor, and the microreactor module and the CONEX container would be closed. The microreactor module within its CONEX container would be transferred to the initial startup testing location.

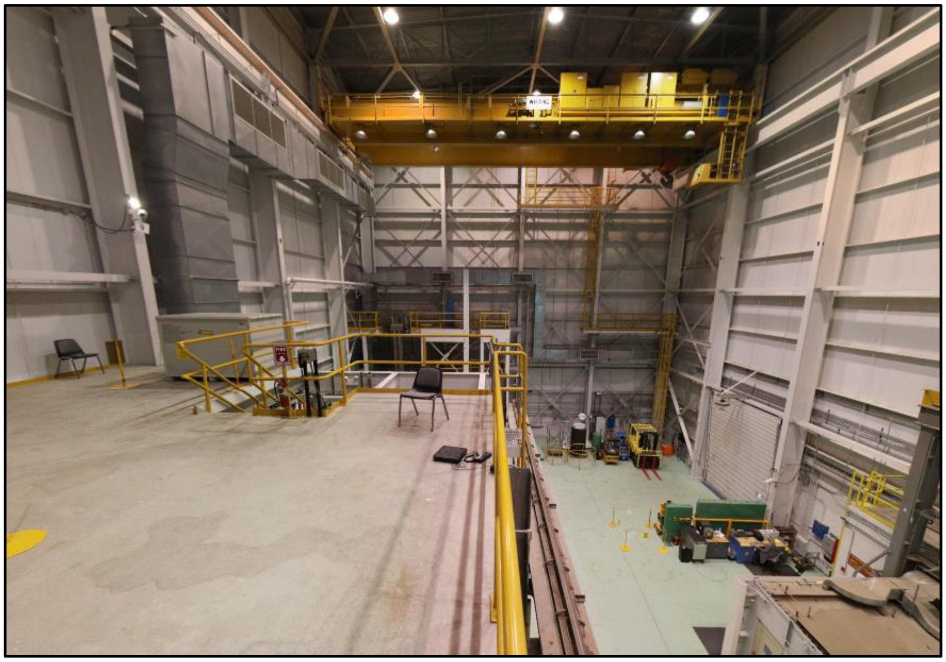
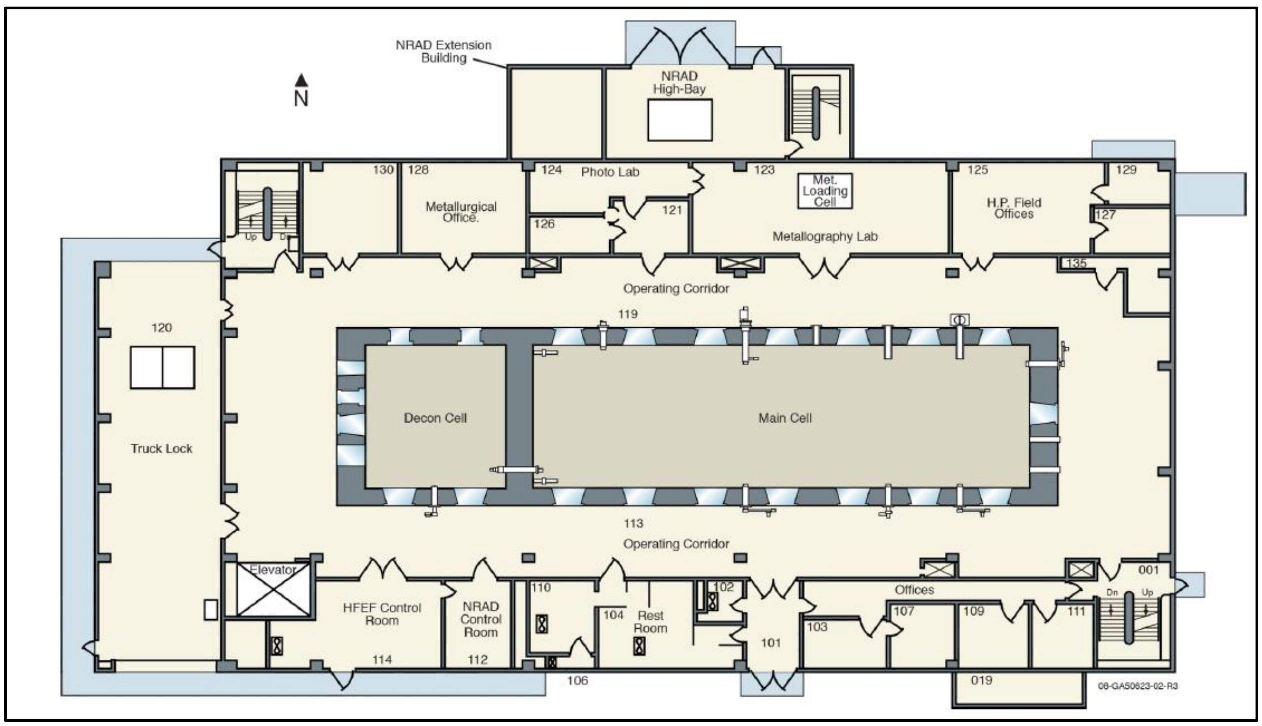


Figure 2.3-4. TREAT Mobile Microreactor Fueling Area



Key: H. P. = Health Physics; HFEF = Hot Fuel Examination Facility; Met. = metallurgical; NRAD = Neutron Radiography Reactor

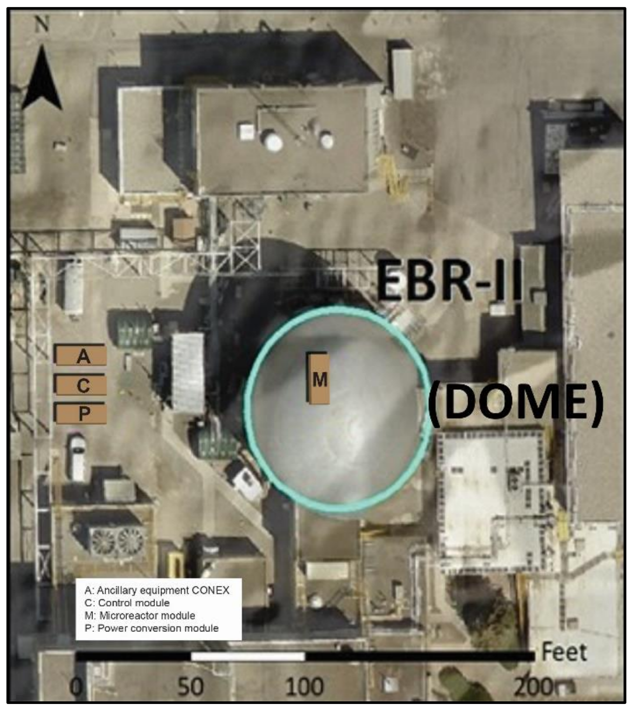
Figure 2.3-5. HFEF First Floor

2.3.3.2 Mobile Microreactor Initial Startup Testing

Final assembly of the mobile microreactor modules would occur at the site of the initial startup testing. The initial startup testing could be performed at MFC in the DOME. Improvements to the DOME are planned in support of other programs at the INL Site. These improvements to the DOME, while not a part of Project Pele,[36] are necessary for the DOME to be able to support the initial startup testing phase of the mobile microreactor demonstration. Should these improvements not be made in time to support the Project Pele schedule, final assembly and startup testing would be performed at CITRC.

Final assembly entails connecting the mobile microreactor modules. The modules within the CONEX containers would be attached via cables, conduit, and pipes. The necessary cables, conduit, pipes, and connectors would have been transported with the mobile microreactor to the INL Site. At this phase of the demonstration, any power generated by the mobile microreactor would be transferred to load banks installed at the startup testing site; the mobile microreactor would not be connected to an electrical distribution grid. Load banks accurately mimic the operational or "real" load that a power source will see in actual application.

The microreactor module, within its CONEX container, would be placed in the DOME. Within the DOME, neutron and gamma radiation shielding would be provided by using materials such as borated polyethylene, water bladders,[37] and concrete. The remaining modules and the ancillary equipment CONEX container would be placed outside the DOME as pictured in **Figure 2.3-6**. At the DOME, the cables, conduits, and pipes would be routed through existing containment dome entry points or penetrations.



Key: DOME = Demonstration of Operational Microreactor Experiments (formerly known as the EBR-II test bed)

Figure 2.3-6. Mobile Microreactor Configuration of CONEX Containers at the DOME

If startup testing is performed at CITRC, the mobile microreactor would be set up as described in Section 2.3.3.4, *Mobile Microreactor Operations at CITRC*, including construction of the concrete pad and installation of shielding.

Startup testing would be performed to verify that the mobile microreactor would perform as designed. Startup of the mobile microreactor would be in accordance with DOE Order 425.1D Chg 2 (DOE, 2019a), *Verification of Readiness to Start Up or Restart Nuclear Facilities*. The mobile microreactor would be operated to confirm that it can operate to DOE nuclear reactor safety basis requirements and all applicable DOE Orders and standards as required.

[36] Modifications to the EBR-II facility to support microreactor experiments at the DOME are proposed under the National Reactor Innovation Center (NRIC) program at the INL Site. Decisions to implement these modifications would be made regardless of any actions associated with Project Pele.

[37] Water used to fill the steel bladders would be treated prior to use to remove minerals and possibly treated after use with spent ion exchange resin and reverse osmosis systems to remove trace radionuclides.

A startup test procedure would be developed, outlining the steps to be followed and identifying the information to be verified at each step. Initial tests would be performed with the mobile microreactor subcritical (i.e., the mobile microreactor would shut down without an additional neutron source). Tests would verify the performance of the core, mobile microreactor integrity, cooling systems, and control systems. Again, mobile microreactor performance would be verified to be within designed parameters.

The startup and initial testing phase is anticipated to take 6 months to complete.

The DOME (formerly the EBR-II test bed, facility number MFC-767) is a safeguards category 4 facility. The DOME is about 80 feet in diameter by 45 feet tall and is constructed of 1-inch steel plating with a 1-foot-thick reinforced concrete inner structure. The containment dome air cooling system consists of two 300-ton air-cooled chillers suppling chilled water to air handling units inside the containment dome (DOE-ID, 2021b).

The DOME ventilation system would remove heat to maintain ambient conditions within the DOME. It is not a required safety structure, system, or component (SSC) for the startup testing of the mobile microreactor. The system includes supply air handling units, exhaust fans, high-efficiency particulate air (HEPA) filters, an exhaust stack, and an exhaust stack monitoring system. Exhaust enters the fans after passing through a single stage of HEPA filtration with a minimum efficiency of 99.97 percent for particles with a median diameter of 0.3 micron. The stack emission sampling system incorporates a continuous record air sampler for particulate radionuclides, a flow monitor, and a continuous alpha monitoring device with alarm functions. The ventilation system also utilizes two HEPA filters in parallel located within the DOME building. These filters are rated for 1,000 cubic feet per minute each.

EBR-II has been designated as Institutional Control Site ANL-67, because asbestos and radioactive materials were left within the EBR-II basement when it was grouted during decontamination and decommissioning (D&D) activities. Institutional Control Site ANL-67 also includes the former location of MFC-795 adjacent on the northeast side of EBR-II. A risk assessment documented that the remaining hazardous materials did not present an unacceptable risk, provided that intrusion was controlled into areas where hazardous materials remain (DOE-ID, 2021b).

No modifications would be necessary to the DOME, as it is designed for the purpose of testing reactors similar to the mobile microreactor. Testing would require site-specific connections to adapt the deployment of the microreactor to the DOME. When testing is completed, these connectors would be disposed of after characterization as either LLW or cold waste.

2.3.3.3 Disassembly and Transport

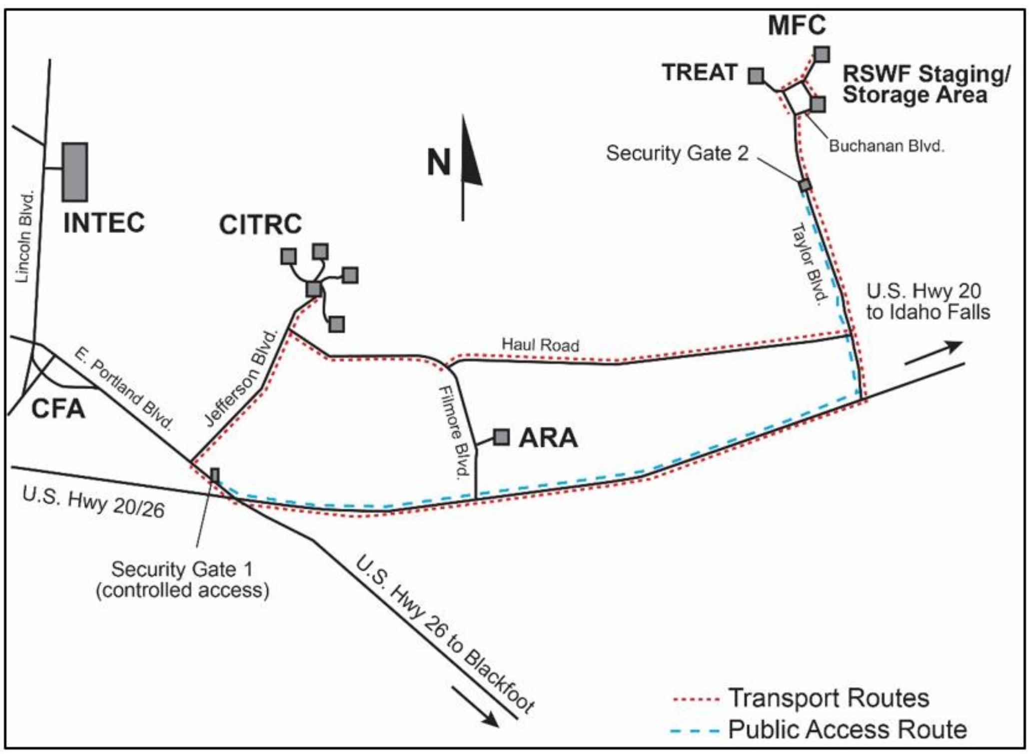
Disassembly and transport would occur between the startup testing and operational testing at CITRC phases regardless of where startup testing would be performed. Disassembly and transport would provide proof-of-concept of the required mobility of the mobile microreactor.

The mobile microreactor would be disassembled at the startup testing site with minimal temporary laydown requirements (for the collection of conduit, piping, etc.). The mobile microreactor would be placed in a safe shutdown mode in which decay heat (from radiation) would be removed via the passive heat removal systems. The mobile microreactor would be depressurized (also known as a blowdown) to equalize the pressure vessel to atmospheric pressures. Two blowdowns are expected to occur at the DOME. The noble gas released as a result of a blowdown would be filtered through HEPA filters prior to being released into the surrounding environment. The mobile microreactor modules would be separated from each other and loaded onto semi-trailers for transport (see **Figure 2.3-7** for an illustrative configuration of shipment of a mobile microreactor in a 40-foot CONEX container). Cables that can be reused that are not specific to DOME application would be packaged and reused at the second testing location. Cables that cannot be reused would be disposed of. The haul road or U.S. Highway 20 (US-20) would be used to transport the mobile microreactor[38] (see **Figure 2.3-8**). If US-20 were to be used, the

[38] Haul road is a term for roads designed for heavy or bulk transfer of materials by haul trucks.

road would be shut down during non-peak hours, to enable safe and unhindered transport of the mobile microreactor between the two locations.[39] (Typically, US-20 is closed for approximately 2 hours between the hours of midnight and 4 a.m. to support on-site shipment of radioactive materials.) The transport design would contain sufficient shielding to protect the co-located worker and public from exceeding the limits in 10 CFR 203 following as low as reasonably achievable (ALARA) principles.

Figure 2.3-7. Illustrative Transport of a Mobile Microreactor



Key: ARA = Auxiliary Reactor Area; ATR = Advanced Test Reactor; CFA = Central Facilities Area; CITRC = Critical Infrastructure Test Range Complex; Hwy = Highway; INTEC = Idaho Nuclear Technology and Engineering Center; MFC = Materials and Fuels Complex; RSWF = Radioactive Scrap and Waste Facility; TREAT = Transient Reactor Test Facility

Figure 2.3-8. Transportation Routes Between MFC and CITRC

[39] The portion of US-20 that would be used is entirely within the INL Site. With the closure of this portion of US-20 during the transport of the mobile microreactor, DOT and NRC off-site transportation regulations are not applicable 49 CFR 171.1 (d) (4).

If startup testing were to be performed in the DOME at MFC, site restoration would entail the removal of shielding and returning the site to its original configuration. No activated materials would be expected, and the waste hauled away would be considered nonradioactive waste. During disassembly and site restoration, an average of three shipments per day would occur until site restoration is complete. Site restoration would not be necessary if the startup testing were to be performed at CITRC. The mobile microreactor would be returned to the same test pad and the existing radiation shielding would be used for the next phase of the mobile microreactor demonstration. The HEPA filters used during the microreactor blowdown may be bagged and disposed of as radiological waste.

This phase is anticipated to take around 5 weeks to complete.

2.3.3.4 Mobile Microreactor Operations at CITRC

CITRC is part of the INL Site's 61-mile 138-kV power loop electric test bed and supports critical infrastructure research and testing. CITRC includes a configurable and controllable substation and a 13.8-kV distribution network. The CITRC infrastructure includes four user locations on a distribution network that can operate alone or together to support larger operations at any of multiple test voltage levels. Each user location allows connection to 13.8-kV power to supply a separate source of noninterrupted power to support test operations. Fiber optic cables route to a centralized command and control shelter allowing communications between any combination of user locations and between the user locations and the command shelter (DOE-ID, 2019b).

Four test pads are located at CITRC within the CITRC distribution grid (Pads A, B, C, and D). Some testing connects multiple test pads using the electrical distribution infrastructure. These test pad locations are shown in **Figure 2.3-9**. These graveled or paved test pads furnish areas to place test equipment (e.g., transformers, circuit breakers, switches). Test pads also serve as parking areas for personnel performing setup and testing. (DOE-ID, 2019b)

Preparation of CITRC would be performed over the course of up to 6 months prior to the arrival of the mobile microreactor at the site. Preparation would involve construction of a 200-foot by 200-foot concrete pad about 8 inches thick to create a level surface for the CONEX containers. Construction at CITRC would be largely above grade to simulate actual deployment of the mobile microreactor. Therefore, excavation for construction of the concrete pad would be minimal. Any asphalt or other material that requires removal would be disposed of at an appropriate waste disposal facility (e.g., the INL Site landfill). Construction would be limited to daylight hours with very limited or nonexistent nighttime or weekend work. Generally, the proposed areas at CITRC that could be disturbed have already been impacted by human surface interactions; below-ground disturbances would be limited to localized areas and minimized as much as reasonably achievable.

Upon arrival at the test pad area for Pad B, C, or D at CITRC, the mobile microreactor would be offloaded from the transports to the concrete pad at the test pad area and the modules would be reconnected. The temporary shielding, possibly consisting of concrete T-walls, steel-reinforced concrete roof panels, concrete wall blocks, steel bladders for water shielding,[40] and HESCO® bags, would be installed. The completed shielding structure would be about 5,000 square feet and up to 30 feet tall around the microreactor and power conversion modules. The concrete pad would be surrounded by a security fence (see **Figure 2.3-9)**. No other construction is anticipated. In addition, the power conversion module would be connected to the test bed equipment. A limited version of the startup tests previously performed at the DOME (or CITRC) would be performed to verify that transporting the modules did not damage any components.

[40] Water used to fill the steel bladders would be treated prior to use to remove minerals and possibly treated after use with spent ion exchange resin and reverse osmosis systems to remove trace radionuclides.

Figure 2.3-9. Mobile Microreactor Located at CITRC Test Pad D

At CITRC, the mobile microreactor system would be connected to a microgrid with diesel generators and load banks attached. The generators and load banks would apply realistic loads and supplies to the microgrid to test the mobile microreactor in a realistic setting. **Figure 2.3-9** provides a satellite image with an overlay of the proposed construction area at CITRC. The figure shows Pad D as a representation of how the deployed mobile microreactor system could look, but the same mobile microreactor pad area of less than 40,000 square feet could be placed at any one of the Pad B, C, or D areas. At all three test pad areas, the area required for the mobile microreactor pad would be predominantly previously disturbed areas. The mobile microreactor pad could extend beyond existing disturbed areas. Additional pads would be used to house the load banks and diesel generators to simulate a microgrid (i.e., electrical power loads for the mobile microreactor) during testing. The design could require a mobile office trailer that could contain a restroom, potable water, donning/doffing facilities, equipment storage, charging stations, etc.

At-power testing, performed according to test procedures yet to be developed, would verify the ability of the mobile microreactor to operate at its rated power level for an extended period under normal, off-normal (but expected) conditions, and upset (not expected but anticipated) conditions. Transient tests performed would demonstrate mobile microreactor features, not push it to damage conditions. Transient testing would demonstrate upset conditions that would last at most a couple of days, but more likely hours. Under normal circumstances, TRISO fuel would not be removed from the mobile microreactor.

If concerns or issues arise with mobile microreactor operation during prototype testing, it may be necessary to remove components, examine them, and—depending upon the component's examination needs—INL staff may remove the component and, if necessary, transport the component to the HFEF for examination.

Additional facilities at MFC may be utilized for small-scale samples (e.g., small analytical chemistry). Prior to removal, INL would shut down the mobile microreactor in accordance with DOE requirements. Pending the results of the component examination, DOE and contractor staff may place the component back into the mobile microreactor or a new component(s) could be installed if the original component(s) are no longer serviceable. Unserviceable components would be decontaminated as necessary and disposed of in accordance with the applicable INL disposition requirements. During operation at CITRC, it may be determined that additional shielding would be necessary for transport or operation of the mobile microreactor. When and if needed, additional shielding would be manufactured on-site at the INL Site and installed within or attached to the outside of the CONEX container that encloses the mobile microreactor. Shielding would be installed when the mobile microreactor is in safe shutdown mode.

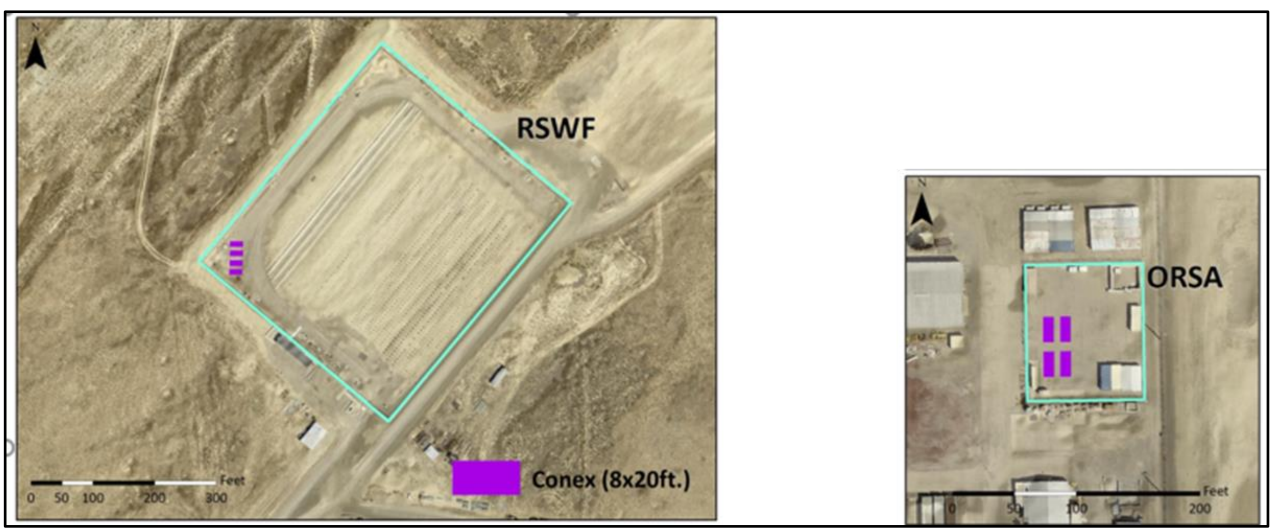
After mobile microreactor testing at CITRC is complete, the test pad areas would be reclaimed to their original state. In this process, all or some of the concrete would be removed. Some of the barriers could be repurposed or recycled, and the pads could be left in place for future projects. The mobile microreactor operations at CITRC phase is anticipated to take around 2.5 years to complete, although this phase could be slightly longer or shorter based on the progress of the test program.

2.3.3.5 Disassembly and Transport from CITRC to Temporary Storage

Disassembly and transport from CITRC to temporary storage would be similar to disassembly and transport from MFC to CITRC. One difference between this phase and the disassembly and transport from MFC to CITRC is that the mobile microreactor would be depressurized four times at CITRC (versus twice at the DOME at MFC). Otherwise, the project description information for disassembly and transport from MFC to CITRC in Section 2.3.3.3, *Disassembly and Transport*, can be used to describe this phase of the project.

2.3.3.6 Temporary Storage at the INL Site

After operational testing, the mobile microreactor would be placed in temporary storage, awaiting eventual disposition. There are two options for temporary storage of the mobile microreactor modules within their CONEX containers at the INL Site: the RSWF receiving area (MFC-771) and the ORSA (MFC-797). Layouts of the two possible locations for temporary storage are shown in **Figure 2.3-10**. The four CONEX containers (the ancillary equipment, the microreactor module, the power conversion module, and the control module CONEX containers) are depicted in purple.



Key: CONEX = container express (shipping container); ft. = feet; ORSA = Outdoor Radioactive Storage Area; RSWF = Radioactive Scrap and Waste Facility

Figure 2.3-10. Temporary Storage Locations

ORSA is an outdoor storage area for radioactive material. Material stored in this area must be stored in an ISO-standard container. The area already has a fence, but either an alarm or security checks would be required.

RSWF is an outdoor storage facility for storage and staging. Use of this storage area would require the security force to modify their current system.

A 50-foot by 50-foot by 8-inch reinforced concrete pad and a shed would be constructed at the temporary storage location. A shed roof structure may be needed to protect the CONEX containers from snow or rain intrusion.

During storage, the mobile microreactor would need to be inspected twice per year to verify safety, cooling, and shielding structures, systems, and components are functional. During these inspections, five workers would be exposed to a radiation field. The inspections would take a half of a shift, or 5 hours, twice per year.

There is no defined duration for this phase although it is expected to last at least 3 years. This time is needed to allow the fuel to cool sufficiently to start the defueling process. Temporary storage of at least portions of the mobile microreactor would continue until an off-site SNF disposal facility or geologic repository is available to accept the mobile microreactor SNF.

2.3.3.7 Post-Irradiation Examination and Disposition

After the mobile microreactor's useful life is complete and after a period of temporary storage, all the materials would be disposed of. The mobile microreactor components would be disposed of through the appropriate waste streams. It is anticipated that the mobile microreactor would be deconstructed and parts and/or fuel removed to aggregate like-class wastes.[41] After deconstruction, irradiated materials would be stored with other similar DOE-irradiated materials and experiments at MFC, most likely in the HFEF or the RSWF, in accordance with DOE's SNF EIS (DOE, 1995a), Record of Decision (DOE, 1995b), supplemental analyses, and the Amended Record of Decision (DOE, 1996a). Ultimate disposal of the irradiated materials that have been declared waste would be along with similar DOE-owned irradiated materials and experiments currently at MFC.

If a determination to pursue PIE of mobile microreactor fuels and components is made, the mobile microreactor would need to be defueled and deconstructed at the INL Site and fuel and components transferred to a facility with hot cells[42] for PIE. Even if a decision is made that no PIE would be performed on the mobile microreactor, it would be defueled and deconstructed to facilitate disposal of the mobile microreactor components. The INL Site has extensive experience in the handling of spent fuel, including the receipt and storage of the spent fuel from the Fort St. Vrain Nuclear Power Plant. (The Fort St. Vrain fuel is composed of kernels of a thorium-uranium carbide encased in carbon-based protective coatings, mixed with graphite and pressed into fuel compacts, and loaded into hexagonal graphite fuel elements similar to one possible form of the mobile microreactor fuel.) The INL Site has existing facilities for the handling of spent fuel, such as the Irradiated Fuels Storage Facility (facility number CPP-603), the Fluorinel Dissolution Process and Fuel Storage [FAST] facility (CPP-666), the Fuel Processing Restoration Facility (CPP-691), the Remote Analytical Laboratory (CPP-684), the Material Security and Consolidation Facility (CPP-651), TREAT (MFC-720), the Fuel Conditioning Facility (MFC-765), and HFEF (MFC-785). Additionally, the DOME or a temporary hot cell facility near MFC could be used. The specific facility for any defueling

[41] It is anticipated that the reactor vessel and two of the CONEX containers would be disposed of as LLW. The remaining two CONEX containers and components within would be nonradioactive waste and disposed of in the appropriate waste stream (hazardous, non-hazardous, etc.).

[42] Hot cells are structures used for the examination of highly radioactive material and include concrete walls and multi-layered, leaded-glass windows several feet thick. Remote manipulators allow operators to perform a range of tasks on test specimens within the hot cell while protecting them from radiation exposure.

activity has not been identified nor have any procedures or plans been developed for such an activity. These are activities routinely performed at the INL Site and the laboratory has developed generalized procedures that would be tailored to the defueling of the mobile microreactor. Selection of the facility and plan development may not be done until a decision has been made regarding what fuels and components would be selected for PIE and may depend on facility availability, costs associated with the use of each facility,[43] and the mobile microreactor design ultimately selected for Project Pele.

Any spent fuel designated for disposal would be packaged in standard casks, transferred to a storage location on the INL Site (several locations at the INL Site, such as Idaho Nuclear Technology and Engineering Center [INTEC] or RSWF, would be capable of storing the spent fuel), and await shipment to an interim storage facility or geologic repository.

If PIE were to be performed on the mobile microreactor materials of interest, HFEF at MFC would most likely be used in conjunction with additional facilities that may be used for small-scale samples (e.g., analytical chemistry). These materials would include the mobile microreactor fuel and potentially some mobile microreactor components. The determination of the components that could be of interest for PIE would not be made until after the demonstration testing has progressed for some time and possibly been completed.

The HFEF, the largest hot-cell facility at the INL Site, is a versatile hot-cell facility that consists primarily of two adjacent shielded cells, the main cell and the decontamination cell, surrounded by offices, laboratories, and personnel-related areas in a three-story (aboveground) building. A service level is located below ground. The facility includes an air-atmosphere decontamination cell, an argon-atmosphere main cell (the main cell), decontamination areas, and repair areas for hot-cell equipment, auxiliary laboratories, offices, and a high bay area.

The main cell is a 70-foot by 30-foot stainless steel-lined gas-tight hot cell. It is fitted with two 5-ton cranes and two electromechanical manipulators. There are 15 workstations, each with a 4-foot-thick window of oil-filled, cerium-stabilized high-density leaded glass and a pair of remote manipulators for use in its purified argon atmosphere. The decontamination hot cell includes five workstations and a water wash spray chamber for decontaminating materials and equipment (INL, 2017a).

Non-destructive and destructive radioactive material examination and processing would be performed in existing INL Site facilities. The radioactive materials involved in these activities include actinides and fission products. Radioactive material examination tasks include, but are not limited to, investigation of material characteristics (microstructure) and measurement of properties (fuel length, bowing, cladding surface distortion, and radionuclide distribution). Investigations of these phenomena are performed on samples ranging in mass from milligrams to hundreds of grams. The samples may be cut, ground, and/or polished to facilitate examination (INL, 2017a).

These activities would utilize current capabilities housed in the HFEF, including:

- Gamma scanning;
- Visual examination and eddy current testing;
- Gas sampling using the Gas Assay Sample and Recharge;
- Accident simulation testing in the Fuel and Accident Condition furnace;
- Metallic and ceramic sample preparation; and
- Bench measurements.

The HFEF hot cells would not require modifications to perform PIE. HFEF operations to support the Project Pele mission are within the scope of activities currently performed at the HFEF.

[43] The facility modifications needed to perform defueling vary from facility to facility.

The disposition and PIE (if performed) would be performed in parallel and would take around 3 years to complete.

2.4 No Action Alternative

Under the No Action Alternative, a mobile microreactor would not be constructed, fuel would not be fabricated by BWXT, and the mobile microreactor would not be demonstrated at the INL Site.

2.5 Alternatives Considered and Dismissed from Detailed Analysis

As discussed in Section 2.1.1, *Siting Requirements for the Mobile Microreactor*, SCO evaluated a range of reasonable alternatives for the Proposed Action in this EIS, including a no action alternative that serves as a basis for comparison with the action alternatives.

The ORNL site met almost all the siting criteria, but, most significantly, ORNL does not have an independent electrical distribution system capable of scheduling and operation independent of and isolated from the local commercial utility grid. The program for demonstration of the mobile microreactor is intended to demonstrate the mobile microreactor's operation under a wide variety of operational conditions. The operational requirements include the ability to provide different amounts of power up to and including its design electrical generation limit. It must be able to synchronize (match frequency) with other loads that may be on the electrical distribution grid. The mobile microreactor must produce power at both 50 and 60 hertz. It should have a load following capability (be able to react to varying power demands by increasing or decreasing electrical power output). Demonstration of all these mobile microreactor capabilities in a controlled environment requires an independent, isolable electrical distribution system that can connect the mobile microreactor with variable loads and power sources.

The development of an independent electrical grid for testing at any location would introduce additional impacts. Construction of a controllable power test grid would require a significant monetary investment. Additionally, development of a new test microgrid integrated into a new electrical power independent grid would potentially affect existing resources due to the permanent commitment of land and introduce risk associated with the connected action of permitting and constructing an electrical grid for testing purposes.

Therefore, ORNL was not considered for further analysis.

While a detailed analysis of potential impacts at ORNL was not performed, there are other factors that indicate the ORNL site would not be an environmentally preferable choice for demonstration of the mobile microreactor. At ORNL, the mobile microreactor would be located in previously undisturbed areas and the ORNL area has a higher population density than the INL Site's CITRC, which could therefore result in higher, but still small, environmental impacts than if the mobile microreactor were demonstrated at CITRC.[44]

Once the INL Site was determined to meet the requirements for the demonstration of the mobile microreactor, several indoor and outdoor sites at the INL Site were identified as potential locations for mobile microreactor demonstration activities. Site selection at INL (INL, 2021b) tiered off previous site selection efforts for the NRIC (INL, 2020a). CITRC Test Pads A, B, C, and D and a location on Test Area North were considered, along with the sites considered for the NRIC. This brought the total number of sites evaluated to 37: 5 indoor sites and 32 outdoor sites. The following are the characteristics used to evaluate each site:

[44] The Versatile Test Reactor EIS (DOE, 2020a) performed an assessment for siting a reactor at ORNL or INL. Results of the radiological assessments for these two sites resulted in higher, but still small, population impacts at ORNL.

- Located on a previously impacted site of a minimum 0.25 acre
- Access to transportation routes for microreactor transport on a semi-trailer between assembly site, demonstration sites, and long-term storage site within boundaries of the INL Site
- Located at a DOE Office of Nuclear Energy–managed site
- Enables connection of microreactor to an electrical grid that can be made independent from any commercial grid for testing
- Meets microreactor design requirements
  - Provides egress from the demonstration site that is large enough to accommodate CONEX containers plus shielding, a 15.6 feet tall by 14 feet wide minimum
  - Able to keep the temperature inside the demonstration site facility below 115°F (46.1°C) for optimal microreactor performance
  - Enables connection of the microreactor module to support modules (inside or outside) using 3- to 4-inch cables with large connectors
  - Provides a demonstration-site facility with a floor-loading capacity of 42 tons, minimum, to support the microreactor and shielding during operation
  - Enables movement of the shielded microreactor in and out of the facility, if applicable
  - Enables lifts of 10 tons, maximum, to move piping within the facility, if applicable
- Located away from population centers of greater than 25,000 people
- Located more than 5 miles from hazardous sites
- Located outside wetland areas
- Located outside of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites
- Located outside of a 100-year floodplain
- Enables electric grid connectivity by 2024

Outdoor sites that were considered were located on or adjacent to several INL facilities (ATR, CFA, CITRC, INTEC, MFC, Naval Reactors Facility, and Test Area North) or at more undeveloped locations on the INL Site. Of these sites, only the CITRC test pad areas met all the siting criteria. Most candidate sites were eliminated for a failure to meet the first criteria listed above (a previously impacted site of a minimum of 0.25 acre). For those that met this criteria, the failure to meet electrical connection criteria or location criteria (not more than 5 miles from a hazardous site) resulted in their elimination from consideration.

In addition to the general siting criteria identified above, the following distinguishing requirements for the mobile microreactor were considered in the evaluation of indoor locations:

- Must provide egress from the demonstration site large enough to accommodate CONEX containers plus shielding, a 15.6 feet tall by 14 feet wide minimum
- Must be able to keep the temperature inside the demonstration site facility below 115°F (46.1°C) for optimal microreactor performance
- Must enable connection of the microreactor module to support modules (inside or outside) using 3- to 4-inch cables with large connectors
- Must provide a demonstration site facility with a floor loading capacity of 42 tons, minimum, to support the microreactor and shielding during operation
- Must enable movement of the shielded microreactor in and out of the facility, if applicable
- Must enable lifts of 10 tons maximum to move piping within the facility, if applicable

The following five sites were considered for an indoor location for testing of the mobile microreactor:

- Fuel Processing Restoration Facility (CPP-691) located at INTEC
- DOME located at MFC
- Zero Power Physics Reactor located at MFC
- CITRC Control System Research Facility (PBF-612)
- CITRC Communications Research Facility (PBF-613)

Of the five facilities considered, only the DOME met all these criteria.

2.6 Preferred Alternative

The Proposed Action is the Preferred Alternative. The mobile microreactor would be fabricated at either BWXT Advanced Technologies or X-energy team facilities, fuel would be fabricated at the BWXT Lynchburg, Virginia, facility. Both fuel and mobile microreactor would be transported to the INL Site where facilities at MFC and CITRC would be used to demonstrate operation of the mobile microreactor and mobility proof-of-concept.

2.7 Summary of Environmental Consequences

This section summarizes the environmental impacts of Project Pele alternatives evaluated in this EIS. Section 2.7.1, *Comparison of Alternatives*, presents the impacts for each alternative. Section 2.7.2, *Summary and Comparison of Cumulative Impacts*, discusses the cumulative impacts of the alternatives in the context of past, present, and reasonably foreseeable future actions.

2.7.1 Comparison of Alternatives

Under the No Action Alternative, DoD and DOE would not pursue Project Pele. Mobile microreactor fabrication, fuel fabrication, mobile microreactor demonstration, PIE, and disposition would not occur. **Table 2.7-1** presents potential incremental environmental consequences for the Proposed Action alternative at the INL Site. All activities at the fuel fabrication sites are activities addressed in existing NEPA documentation; environmental impacts associated with the fuel fabrication activities of Project Pele would be bound by the impacts previously identified. Microreactor fabrication is a typical industrial activity to be performed at existing facilities that operate under applicable permits and regulations. Fabrication of the mobile microreactor (over a period of less than 2 years) would be a small part of the activities at these facilities. Under the No Action Alternative, there would be no increase in environmental impacts at the INL Site and the fuel and reactor fabrication sites above the existing conditions described in Chapter 3, *Affected Environment*.

Table 2.7-1. Summary of Project Pele Environmental Consequences

Resource Area	***Impacts Summary***
Land Use and Aesthetics (Chapter 4, Section 4.1)	
Land Use	There would be minor impacts on land use from the disturbance of less than 2 (up to about 1.6) acres during construction activities at the CITRC test location. Less than an additional 0.1 acre would be disturbed at the temporary storage site. No additional land would be disturbed during operations.
Aesthetics	Localized and temporary visual impacts could result from construction equipment (e.g., cranes), but only in areas within the line of sight of CITRC and the temporary storage location during construction. Construction and other related activities at CITRC would be limited to daylight hours with very limited or nonexistent nighttime or weekend work and thus would not contribute to any local or

Table 2.7-1. Summary of Project Pele Alternative Environmental Consequences (Continued)

Resource Area	*Impacts Summary*
	regional night sky impacts. New facilities associated with mobile microreactor demonstration would be designed to minimize, to the extent practicable, new sources of light pollution. Impacts on the Craters of the Moon National Monument and Preserve (an International Dark-Sky Park) would not be expected from exterior lighting required for the mobile microreactor demonstration at CITRC.
Geology and Soils (Chapter 4, Section 4.2)	
	Area disturbed would be less than 2 acres. Volume of excavated materials would be about 4,250 cubic yards. Rock/gravel needed would be 3,200 cubic yards. The total quantities of geologic and soil materials needed during construction would represent small percentages of regionally plentiful resources and are unlikely to adversely impact geology and soil resources. At the conclusion of testing, any soil determined to be LLW would be removed and the area returned to a state allowing unrestricted access and use.
Water Resources (Chapter 4, Section 4.3)	
Surface Water	No effluent would be discharged across the previously graded ground surface, and no surface water would be used. No activities are expected to add to or change the constituents in the stormwater discharge during construction. Sanitary wastewater from the construction and operational workforce would be handled by existing on-site systems.
Groundwater	No effluent would be discharged directly to groundwater, and thus, the Proposed Action would not adversely affect groundwater quality. The Proposed Action would use 260,500 gallons of groundwater over the approximately 6 years of mobile microreactor demonstration and potential PIE activities.
Air Quality (Chapter 4, Section 4.4)	
	None of the proposed operations would produce substantial air emissions. The combined annual emissions from all sources would be well below annual indicator thresholds. Therefore, annual emissions from the proposed project would not result in adverse impacts to air quality. The mobile and/or intermittent operation of project emission sources would result in dispersed concentrations of air pollutants at locations outside the INL Site. The transport of these emissions to the nearest boundary of the Craters of the Moon National Monument and Preserve would produce substantial dispersion and would result in negligible concentrations of air pollutants within this pristine Class I area. PM_{10} emissions from the project also would negligibly impact the nearest PM_{10} nonattainment or maintenance area to the INL Site, which is the Fort Hall Indian Reservation PM_{10} nonattainment area in northeastern Power County and northwestern Bannock County.
Biological Resources (Chapter 4, Section 4.5)	
	The Proposed Action could disturb 28 vegetated acres across Pads B, C, or D at CITRC. Appropriate mitigations (such as sagebrush replacement, invasive species management, and the INL Revegetation Assessment program) would be enforced. As described in Section 4.10, *Human Health – Normal Operations*, radiological emissions from the Proposed Action would not substantially contribute to impacts on human health or biological resources. If an unforeseen hypothetical accident were to occur, radiological exposure could affect biological resources. Some plant and wildlife species may be more sensitive than others. In general, exposure to radiation may lead to increased mutation rates, reduced growth rates, changes in pollen production and seed viability, as well as abnormal development.
Cultural and Paleontological Resources (Chapter 4, Section 4.6)	
	The proposed project is expected to have no effect on ethnographic, significant cultural, and paleontological resources from construction and land disturbance.
Infrastructure (Chapter 4, Section 4.7)	
	The Proposed Action would use 140 megawatt-hours of electricity, with the majority (100 megawatt-hours) of this associated with any PIE activities, 34,000 pounds of propane, and

Table 2.7-1. Summary of Project Pele Alternative Environmental Consequences (Continued)

Resource Area	***Impacts Summary***
	210,500 gallons of water for staff and operational use plus another 50,000 gallons of water for the water bladders used for neutron shielding. Additionally, small quantities of diesel fuel (72,000 gallons) and gasoline (9,000 gallons) would be used.
Noise and Vibration (Chapter 4, Section 4.8)	
	The noise generated from operation would be consistent with other existing industrial activities and equipment at the INL Site and the potential concurrent noise would be similar to existing levels at the INL Site. Due to the distance, estimated noise levels at the INL Site boundary (5.9 miles from CITRC) and closest receptor (6.5 miles) would not be perceptible and would be consistent with ambient levels. Ground-borne vibration due to construction and operational activities are expected to be below the threshold of human perception at off-site locations.
Waste Management and Spent Nuclear Fuel Management (Chapter 4, Section 4.9)	
	Small amounts of waste and spent nuclear fuel would be generated as a result of the proposed project. All waste would be packaged on-site and would be disposed of off-site or stored at approved INL Site facilities. **Low-Level Waste** 247.1 cubic meters 533.4 meters 50 connections (units) **Mixed Low-Level Waste** 3.2 cubic meters **Cold Waste** 2,379.7 cubic meters 92.9 meters **Tru or GTCC-Like Waste** Small quantities (less than 3.4 cubic meters) **Spent Nuclear Fuel** Small quantities (less than 3.4 cubic meters)
Human Health – Normal Operations (Chapter 4, Section 4.10)	
	The annual dose to individuals in the INL Site areas from natural background radiation is about 380 millirem per year (Section 3.10.1, *Radiation Exposure and Risk*). The estimated population dose from natural background to the approximately 257,000 persons within 50 miles of the proposed operations is about 98,000 person-rem. The dose from demonstration of the microreactor to both the maximally exposed individual and the total population would be an insignificant fraction of this dose (equivalent to less than 15 minutes of exposure to natural background radiation and much less than the dose received on a flight from New York to Los Angeles). No latent cancer fatalities (LCF) would be expected to result from these doses. *Operations (annual radiological impacts)*: Off-site population within 50 miles Dose: less than 0.001 person-rem LCFs: 0 (less than 1×10^{-6}) (i.e., less than 0.000001) Maximally exposed individual Dose: less than 0.01 millirem LCF risk: less than 1×10^{-8} (i.e., less than 0.00000001) Worker population Dose: 3 person-rem LCFs: 0 (calculated: 2×10^{-3}) (i.e., 0.002) Industrial accidents: less than 1 injury with no fatalities expected.
Human Health – Facility Accidents (Annual Impacts) (Chapter 4, Section 4.11)	

Table 2.7-1. Summary of Project Pele Alternative Environmental Consequences (Continued)

Resource Area	***Impacts Summary***
	Because of the protective characteristics of the TRISO fuel particles, only a very, very small fraction of the radioactive materials would be released from the fuel under operating or accident conditions and temperatures. As a result, radiological impacts to the public from any accident would be a small fraction of an individual's annual natural background radiation dose rate of about 0.38 rem per year. The largest impacts to receptors would be associated with different accidents. Both the off-site population and non-involved worker dose shown would be associated with an operational accident at CITRC. The maximally exposed individual dose would be associated with an inadvertent criticality accident (i.e., accidental uncontrolled nuclear fission chain reaction) during transport of the mobile microreactor between locations on the INL Site. Projected radiological impacts from the accident with the largest consequences are: Off-site population within 50 miles Accident probability: less than one in 10,000 per year Collective Population Dose: 12 person-rem In contrast, the projected population dose from natural background is about 98,000 person-rem. (approximately 0.380 rem per year [Section 3.10.1] x 257,000 people or 98,000 person-rem) LCFs: 0 (0.007) Maximally exposed individual Accident probability: less than one in 10,000 per year Dose: 0.031 rem (natural background 0.38 rem per year) LCF risk: 2×10^{-5} (i.e., 0.00002) Non-involved worker Accident probability: less than one in 10,000 per year Dose: 0.52 rem LCF risk: 3×10^{-4} (i.e., 0.0003)
Human Health – Transportation Impacts (Chapter 4, Section 4.12)	
	The transportation of radioactive material (fuel) and waste likely would result in no additional fatalities as a result of radiation, either from incident-free operation or postulated transportation accidents. No potential traffic fatalities would be expected over the duration of activities. The nonradiological accident risks (the potential for fatalities as a direct result of traffic accidents) are greater than the radiological accident risks.
Traffic (Chapter 4, Section 4.13)	
	The impacts on traffic from the Proposed Action are anticipated to be negligible to minor.
Socioeconomics (Chapter 4, Section 4.14)	
	The increase in jobs and income from construction and operations would have a small and short-term beneficial impact on the local and regional economy. The population influx associated with an in-migrating workforce and their families is considered relatively small and would have no major adverse impacts on the region in terms of population, employment, income levels, housing, or community services.
Environmental Justice (Chapter 4, Section 4.15)	
	No disproportionately high and adverse impacts on minority or low-income populations are expected. Increased health risks to minority or low-income individuals or populations exposed to radiation would be negligible.

Key: CITRC = Critical Infrastructure Test Range Complex; HALEU = high-assay low-enriched uranium; INL = Idaho National Laboratory; LCF = latent cancer fatality; LLW = low-level radioactive waste; PIE = post-irradiation examination; PM_{10} = particulate matter less than or equal to 10 microns in diameter; rem = roentgen equivalent man (a measure of radiation); TRISO = tristructural isotropic

2.7.2 Summary and Comparison of Cumulative Impacts

CEQ regulations define cumulative impacts as effects on the environment that result from implementing any of the alternatives when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions (40 CFR 1508.7). Cumulative impacts were assessed by combining the effects of activities at the INL Site for the Proposed Alternative assessed in this EIS with the effects of other past, present, and reasonably foreseeable future actions. Many of these actions occur at different times and locations and may not be truly additive, but the effects were combined irrespective of the time and location of the impact, to encompass any uncertainties in the projected activities and their effects. This approach produces a conservative estimate of cumulative impacts for the activities considered. **Table 2.7-2** presents a summary and comparison of cumulative impacts at the INL Site. Cumulative impacts for issues of national and global concern (i.e., transportation and climate change) are included within the table. For the full discussion of cumulative impacts, refer to Chapter 5, *Cumulative Impacts*.

Table 2.7-2. Summary of Cumulative Impacts

Resource Area	***Cumulative Impacts***
Land Use and Aesthetics	Activities evaluated under the Proposed Action would disturb less than 2 acres of primarily previously disturbed land, or less than 0.01 percent of the 45,400 acres of currently developed land at the INL Site and less than 0.001 percent of the 569,600 acres of land available at the INL Site, and would represent a negligible contribution to cumulative impacts on land use impacts. Because construction would disturb less than 2 acres, would be located at CITRC in a developed area, and would be geographically separated from most of the other activities at the INL Site, the Proposed Action would represent a negligible contribution to cumulative impacts on aesthetics impacts.
Geology and Soils	Based on the information presented above for Land Use, the amount of soil in predominately previously disturbed areas by the Proposed Action would be a small percentage of the total soil disturbed at the INL Site. The amount of geologic and soils materials used by the Proposed Action would be at most 3,200 cubic yards or less than 1 percent of the 1,230,000 cubic yards used by other activities at the INL Site and would represent a negligible contribution to cumulative impact.
Water Resources	Under the Proposed Action, no effluent would be discharged across the previously graded ground surface, and no surface water would be used. No effluent would be discharged directly to groundwater, and thus the Proposed Action would not contribute to cumulative impacts on groundwater quality. The 260,500 gallons of groundwater required over the approximately 6 years of mobile microreactor demonstration and potential PIE activities would represent a negligible contribution to cumulative impacts on groundwater.
Air Quality	The minor increase in off-site air pollutant concentrations produced from construction and operation, in combination with emissions from other past, present, and reasonably foreseeable future actions, would result in air pollutant concentrations that would not exceed the state and national ambient air quality standards. Emissions from construction and operations activities would not substantially contribute to cumulative air quality impacts.
Biological Resources	Cumulative impacts on biological resources would not be substantial because ground disturbance and land clearing for the Proposed Action would be less than 1 percent of habitat at the INL Site; other past, present, and reasonably foreseeable future actions would occur at different locations and times; and appropriate best management practices (such as sagebrush replacement and invasive species management) would be enforced.

Table 2.7-2. Summary of Cumulative Impacts (Continued)

Resource Area	***Cumulative Impacts***
Cultural and Paleontological Resources	The Proposed Action is expected to have no effect to sites and buildings that are listed, eligible for, or unevaluated for eligibility for the NRHP and paleontological resources. Therefore, the Proposed Action would not contribute to cumulative impacts to eligible cultural and paleontological resources.
Infrastructure	Annual electricity use for the Proposed Action would be approximately 30 megawatt-hours of electricity, which represents a small fraction of the projected cumulative site activities usage of up to 471,000 megawatt-hours and of the site capacity of 481,800 megawatt-hours. Operation of the Proposed Action would use about 260,500 gallons of water, which represents a small fraction of the 872 million gallons cumulative infrastructure use and an even smaller fraction of the 11.4 billion gallons total site capacity. Therefore, operation activities would not substantially contribute to cumulative water use impacts.
Noise	The closest off-site receptor for the Proposed Action is a small development of homes in Atomic City that is about 6.5 miles away. Given the large distance, cumulative noise from construction or operation of projects at CITRC and other locations within the INL Site would be indistinguishable from background at the closest off-site noise-sensitive receptor.
Waste Management and Spent Nuclear Fuel Management	The waste management infrastructure at the INL Site was developed such that it would be able to accommodate the quantities of waste generated by the Proposed Action. Therefore, cumulative waste generation would be within site capacities. There are existing off-site DOE and commercial waste management facilities with sufficient capacities for the treatment and disposal needs associated with the relatively small volumes of LLW and MLLW wastes that would be generated by the Proposed Action. Therefore, substantial cumulative impacts on off-site LLW and MLLW treatment and disposal facilities would not be expected. The PIE activities, which may occur if a decision is made to examine the fuel for research and development purposes, could generate a small amount of TRU/GTCC-like waste (from the examination of a single fuel pin). A determination would be made of whether the waste qualifies as defense TRU waste or is GTCC-like waste. The Waste Isolation Pilot Plant (WIPP) is currently the only disposal option for defense TRU waste. WIPP's Land Withdrawal Act total TRU waste volume limit is 175,564 cubic meters. As of April 3, 2021, 70,115 cubic meters of TRU waste were disposed of at the WIPP facility. TRU waste volume estimates, such as those provided in NEPA documents, cannot be used to determine compliance with the WIPP Land Withdrawal Act TRU waste volume capacity limit. These wastes and waste from other actions will be incorporated, as appropriate, into future *Annual Transuranic Waste Inventory Report* TRU waste inventory estimates. Currently, there is not a disposal facility for GTCC-like waste. DOE evaluated potential environmental impacts of alternatives for the disposal of 12,000 cubic meters of GTCC LLW and DOE GTCC-like waste in the *Final Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste* (GTCC LLW EIS) (DOE, 2016a) and the *Environmental Assessment for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste at Waste Control Specialists, Andrews County, Texas* (DOE, 2018a). As of September 2021, DOE has not announced a decision on a disposal location for GTCC and GTCC-like waste. If the Proposed Action waste is determined to be GTCC-like waste, additional NEPA analysis may be required. This waste was not part of the inventory evaluated in the GTCC LLW EIS because the Proposed Action was established after the 2016 GTCC LLW EIS was issued. Existing or new facilities would safely store GTCC-like waste at the INL Site in accordance with applicable requirements until a disposal capability is available. The small amount of spent nuclear fuel (up to 400 kilograms and less than 3.4 cubic meters) would be managed with existing spent nuclear fuel at the INL Site, pending ultimate off-site disposal.

Table 2.7-2. Summary of Cumulative Impacts (Continued)

Resource Area	***Cumulative Impacts***
Human Health – Normal Operations	The cumulative population dose from all current and reasonably foreseeable activities would be 0.11 person-rem per year with no expected LCFs (calculated value of 8×10^{-5}) (i.e., 0.00008). Operation of the Proposed Action would result in a total population dose of less than 0.001 person-rem per year with no expected LCFs. The Proposed Action would not substantially contribute to human health impacts. The cumulative MEI dose from all current and reasonably foreseeable activities would be 1.9 millirem per year with an associated LCF risk of 1×10^{-6} (i.e., 0.000001). Operation of the Proposed Action would result in a total MEI dose of less than 0.01 millirem per year with essentially no associated LCF risk. The Proposed Action would not substantially contribute to cumulative human health impacts. The cumulative worker dose would be 230 person-rem per year with no expected LCFs (calculated value of 0.1). Operation of the Proposed Action would result in a total worker dose of 3 person-rem per year with no expected LCFs (calculated value of 0.002).
Transportation	Transportation of fuel and nuclear waste associated with the Proposed Action would result in transportation worker doses of about 1 rem and public doses of about 2 rem. These doses would be an imperceptible increase in the cumulative radiological dose to transportation workers (430,000 person rem) and the public (441,000 person-rem).
Traffic	The impacts on traffic from construction and operation activities are anticipated to be negligible to minor. As such, they would not substantially contribute to cumulative traffic impacts.
Socioeconomics	The 40 to 50 workers (not all of whom would be additions to the current work force) associated with the Proposed Action would negligibly add to the cumulative labor force (estimated to be nearly 160,000) from current and reasonably foreseeable actions.
Environmental Justice	There would be no high and adverse human health or environmental impacts on any population within the region of influence because of the proposed project. Impacts on minority and low-income populations would be comparable to those on the population as a whole and would be negligible.
Global Commons – Greenhouse Gas Emissions	The proposed project would emit 1,300 metric tons of CO_2e over a period of about 6 years and would imperceptibly add to U.S. and global greenhouse gas (GHG) emissions, which were estimated to be 6.6 billion metric tons of CO_2e and 36.4 billion metric tons of CO_2e, respectively in 2019. GHG emitted from the proposed project would equate to a negligible percentage of U.S. and global GHG emissions and would not substantially contribute to future climate change.

Key: CITRC = Critical Infrastructure Test Range Complex; CO_2e = carbon dioxide equivalent; DOE = U.S. Department of Energy; EIS = Environmental Impact Statement; GHG = greenhouse gas; GTCC = greater-than-Class-C; INL = Idaho National Laboratory; LCF = latent cancer fatality; LLW = low-level radioactive waste; MEI = maximally exposed individual; MLLW = mixed low-level radioactive waste; NEPA = National Environmental Policy Act; NRHP = National Register of Historic Places; rem = roentgen equivalent man (a measure of radiation); TRU = transuranic; WIPP = Waste Isolation Pilot Plant

Chapter 3
Affected Environment

This page left blank intentionally.

3 AFFECTED ENVIRONMENT

3.0 Introduction

This chapter describes the environmental resource areas that could be affected by Project Pele. The description of the affected environment for each resource area provides the context for understanding the environmental consequences described in Chapter 4 of this EIS and serves as a baseline for evaluating potential environmental impacts.

To analyze impacts, the region of influence (ROI) for each resource area has been identified. Each ROI is specific to the type of effect evaluated for the resource area and encompasses the geographic area where potential impacts could be expected to occur. **Table 3.0-1** briefly describes the ROI for each resource area evaluated in this EIS.

Table 3.0-1. General Regions of Influence for Resource Areas

Resource Area	*Region of Influence*
Land Use and Aesthetics	The INL Site (including MFC and CITRC) and lands immediately adjacent, including portions of the five-county region where the INL Site is located (Bingham, Bonneville, Butte, Clark, and Jefferson Counties)
Geology and Soils	The INL Site as a whole and MFC and CITRC, individually
Water Resources	Water resources that would be directly affected by the Proposed Action as well as features located within 0.5 mile that may be indirectly affected
Air Quality	The five counties that encompass the INL Site (Bingham, Bonneville, Butte, Clark, and Jefferson Counties)
Biological Resources	The project footprint at CITRC and a 0.5-mile radius buffer that extends beyond the construction fence
Cultural and Paleontological Resources	MFC and CITRC
Infrastructure	MFC and CITRC, where electricity, fuel, water, and sewage and their distribution systems are located
Noise	Proposed construction area at CITRC and a 0.5-mile buffer zone from the edge of that area
Waste Management	INL Site locations where waste is generated and managed prior to shipment off-site for disposition
Human Health – Normal Operations	INL Site where on-site project workers are located and areas off-site within 50 miles of the project location
Human Health – Facility Accidents	INL Site where on-site project workers are located and areas off-site within 50 miles of the project location
Traffic	INL Site on-site road systems and regional U.S. interstate highways, U.S. routes, state routes, major arterial roadways, and collector roads that intersect with the INL Site
Socioeconomics	The five counties that encompass the INL Site as well as surrounding counties
Environmental Justice	Areas within 50 miles of CITRC where minority and low-income populations reside

Key: CITRC = Critical Infrastructure Test Range Complex; INL = Idaho National Laboratory; MFC = Materials and Fuels Complex

For purposes of this EIS, discussion of the present-day setting is limited to environmental information that relates to the scope of Project Pele. The level of detail provided for each resource area varies depending on the potential for impacts discussed in Chapter 4, *Environmental Consequences*. Current project plans indicate that activities planned at MFC (i.e., the Materials and Fuels Complex), including final assembly, reactor fueling, startup testing, PIE, and temporary storage, would occur within existing facilities that are currently utilized for similar activities and would not require facility improvements. Additionally, existing road infrastructure would not require improvements for transport activities. Therefore, the affected environment discussion for most resources primarily focuses on CITRC (i.e., the Critical Infrastructure Test Range Complex). Subsections on specific resource areas also incorporate by reference recent NEPA documentation at the INL Site, which, where applicable, contains additional information on that specific resource used as a baseline for understanding the affected environment (see Section 1.5, *Related NEPA Documents*).

3.1 Land Use and Aesthetics

This section describes land use and aesthetics applicable to Project Pele. The ROI for land use and aesthetics consists of the INL Site (including MFC and CITRC) and lands immediately adjacent, including portions of the five-county region that encompasses the INL Site. Off-site areas potentially impacted by activities at the INL Site (e.g., Craters of the Moon National Monument and Preserve) are described as nearby land uses because these areas are considered to be within the ROI for aesthetics.

3.1.1 Land Use at Idaho National Laboratory

The INL Site is located on an 890-square mile parcel of land in the Eastern Snake River Plain (ESRP) in southeastern Idaho. The present-day boundary of the INL Site was created through several land transfers and land withdrawals beginning in the 1940s. About 94 percent of the INL Site remains open and undeveloped. Pastures, foothills, and farmlands border much of the INL Site, with agricultural activity concentrated in areas to the northeast. About 11,400 acres of the total land area at the INL Site has been developed at eight primary facility areas associated with energy research and waste management activities. Developed areas are surrounded by about 45,000 acres of security and safety buffer areas. The developed area and buffers are located within an approximately 230,000-acre central core area of the INL Site. An additional 34,000 acres at the INL Site have been developed for utility rights-of-way and public roads (DOE, 2020a).

About 60 percent of the INL Site is available to livestock grazing, including on the Sagebrush-Steppe Ecosystem Reserve located in the northwestern corner of the INL Site, with up to 340,000 acres leased for cattle and sheep grazing. Grazing is not permitted within 0.5 mile of any primary facility boundary or within 2 miles of any nuclear facility. The U.S. Sheep Experiment Station uses about 900 acres of land at the junction of Idaho State Highways 28 and 33 as a winter feedlot for sheep (DOE, 2020a).

3.1.2 Land Use at the Materials and Fuels Complex

MFC is located about 28 miles west of Idaho Falls and 50 miles north of Pocatello, Idaho. US-20 is about 1.5 miles from MFC's southern boundary. MFC consists of a 60-acre developed area surrounded by an undeveloped security perimeter. Structures tend to be one- or two-story, block concrete buildings with several towers and storage tanks interspersed. The MFC operational area contains analytical laboratories and other facilities for nuclear research, including the HFEF, Irradiated Materials Characterization Laboratory, Experimental Fuels Facility, Fuel Conditioning Facility, TREAT (about 0.5 mile northwest of the primary MFC facilities), and the decommissioned Zero Power Physics Reactor and the DOME (formerly referred to as the EBR-II test bed). The historic DOME building, a metallic dome that is 80 feet high, is the most recognizable feature of MFC (see Figure 2.3-3, Project Pele MFC Facilities).

DOE cooperates with the Idaho Department of Fish and Game (IDFG) in allowing limited, controlled hunts for elk and antelope in a section of the northern half of the INL Site. These hunts, which are restricted to certain species and specific times and locations, are managed in accordance with an existing DOE/IDFG Memorandum of Agreement. The hunts are one of the few permitted public uses of the INL Site (DOE, 2020a).

Over the last few years, significant infrastructure improvements have been made and will continue over the next several years, including the construction of a Sample Preparation Laboratory, which began in June 2020 (INL, 2021c). Land outside the security fencing at MFC is similar in type and visual characteristics to other undeveloped areas of the INL Site.

3.1.3 Land Use at the Critical Infrastructure Test Range Complex

CITRC is located about 12 miles southwest of MFC and about 2 miles north-northeast from the junction of US-20 and US-26. CITRC consists of a largely undeveloped area of about 960 acres with multiple dispersed sites located on asphalt pads (Pads A through D) connected by a network of paved access roads. Structures tend to be one- or two-story, block concrete buildings or standalone trailers and storage sheds with no structure taller than 35 feet. Only about 5 percent of the total area at CITRC has been disturbed (INL, 2021a). Land on CITRC is similar in type and visual characteristics to other undeveloped areas of the INL Site. CITRC encompasses a collection of specialized test beds and ranges that are utilized to test infrastructure systems and includes an isolated electrical transmission and distribution system and a comprehensive communications test bed. It is also the location of the Dispersion Devices Training Ranges and Biotechnology Center, where specialized, hands-on training is conducted for military and civilian first responders (INL, 2015b).

3.1.4 Regional Land Use

Figure 3.1-1 shows the regional location of the INL Site and land ownership of surrounding areas. The INL Site is surrounded by a mixture of public and private land, about 75 percent of which is managed by the Federal Government via the Bureau of Land Management (BLM). Land uses in these federally administered areas include mineral and energy production, livestock grazing, and recreation. Approximately 1 percent of the adjacent land is owned by the State of Idaho and used for the same purposes as the Federal land. The remaining 24 percent of the land adjacent to the INL Site is privately owned and used primarily for grazing and crop production. In 2017, about 825,165 of the 1,005,921 acres of total cropland available for use was harvested within the five-county area that encompasses the INL Site (USDA, 2019).

Populated areas near the INL Site are relatively sparse, with the largest population centers of Idaho Falls and Pocatello to the east and south, respectively. Based on U.S. Census Bureau (USCB) population estimates, the total population of the five-county area where the INL Site is situated is 195,952, of which only 2,611 reside in Butte County (USCB, 2019). Idaho Falls (population of 62,888), Pocatello (population of 56,637), and Rexburg (population of 29,400) are the largest population centers within 50 miles of the INL Site (USCB, 2019). No permanent residents live on the INL Site.

Several areas adjacent to the INL Site are used for recreational purposes, including the Big Southern Butte and Hell's Half Acre Lava Field National Natural Landmark south of the INL Site border and the Mud Lake and Market Lake Wildlife Management Areas to the northeast of the INL Site. Other tourist and recreational attractions in the vicinity of the INL Site include Craters of the Moon National Monument and Preserve, Challis National Forest, Caribou-Targhee National Forest, Beaverhead-Deerlodge National Forest, Camas National Wildlife Refuge, and Black Canyon Wilderness Study Area. Yellowstone National Park and Grand Teton National Park are within a few hours' drive east of the INL Site (DOE, 2020a).

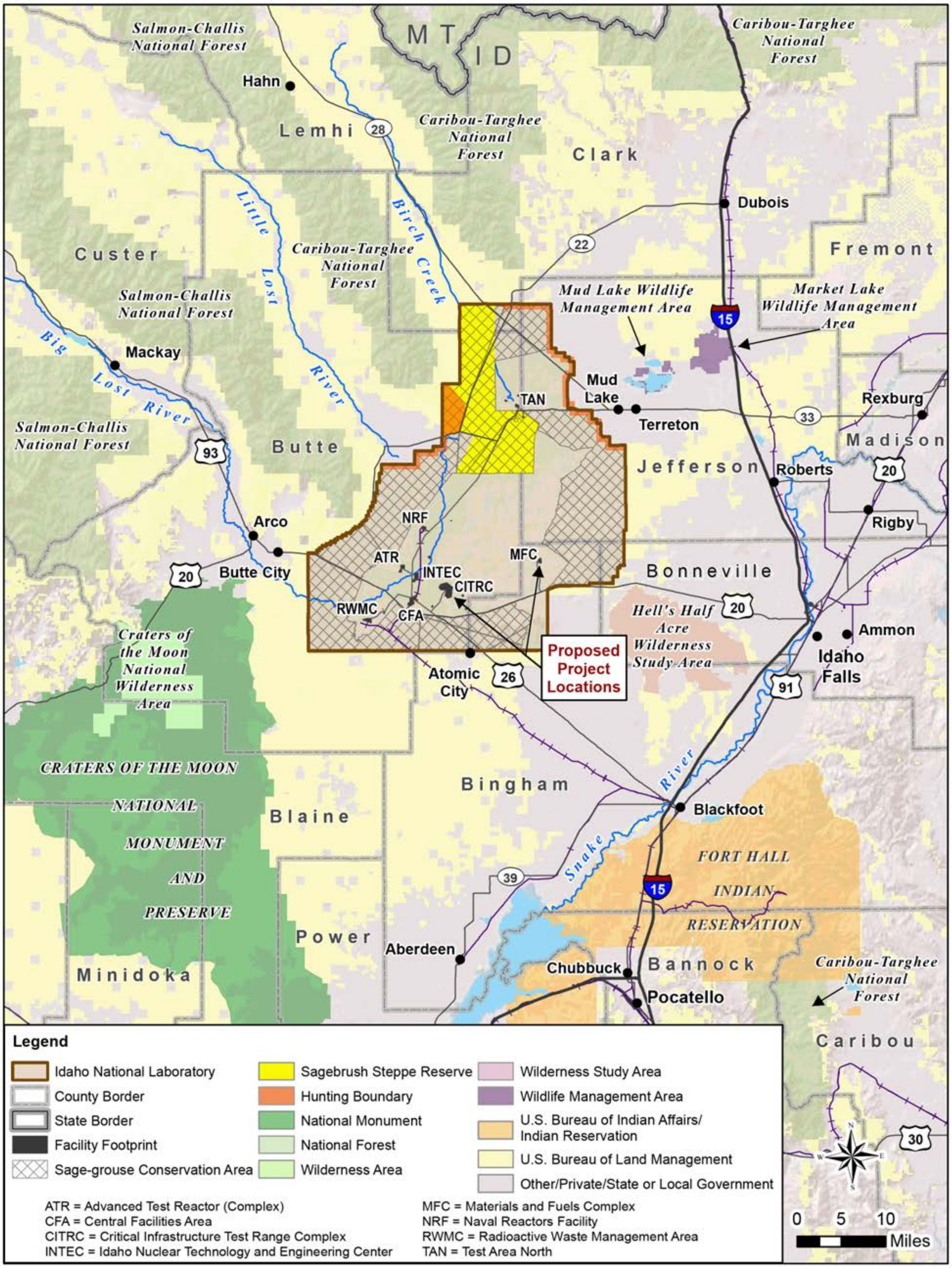


Figure 3.1-1. INL Site Regional Location and Land Ownership

3.1.5 Craters of the Moon National Monument and Preserve

In 2017, the International Dark-Sky Association (IDA) designated Craters of the Moon National Monument and Preserve, located approximately 23 miles west southwest of CITRC, as a silver-tier International Dark Sky Park. An International Dark Sky Park is a land area possessing an exceptional or distinguished quality of starry nights and a nocturnal environment specifically protected for its scientific, natural, educational, cultural heritage, and/or public enjoyment. The IDA only designates International Dark Sky Places following a rigorous application process requiring applicants to demonstrate robust community support for dark sky protection and documentation of designation-specific program requirements. The park's silver-tier designation indicates that the Milky Way must be visible in summer and winter, while "minor to moderate" illumination from artificial sky glow is permitted (IDA, 2019).

Craters of the Moon National Monument and Preserve is host to some of the darkest night skies of any national park unit and represents one of the largest remaining pools of natural darkness in the lower 48 states. Light pollution from the INL Site and distant cities such as Idaho Falls, Twin Falls, and Pocatello, Idaho, can influence views of the night sky. Due to regional topography, unshielded lights and scattered light can travel for considerable distances. As a result, light domes and sky glow from the INL Site can affect the nighttime visual landscape of Craters of the Moon National Monument and Preserve.

Current operations at the INL Site have been identified as a potential cause of one of the largest light domes visible near the park's visitor center. This dome spans 20 degrees across the horizon and 5 degrees in height, resulting in an area between 25 and 30 percent brighter than natural conditions. In addition, the ratio of artificial to natural light above the INL Site, for a full hemisphere observed from a single point at Craters of the Moon National Monument and Preserve, is reported to be between 60 to 80 percent brighter than average natural conditions (USDOI, 2021).

3.1.6 Aesthetics at the Idaho National Laboratory Site

Aesthetics includes natural and man-made features that lend character and visual quality to a particular landscape. The ROI for aesthetics includes the INL Site and areas within the line of sight of INL Site facilities when visibility is clear, including the ESRP; Fort Hall Reservation; the Bitterroot, Lemhi, and Lost River Mountain Ranges; the Big Southern Butte, East Butte, Middle Butte, Circular Butte, and Antelope Butte; Hell's Half Acre National Natural Landmark; and Hell's Half Acre Wilderness Study Area. The ROI also includes areas at a greater distance from the INL Site potentially impacted by effects such as light pollution (e.g., Craters of the Moon National Monument and Preserve).

The INL Site is located in a large, relatively undisturbed expanse of sagebrush steppe, with small volcanic buttes dotting the landscape. Topographic features, such as volcanic landforms and mountain ranges, are visible from most locations on the INL Site. Several mountain ranges (including the Bitterroot, Lemhi, and Lost River Ranges) are visible to the north and west of the INL Site. The Big Southern Butte, East Butte, and Middle Butte are visible from the southern boundary of the INL Site; Circular and Antelope Buttes are visible to the northeast. In general, the visual character of the INL Site consists of sagebrush-dominated terrain with an understory of grasses. Juniper is common near the buttes and foothills of the Lemhi Range, and crested wheatgrass is scattered throughout the INL Site.

The INL Site includes eight primary facility areas, each of which resembles a low-density commercial or industrial complex area. Structures generally range in height from 10 to 100 feet, some with emission stacks that tower up to 250 feet tall. While several facilities on the INL Site are visible from public highways (particularly US-20, US-26, and Idaho State Road 33), most buildings are located more than 0.5 mile from public roads.

Lands within and adjacent to the INL Site follow the BLM Visual Resource Management (VRM) guidelines. This system relies on two main components: visual resource inventories and visual resource management. There are four levels of VRM rating, designated as VRM Classes I to IV, with Class I being the most restrictive and protective of the visual landscape and Class IV being the least restrictive. Undeveloped lands adjacent to the INL Site (including the buffer area around the INL Site) have been designated visual resource Class II areas; developed lands within the INL Site have been designated as Class III and Class IV (DOE, 2020a).

3.2 Geology and Soils

This section describes geology and soils applicable to the Proposed Action. The ROI for geology and soils includes the INL Site as a whole, and MFC and CITRC individually. The INL Site is located on a relatively flat area along the northwestern edge of the ESRP Physiographic Province (DOE, 2016c). The land surface at the INL Site is gently sloping with elevations ranging from 4,790 feet in the south to 5,912 feet in the northeast (Mattson et al., 2004; DOE, 2020a).

3.2.1 Regional Geology

The INL Site is underlain by about 0.6 to 1.2 miles of basaltic lava flows interbedded with poorly consolidated sedimentary materials deposited during the Quaternary Period (the last 2.6 million years). Interbedded sediments consist of materials deposited by streams and rivers (silts, sands, and gravels), historical lakes (clays, silts, and sands), and wind (silts) that accumulated between volcanic events. The interbedded basalt flow and sediment sequences are collectively known as the Snake River Group (DOE, 2005). The Snake River Group is composed of sedimentary deposits as thick as 197 feet that are interbedded with basalts that are 16 to 82 feet thick (NRC, 2011b).

The Quaternary Period Yellowstone Group and Plateau Rhyolite, composed of rhyolite ash-flow tuff and ash and pumice beds, are found in some areas of the ESRP. Below the Snake River Group, in the northeast and southeast area of the ESRP, lies the upper part of the Idaho Group consisting of basalts and poorly consolidated sediment beds deposited during the Tertiary Period (between 66 and 2.6 million years ago). The lower part of the Idaho Group (Tertiary) is composed of basalt exhibiting columnar jointing, which is ubiquitous throughout the entire Snake River Plain. The Tertiary Period Idavada Volcanics are found in the northeast and southwest areas of the ESRP (NRC, 2011b).

The most recent basalt flow at the INL Site is the Cerro Grande flow, which occurred about 13,000 years ago and originated from a vent south of the INL Site (Kuntz et al., 1994). In contrast, the Hell's Half Acre flow, immediately southeast of the INL Site, is only about 5,200 years old, and flows at the nearby Craters of the Moon National Monument and Preserve are as recent as 2,100 years old. The much older basalt lava flows characteristic of the southern portion of the INL Site are between 200,000 and 730,000 years old (Hackett & Smith, 1992). Basalt on the northern portion of the INL Site is at least 1 million years old (INL, 2015a).

Overlying the basalts are thin, discontinuous deposits of windblown sand (loess composed of calcareous silt), floodplain sediments, and riverbed and lake sediments (clays, silts, sands, and gravels) (NRC, 2004). These surficial sediments range from 0 to more than 310 feet thick (Anderson et al., 1996; DOE, 2005).

3.2.2 Soils

Four basic soilscapes exist at the INL Site: river-transported sediments deposited on alluvial plains, fine-grained sediments deposited into lake or playa basins, colluvial sediments originating from bordering mountains, and windblown sediments (silt and sand) over lava flows. The alluvial deposits follow the courses of the modern Big Lost River and Birch Creek. The playa soils are found in the north-central part of the site; the colluvial sediments, along the western edge of the site; and the windblown sediments, throughout the rest of the site (DOE, 2020a). No soils have been designated as prime farmland within the INL Site boundaries (DOE, 2005).

Soils beneath MFC generally consist of light brown-gray, well-drained silty loams to brown, extremely stony loams. Soils are highly disturbed within the developed areas of MFC (DOE, 2002a). The thickness of surficial soils and sediment range from 0.5 to 26 feet, with deposits at two locations that are 31.5 and 46 feet thick (INL, 2006). The two primary types of soils at MFC are classified as Bondfarm-Rock outcrop-Grassy Butte complex and Maim-Bondfarm-Matheson complex (DOE-ID, 1998). The permeability of these soils is moderately rapid to rapid, and their erosion hazard is slight or moderate (INL, 2010a).

Soils beneath CITRC are less than 20 inches to more than 60 inches thick (USDA, 2019). Grassy Butte sand is characteristic of soils at CITRC and present in 74 to 78 percent of the area surveyed near Pads B, C, and D. This soil is excessively well drained with a very high hazard of soil blowing (wind erosion). The Malm-Bondfarm-Matheson complex soils are moderately to well-drained sandy loam over bedrock and are present in 22 to 25 percent of the area surveyed near Pads B, C, and D. This soil complex has a high hazard of soil erosion. The Menan silt loam is fairly deep and usually a combination of silt loam and silty clay loam that is fairly resistant to erosion. This soil is only present in a small area (1 percent) near Pad D (Veolia, 2020).

3.2.3 Radiological Monitoring

Potential radiological releases from INL Site facilities with significant air emissions in 2013 were modeled using CALPUFF (Rood & Sondrup, 2014) to estimate particulate deposition rates and accumulation of radionuclides on surfaces such as soils (INL, 2016a). The results showed that for the on-site facilities, only the Radioactive Waste Management Complex (RWMC) had the potential for radionuclide soil accumulations to be detectable in less than a decade. Results for the other INL facilities, including MFC and CITRC, showed the potential for radionuclide soil accumulations to be detectable after hundreds to thousands of years (INL, 2016a).

Data from soil sampling and analysis on the INL Site show slowly declining concentrations of short-lived, man-made radionuclides (e.g., cesium-137), with no evidence of detectable concentrations depositing onto surface soil from ongoing INL Site releases. Results from soil samples collected at off-site locations indicate that the source of detected radionuclides is not from INL Site operations and is most likely derived from fallout from past worldwide atmospheric nuclear weapons tests and other radioactive releases (DOE-ID, 2014b).

3.2.4 Geologic and Soil Resources

Mineral resources at the INL Site are limited to several quarries, or “borrow sources,” which supply sand, gravel, pumice, silt, clay, and aggregate. On-site topsoil is a very limited commodity. The INL Site contains six active gravel/borrow sources that support on-site maintenance operations, new construction, and environmental restoration and waste management activities (DOE-ID, 2019c). The Ryegrass Flats borrow source, the nearest borrow source, is about 11 miles to the southwest of MFC and less than 2 miles to the south of CITRC. Outside of the INL Site and within about 100 miles of the boundary, mineral resources include sand, gravel, pumice, phosphate, and base and precious metals (NRC, 2004).

3.2.5 Seismic Hazards

The ESRP has historically experienced infrequent, small-magnitude earthquakes (DOE, 2002b). In contrast, the majority of contemporary seismicity is associated with the major episode of Basin and Range Province faulting that began about 16 million years ago and continues today (Rodgers et al., 2002).

The majority of earthquakes with the potential to affect the INL Site occur along normal faults (type of fault associated with Basin and Range tectonics) in the Basin and Range Province. The faults closest to the INL Site are the Quaternary Lost River, Lemhi, and Beaverhead Faults. They are normal faults located along the base of the mountains to the north and west of the INL Site (INL, 2010b). The nearest capable faults are the southernmost segments of the Lost River and Lemhi Faults about 20 miles northwest of MFC and CITRC. A capable fault is one that has had movement at or near the surface at least once within the past 35,000 years or recurrent movement within the past 500,000 years (10 CFR 100).

The historical earthquake record shows the ESRP has a remarkably low rate of seismicity compared to the surrounding Basin and Range Province. The basalt layers interbedded with ancient stream and lakebed sediments under the INL Site may dampen or attenuate ground motions generated by earthquakes (Payne, 2006). Due to the large distances from the INL Site, the 1959 Hebgen Lake earthquake (moment magnitude[45] 7.3), the 1983 Borah Peak earthquake (moment magnitude 6.9), and the recent March 2020 central Idaho earthquake (moment magnitude 6.5) were felt at the INL Site but did not cause any damage (Bechtel Marine Propulsion Corporation, 2017; Defense Nuclear Facilities Safety Board, 2020). Earthquake-produced ground motion is expressed in units of percent *g* (acceleration relative to that of the Earth's gravity). The Borah Peak earthquake produced horizontal peak accelerations ranging from 0.022 *g* to 0.078 *g* across the INL Site (Jackson & Boatwright, 1985). At MFC, recorded peak accelerations in the basement of two facilities ranged from 0.032 *g* to 0.048 *g* (Jackson & Boatwright, 1985). No recordings exist for CITRC.

3.2.6 Volcanic Hazards

The potential for future volcanic activity and associated volcanic hazards at the INL Site are based on the volcanic history of the ESRP. Hazards associated with explosive, silica-rich, caldera-forming eruptions, similar to those that have occurred at the Yellowstone Plateau, are considered to be negligible for the INL Site since the locus of this activity is now in the Yellowstone Plateau. Eruptions from the Yellowstone Volcanic Zone could produce appreciable ash-fall deposits at the INL Site, in the unlikely event that regional winds are directed to the southwest during a potential small-volume eruption (INL, 2010b) or the size of the eruption overwhelms prevailing winds (Mastin et al., 2014). Rhyolite dome volcanoes, such as Big Southern Butte or East Butte, also have the potential to produce ash-fall deposits. The estimated recurrence of silicic volcanism is estimated at no more than 4.5×10^{-6} (i.e., 0.0000045) per year (NRC, 2011b). In addition, volcanic ash-falls could occur at the INL Site from eruptions as far away as the Cascade Mountains. An annual probability of 1.0×10^{-3} (i.e., 0.001) is estimated for a 0.4-inch-thick ash deposit forming at the INL Site from a Cascade volcano eruption (NRC, 2004).

Based on an analysis of the volcanic history on and around the INL Site, the conditional probabilities that MFC and CITRC would be affected by basaltic volcanism are once in 16,000 to 40,000 years and once in 100,000 years, respectively (Hackett et al., 2002). A recent study (Gallant et al., 2018) shows a 30 percent probability of partial inundation of the INL Site given an eruption on ESRP, with an annual inundation probability of 8.4×10^{-5} to 1.8×10^{-4} (i.e., 0.000084 to 0.00018). An annual probability of 6.2×10^{-5} to 1.2×10^{-4} (i.e., 0.000062 to 0.00012) is estimated for the opening of a new eruptive center within the INL Site boundaries.

3.2.7 Slope Stability, Subsidence, and Liquefaction

No factors at MFC and CITRC that would produce slope instability, subsidence, or liquefaction have been reported (DOE, 2020a). As described above, slopes are very gradual and soils are generally thin.

[45] The moment magnitude scale is a measure of an earthquake's magnitude (size or strength) based on its seismic moment.

3.3 Water Resources

The ROI for water resources includes features that would be directly affected by the Proposed Action as well as features located within 0.5 mile that may be indirectly affected. For purposes of this EIS, water resources include natural surface waters, surface water features into which stormwater, industrial wastewater, or sanitary wastewater are discharged; and the Snake River Plain Aquifer (SRPA) beneath the proposed project area. As discussed in Section 3.0, *Introduction*, activities planned at MFC (final assembly, reactor fueling activities, startup testing, PIE, and temporary storage) would occur within existing facilities and infrastructure currently utilized for similar activities and would not require facility improvements or affect water resources. As such, this section does not discuss the specific water resources of MFC but rather focuses on CITRC.

3.3.1 Surface Water

3.3.1.1 Natural Water Features

The INL Site is in the Mud Lake – Lost River Drainage Basin. This is a closed basin that includes the Big Lost River, Little Lost River, and Birch Creek, which drain the mountain areas to the north and west of the INL Site. These three surface waters occur intermittently on the INL Site, as much of the surface water is diverted for irrigation before reaching the INL Site boundary. Flow that reaches the INL Site seeps into the ground surface along the length of the streambeds and in the Big Lost River spreading areas and sinks. The spreading areas are natural, low elevation, closed basins associated with the INL Site's diversion dam. The sinks are the lowest elevation in the closed drainage basin where the Big Lost River terminates in a series of playas, where seasonal wetlands have formed. The wetlands associated with the Big Lost River Sinks are the only potential jurisdictional wetland features within the INL Site (DOE-ID, 2021c). Surface water on the INL Site that does not infiltrate the ground surface is lost from the system through evapotranspiration. As a result of the diversion, seasonal changes in climate, and seepage into the ground, any surface water that reaches the INL Site is lost to the SRPA or evapotranspiration. No surface water flows off the INL Site. Surface waters are not used for drinking water at the INL Site, nor are effluents discharged directly to them.

A diversion dam was constructed to protect portions of the INL Site located within the Big Lost River floodplain from a potential 300-year flood. A diversion dam was constructed on the INL Site to direct flow from the Big Lost River through a diversion channel into four spreading areas. The estimated flood hazard area for a probable maximum flood due to a failure of the diversion dam includes the west-central portion of the INL Site along the Big Lost River drainage. Because the ground surface at the INL Site is relatively flat, floodplains outside the banks of the Big Lost River would spread over a large area and pond into areas with lower topography. CITRC is not located within the probable maximum flood hazard area. In addition, the Federal Emergency Management Agency (FEMA) has not identified any floodplains at the proposed project site (FEMA, 2020).

When the Big Lost River is flowing, locations along this surface water within the INL Site are sampled for gross alpha activity, gross beta activity, tritium, and cesium-137. Recently, the Big Lost River flows were sufficient to collect water samples in April, May, and June 2019. Gross alpha activity and gross beta activity were detected at 5.9 picocuries per liter (pCi/L) and 15 pCi/L, respectively. Tritium was detected at levels within the range of values found in 2017 and 2018. The maximum tritium concentration reported in 2017 was 163 pCi/L (DOE-ID, 2021c). For reference, the EPA maximum contaminant level (MCL) for gross alpha activity is 15 pCi/L, the EPA screening level for gross beta activity is 50 pCi/L, and the EPA MCL for tritium is 20,000 pCi/L. Thus, all concentrations detected in 2019 are well below regulatory levels. All concentrations detected were similar to those found in atmospheric moisture and precipitation samples and were consistent with the findings from sampling events occurring in prior years. No man-made, gamma-emitting radionuclides (e.g., cesium-137) were found during this sampling effort (DOE-ID, 2021c).

At CITRC, an unnamed intermittent waterway flows west between Pads C and D and terminates just east of Navaho Road (USFWS, 2021a). Within CITRC, no features have been identified as a water of the U.S. (INL, 2021a). The U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory identifies a total of four wetlands within CITRC, including three freshwater ponds and one riverine wetland associated with the unnamed intermittent stream. The most proximate surface water feature is located about 0.3 mile to the west of Pad B. This feature is a 0.70-acre freshwater pond categorized under the Cowardin class system as PUSCx (i.e., an excavated (x), palustrine (P) feature with an unconsolidated shore (US) that is seasonally flooded (C)) (Cowardin et al., 1979). A second freshwater pond, encompassing 0.17 acre and also categorized as PUSCx, is located less than 0.1 mile southeast of Pad C. The nearest feature to Pad D is the 2.72-acre riverine wetland, located about 0.25 mile to the north. No jurisdictional surveys have been conducted for the project. **Figure 3.3-1** depicts all surface water features within CITRC.

3.3.1.2 Wastewater

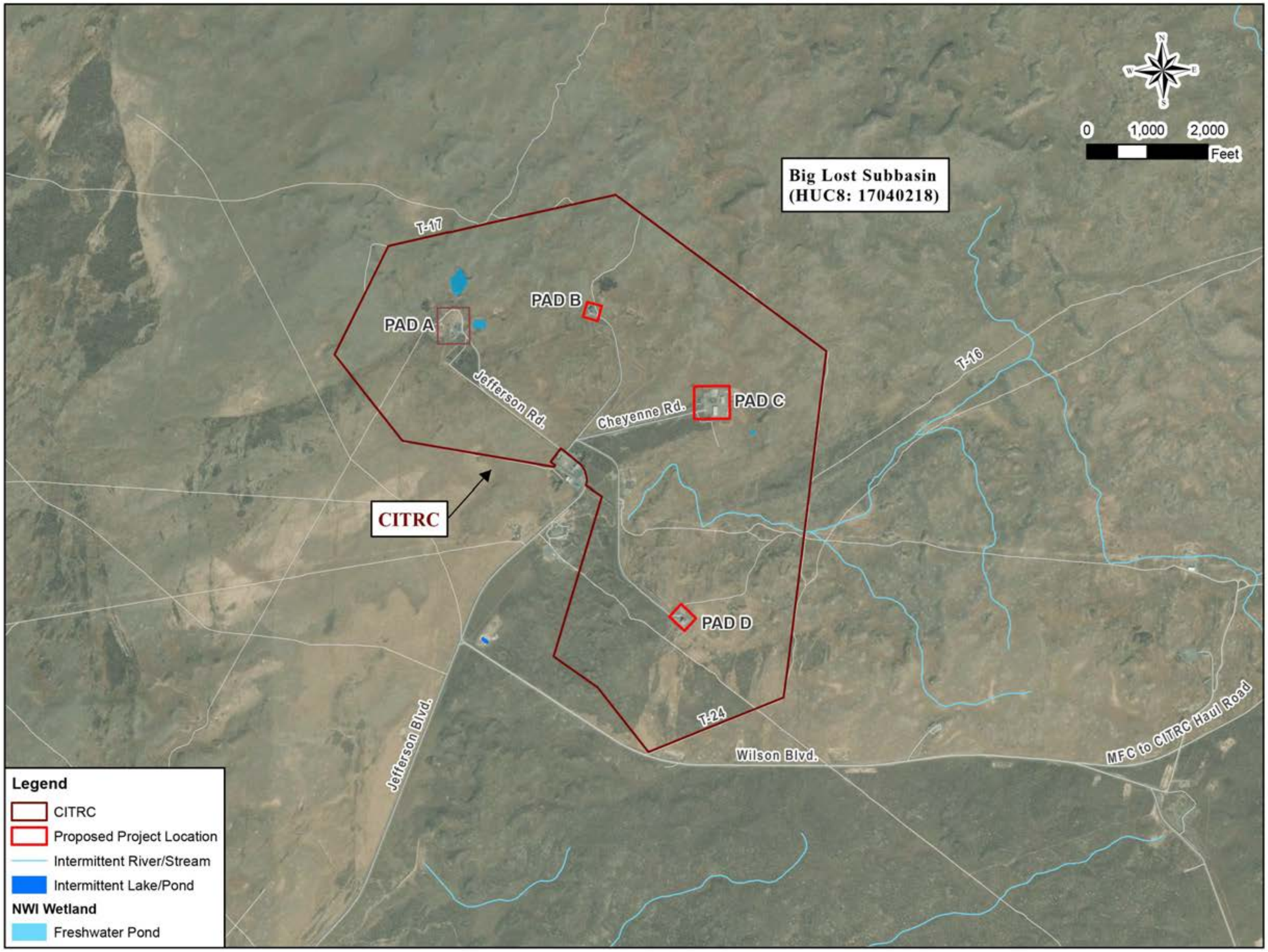
Other surface water bodies on the INL Site include man-made percolation and evaporation ponds, sewage lagoons, and industrial waste ditches. Discharge of industrial wastewater to the land surface at the INL Site is regulated by the Idaho Administrative Procedures Act (IDAPA) 58.01.16 and IDAPA 58.01.17 and may require an industrial reuse permit. Currently, there are three permitted wastewater facilities at the INL Site: the ATR Complex Cold Waste Pond, INTEC New Percolation Ponds, and MFC Industrial Waste Pond. In 2019, these facilities were sampled for parameters required by facility-specified permits, and no limits were exceeded (DOE-ID, 2021c). See Section 7.2, *Applicable Permits*, for further information regarding the INL Site's wastewater reuse permit.

Sanitary wastewater produced at CITRC is discharged to septic tanks with drainage fields. There are no operational industrial wastewater discharge locations at this facility (INL, 2021a).

3.3.1.3 Stormwater

Stormwater from facilities on the INL Site discharge to industrial waste ditches, sewage lagoons, or infiltration ponds. Stormwater that is discharged to sewage lagoons is contained, and stormwater discharged to infiltration ponds or trenches evaporates or infiltrates the ground surface. Stormwater systems are present at some facilities on the INL Site, and three deepwater injection wells (Special Power Excursion Reactor Test [SPERT] Disposal Wells #1, 2, and 3) classified for industrial storm runoff previously existed within CITRC. All three wells were decommissioned within the last few years. No stormwater features currently exist within CITRC, but the ground has been graded to drain water away from existing structures (INL, 2021a). Basins associated with the former injection wells still provide flooding protection for the road into CITRC. Because stormwater from facilities on the INL Site is not discharged to regulated waters, the National Pollutant Discharge Elimination System (NPDES) permit provisions for discharges into regulated surface waters do not apply to operations (INL, 2021a).

Administrative authority for the NPDES program has been transferred to the State of Idaho, where it is known as the Idaho Pollutant Discharge Elimination System (IPDES) program. For construction stormwater discharges, facilities on the INL Site maintain compliance with permits issued under the IPDES program. INL contractors file an NOI, obtain permit coverage, and develop stormwater pollution prevention plans for individual construction projects if it is determined there is reasonable potential to discharge pollutants to regulated surface waters. The permit and plan would provide best management practices (BMPs) to prevent pollution of stormwater from construction activities at the INL Site. CITRC and MFC lie outside of the stormwater corridor and are therefore exempt. See Section 7.2, *Applicable Permits*, for further information regarding the INL Site's IPDES permit.



Key: CITRC = Critical Infrastructure Test Range Complex; MFC = Materials and Fuels Complex; NWI = National Wetlands Inventory

Figure 3.3-1. CITRC Project Area and Water Resources

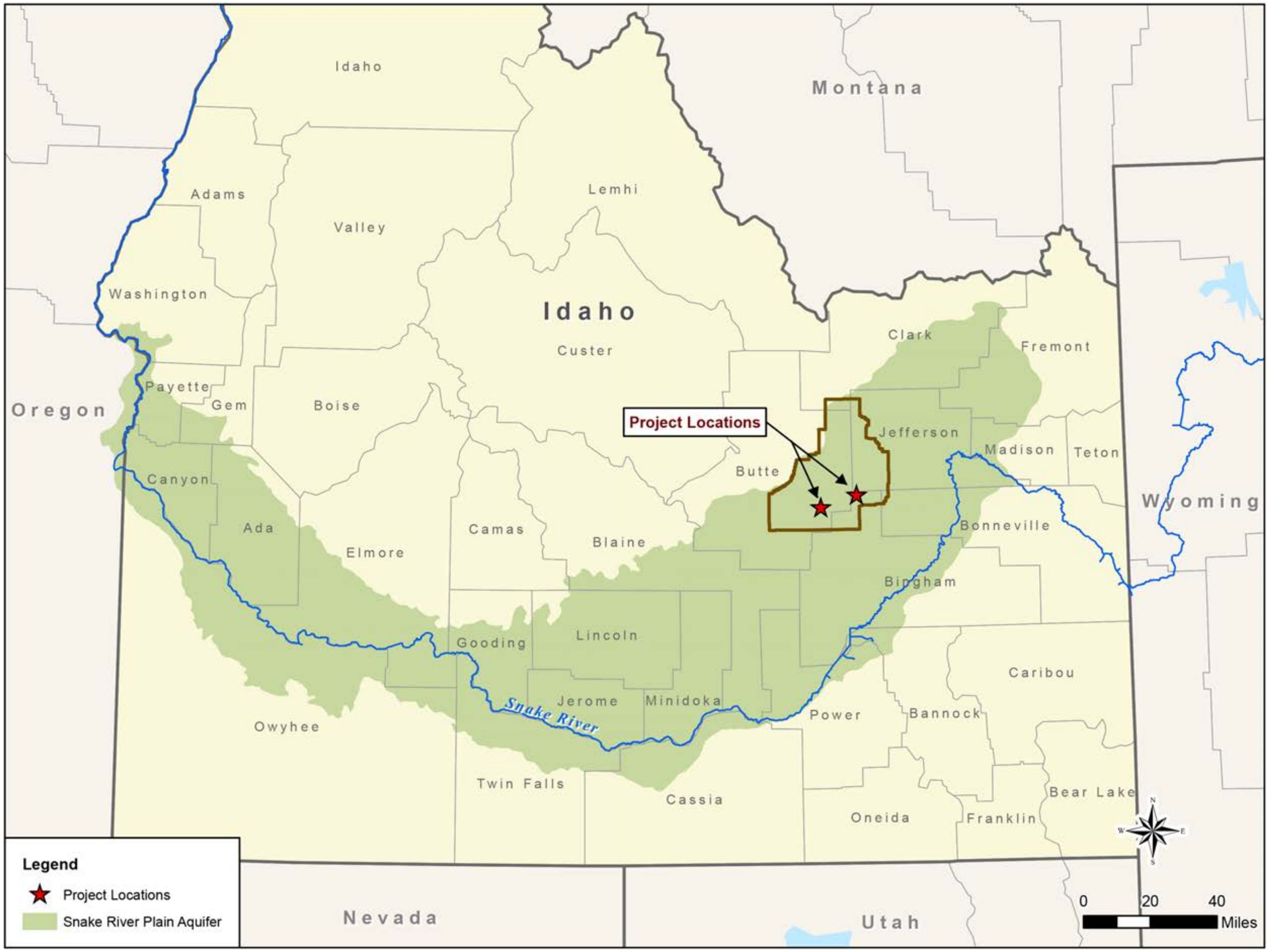


Figure 3.3-2. Snake River Plain Aquifer

3.3.2 Groundwater

3.3.2.1 Local Hydrology

The SRPA underlies about 10,800 square miles, including the INL Site (see **Figure 3.3-2**). The SRPA is the major source of drinking water and crop irrigation for southeastern Idaho and has been designated a sole source aquifer by EPA (IDEQ, 2021a). In the SRPA ranges, transmissivity averages about 93,000 square feet per day. Groundwater flow rates in the aquifer have been reported to range from about 2 to 20 feet per day in the vicinity of the INL Site (DOE-ID, 2011). Regionally, water in the aquifer moves horizontally, mainly through fractures in the basalts and basalt interflow zones. Interflow zones are composed of highly permeable rubble zones between basalt flows. Groundwater flows primarily toward the southwest.

The Big Lost River, Little Lost River, and Birch Creek terminate at sinks on or near the INL Site and recharge the aquifer (when flow is present). Recharge occurs when water infiltrates through the ground surface; possible sources of recharge vary and may include melting of local snowpacks and local agricultural irrigation activities. Valley underflow from the mountains to the north and northeast has been cited as a source of recharge. Water is primarily discharged from the SRPA through springs that eventually flow to the Snake River. Two major discharge areas are located near American Falls and Twin Falls, Idaho (Whitehead, 1994).

3.3.2.2 Subsurface Water Quality

The INL Site has an extensive groundwater quality monitoring network maintained by the U.S. Geological Survey (USGS) and INL contractors. This network includes monitoring or production wells in the SRPA from which samples are collected and analyzed for selected organic, inorganic, and radioactive constituents (DOE, 2020a). Localized areas of radiochemical and chemical contamination are present in the SRPA beneath the INL Site. These areas, or plumes, are considered to be the result of past disposal practices. Of principal concern over the years has been the movement of the tritium, strontium-90, and iodine-129 plumes at the INL Site. Groundwater monitoring has shown long-term trends of decreasing concentrations for these radionuclides, and current concentrations are near or below EPA MCLs for drinking water (DOE-ID, 2021c). The decreases in concentrations are attributed to discontinued disposal to the aquifer, radioactive decay, and dilution within the aquifer.

USGS collects samples annually from select wells at the INL Site for analysis of gross alpha activity, gross beta activity, gamma spectroscopy, and plutonium and americium isotopes. Between 2016 and 2018, samples from wells showed exceedances of reporting levels for gross alpha activity, gross beta activity, and cesium-137 in at least one sampling location (DOE-ID, 2021c). Concentrations of chloride, sulfate, sodium, fluoride, nitrate, chromium, selected other trace elements, total organic carbon, and volatile organic compounds (VOCs) were below established MCLs or secondary MCLs in all wells sampled in 2018 (DOE-ID, 2021c). In 2019, samples from 30 groundwater monitoring wells and one perched well across the INL Site were analyzed for 61 purgeable organic compounds; 11 of these compounds were detected above the minimum detection limit in at least one well (DOE-ID, 2021c).

3.3.2.3 Drinking Water

Currently, the INL Site has 10 drinking water systems, which are monitored for drinking water parameters at least every 3 years. Drinking water samples collected from these systems in 2019 were all well below the limits for all regulatory parameters for drinking water (DOE-ID, 2021c).

The CITRC drinking water system draws water from the SRPA via two deep wells (INL, 2021a).

3.3.2.4 Water Use and Rights

The SRPA is the only source of water for INL Site facilities. The INL Site's Federal Reserved Water Right permits a maximum water consumption of 11.4 billion gallons per year from the SRPA and a maximum diversion rate of 35,904 gallons per minute. In 2019, the INL Site's production well system withdrew a total of about 755 million gallons of water, which represents about 6.6 percent of the Federal Reserved Water Right for the INL Site (INL, 2018).

Total water use at CITRC has declined about 2.4 percent over the last 3 years, from 5,230,300 gallons in 2018 to 5,106,400 gallons in 2020 (INL, 2021a).

3.4 Air Quality

This section describes the existing air quality and climate change conditions of the INL Site. The five counties that encompass the INL Site—Bingham, Bonneville, Butte, Clark, and Jefferson Counties—compose the immediate ROI for the air quality analysis.

3.4.1 Meteorology and Climatology

The altitude, latitude, and intermountain setting of the INL Site combine to produce a continental and semi-arid climate for the region. This climate is characterized by relatively low precipitation, warm summers, cold winters, and wide fluctuations in diurnal and seasonal temperatures (DOE, 2020a).

A prevailing westerly flow transports polar storm systems and moisture from the Pacific Ocean into the INL Site region for much of the year. The Cascade Mountains, Coastal Ranges, and northern extension of Sierra Nevada Mountain Range block much of this moisture flow, which produces a rain shadow effect in the region and contributes to its aridity. This westerly flow regime provides the majority of annual precipitation to the region. From roughly July through September, weak westerly flow can be replaced by southerly flow that is part of the North American monsoon. This regime produces widely scattered rain showers and thunderstorms, especially over the higher terrain within the region (DOE, 2020a).

3.4.2 Nonradiological Air Emissions and Standards

Air quality at a given location can be described by the concentrations of various air pollutants in the atmosphere. The Clean Air Act (CAA) and its subsequent amendments established air quality regulations and the National Ambient Air Quality Standards (NAAQS). In Idaho, EPA has delegated authority to the Idaho Department of Environmental Quality (IDEQ) to enforce air quality regulations. The CAA establishes air quality planning processes and requires states to develop a State Implementation Plan that details how they will maintain the NAAQS or attain a standard in nonattainment within mandated time frames.

Air pollutants are defined as two general types: (1) criteria pollutants and (2) hazardous air pollutants (HAPs). EPA establishes the NAAQS to regulate the following criteria pollutants: ozone (O_3), carbon monoxide, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter less than or equal to 10 microns in diameter (PM_{10}), particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$), and lead (EPA, 2021a). These standards represent atmospheric concentrations to protect public health and welfare and include a reasonable margin of safety to protect the most sensitive individuals in the population. For purposes of regulating air quality in Idaho, IDEQ implements the NAAQS and a State ambient standard for fluoride. While no ambient standards have been established for VOCs and nitrogen oxides (NO_x), they are important as precursors to ozone formation.

EPA designates all areas of the United States as having air quality better than (attainment) or worse than (nonattainment) the NAAQS. Former nonattainment areas that have attained the NAAQS are designated as maintenance areas. Presently, EPA categorizes the five counties that encompass the INL Site as in attainment of all NAAQS. The nonattainment area nearest to the INL Site is the Fort Hall Indian Reservation PM_{10} nonattainment area, which is in northeastern Power County and northwestern Bannock County. Directly east of this area and centered in Pocatello is the Portneuf Valley PM_{10} maintenance area, which is the nearest maintenance area to the INL Site (see **Figure 2.3-1**) (EPA, 2021b).

The CAA, through its Prevention of Significant Deterioration (PSD) provisions, provides special protection for air quality and air quality-related values (including visibility and pollutant deposition) in select national parks, national wilderness areas, and national monuments in the United States. These Class I areas are areas in which any appreciable deterioration of air quality is considered significant. Craters of the Moon National Monument and Preserve is the closest PSD Class I area to the INL Site (see **Figure 2.3-1**). Its nearest border is about 23 and 34 miles west southwest of CITRC and MFC, respectively. Therefore, this EIS provides qualitative analyses of the potential for emissions generated by the Proposed Action to affect visibility within this pristine area.

EPA also regulates HAPs that are known or are suspected to cause serious health effects or adverse environmental effects. The CAA identifies 187 substances as HAPs (e.g., benzene, formaldehyde, mercury, and toluene). HAPs are emitted from a range of industrial facilities and vehicles. EPA sets Federal regulations to reduce HAP emissions from stationary sources in the National Emission Standards for Hazardous Air Pollutants (NESHAP) (EPA, 2021c). A "major" source of HAPs is defined as any stationary facility or source that directly emits or has the potential to emit 10 tons per year or more of any HAP or 25 tons per year or more of combined HAPs. In Idaho, the IDEQ regulates HAPs and about 350 toxic air pollutants (TAPs), as the Idaho TAP program preceded the Federal program. Both programs set ambient levels of concern for HAPs and TAPs.

The IDEQ Air Quality Division is responsible for enforcing air pollution regulations in Idaho. The Air Quality Division enforces the NAAQS by monitoring air quality, developing rules to regulate and to permit stationary sources of air emissions, and managing air quality attainment planning processes in Idaho. The IDEQ air quality regulations, "Rules for the Control of Air Pollution in Idaho," are found in the IDAPA Section 58.01.01. The operation of the INL Site includes sources that emit criteria and HAPs and require a permit to construct (PTC), as outlined in IDAPA 58.01.01.200 through 228. These sources currently are authorized under a PTC (PTC #P-2020.045) with a facility emissions cap. This PTC limits facility-wide emissions levels below those that would require a Title V operating permit (IDEQ, 2021b; INL, 2020b).

Sources of nonradiological air emissions at the INL Site include oil-fired boilers, diesel engines, emergency diesel-powered electrical generators; small gasoline, diesel, and propane combustion sources; and chemical and solvent usages. Boilers generate steam for heating facilities and are the main source of nonradiological air emissions at the INL Site. Diesel engines are mainly used to generate emergency electricity for facility operations. Miscellaneous nonvehicle sources include small portable electrical generators, air compressors, and welders. The main combustive sources at MFC are emergency diesel-powered electrical generators and firewater pumps.

3.4.3 Greenhouse Gases and Climate Change

It is well documented that the Earth's climate has fluctuated throughout its history. Recent scientific evidence indicates a correlation between increasing global temperatures over the past century and the worldwide proliferation of greenhouse gas (GHG) emissions by mankind. Climate change associated with global warming is predicted to produce negative environmental, economic, and social consequences across the globe (IPCC, 2014; USGCRP, 2018).

The most common GHGs emitted from natural processes and human activities include carbon dioxide (CO_2), methane, and nitrous oxide. Examples of GHGs emitted through human activities alone include fluorinated gases (such as hydrofluorocarbons and perfluorocarbons) and sulfur hexafluoride. Each GHG is assigned a global warming potential (GWP). The GWP is the ability of a gas or aerosol to trap heat in the atmosphere over a given period of time. The GWP rating system is normalized to CO_2, which has a value of one. For example, methane has a GWP of 28 over 100 years, which means that it has a global warming effect 28 times greater than CO_2 on an equal-mass basis (IPCC, 2014). To simplify GHG analyses, total GHG emissions from a source are often expressed as a CO_2 equivalent (CO_2e), which is calculated by multiplying the emissions of each GHG by its GWP and adding the results together to produce a single, combined emission rate representing all GHGs. While methane and nitrous oxide have much higher GWPs than CO_2, CO_2 is emitted in such greater quantities that it is the overwhelming contributor to global CO_2e emissions from both natural processes and human activities.

Federal agencies address emissions of GHGs by reporting and meeting reductions mandated in Federal laws, executive orders, and agency policies. INL personnel implement the *INL Site Sustainability Plan*, as required by DOE and executive orders (such as Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*). The *INL Site Sustainability Plan* contains strategies and activities that will lead to continual GHG reductions at the INL Site through efficiencies in energy, water, and vehicle fleet fuel usages; nonhazardous solid waste and construction debris diversion; use of clean and renewable energy; and development of green buildings (DOE-ID, 2019d).

The potential effects of GHG emissions from Project Pele are by nature global and cumulative. Given the global nature of climate change and the current state of the science, it is not useful at this time to attempt to link the emissions quantified for local actions to any specific climatological change or resulting environmental impact. Nonetheless, GHG emissions resulting from Project Pele are quantified in this EIS (see Section 4.4.1, *All Project Phases*) for use as indicators of their potential cumulative contributions to climate change effects and for making reasoned choices among alternatives. In addition, Section 5.3.7, *Global Commons – Climate Change*, presents the cumulative impact analysis of project GHGs.

3.4.4 Radiological Air Emissions and Standards

Facilities at the INL Site have the potential to emit radioactive materials and, therefore, are subject to NESHAP, Subpart H, *National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities* (EPA, 2021d). This regulation limits the radionuclide dose to a member of the public to 10 millirem per year from the air pathway. Subpart H also establishes requirements for monitoring emissions from facility operations and analyzing and reporting of radionuclide doses. Airborne radiological effluents are monitored at individual facilities at the INL Site (including MFC) to comply with the requirements of NESHAP and DOE Order 458.1, *Radiation Protection of the Public and the Environment* (DOE, 2020b).

Radionuclide emissions at the INL Site occur from (1) point sources, such as process stacks and vents; and (2) fugitive sources, such as waste ponds, buried waste, contaminated soil areas, and D&D operations. During 2019, an estimated 1,611 curies of radioactivity were released to the atmosphere from all INL Site sources (DOE-ID, 2021c). This level of release is within the range of releases from recent years and is consistent with the general downward trend observed over the past 10 years. For example, reported releases for 2010 and 2015 were 4,320 curies and 1,870 curies, respectively.

Radiological air emissions from MFC in 2019 primarily occurred from activities at the Radiochemistry Lab, spent fuel treatment at the Fuels Conditioning Facility, waste characterization at the HFEF, fuel research and development at the Fuel Manufacturing Facility, and operations at the TREAT facility. These facilities are equipped with continuous emission monitoring systems, and all radionuclide sources are controlled with HEPA filters. Radiological air emissions from CITRC in 2019 primarily occurred from testing of various infrastructure components and training for radiological counter-terrorism. MFC (including TREAT) released about 119 curies in 2019, which equates to about 7.4 percent of the total INL Site emissions (DOE-ID, 2021c). CITRC released about 50 curies in 2019, which equates to about 3.1 percent of the total INL Site emissions.

For calendar year 2020, the effective dose equivalent from combined INL Site emissions to the maximally exposed individual (MEI) member of the public was 0.062 millirem per year, which is 0.62 percent of the Subpart H standard of 10 millirem per year (DOE-ID, 2021c). Subpart H defines the MEI as any member of the public at any off-site location where there is a residence, school, business, or office. Radionuclide emissions from MFC and CITRC contributed to 96 percent and less than 1 percent of the total INL impact, respectively. See Section 3.10, *Human Health – Normal Operations*, for additional discussion of the radiological impacts from current site operations.

3.5 Biological Resources

Biological resources include the plant and animal species, habitats, and ecological relationships of the land and water areas within the ROI, which is the area affected by the Proposed Action. The ROI for the project was defined as the project footprint and a 0.5-mile (805-meter) radius buffer that extends beyond the construction fence surrounding Pads B, C, and D at CITRC (referred to as the ecological review area), which was included to account for an unforeseen hypothetical accident (see Section 3.11, *Human Health – Facility Accidents*). Particular consideration is given to federally regulated resources under the Endangered Species Act (ESA) and listed by the USFWS as endangered, threatened, proposed, or candidate species; migratory birds; and bald and golden eagles. Consideration is also given to species that are state-listed by the IDFG as threatened and endangered. For the purposes of this EIS, sensitive and protected biological resources include plant and animal species that are federally listed or state-listed for protection.

As discussed in Section 3.0, *Introduction*, activities planned at MFC (final assembly, reactor fueling activities, startup testing, PIE, and temporary storage) would occur within existing facilities and infrastructure that are currently utilized for similar activities and would not require facility improvements. Consequently, the activities would not affect biological resources. As such, this section does not discuss the specific biological resources of MFC but rather focuses on CITRC. References to CITRC in this section include Pads B, C, and D (the primary locations for potential disturbance) and the corresponding 0.5-mile buffer, approximately 1,325 acres.

Biological resources at the INL Site are monitored by the Environmental Surveillance, Education, and Research (ESER) Program. This program conducts comprehensive species monitoring via routine plant and animal inventories as well as numerous focused surveys (including, but not limited to, sensitive species, breeding birds, pygmy rabbits, greater sage-grouse, and bats), and vegetation classification efforts. Revegetation and weed management are also supervised through the program as needed. Historical reports and further information on ecological resources available on the INL Site are identified on the Idaho ESER website (INL, 2021d).

3.5.1 Vegetation

The greater INL Site covers about 569,135 acres (or about 890 square miles), supports over 420 plant species, and occupies one of the largest tracts of relatively undisturbed sagebrush steppe habitat in the region (INL, 2020c). CITRC has a semi-arid, cold desert habitat with perennial grass and shrub dominated upland communities (Veolia, 2020). The 2019 Sheep Fire burned about 79 percent of the land area within CITRC. Post-fire vegetation consists of a healthy native species population with remnant stands of big sagebrush (*Artemisia tridentate*) and native herbaceous species (Veolia, 2020).

Vegetation communities within the 1,325-acre CITRC ecological review area were determined using existing ecological datasets from historical and ongoing vegetation monitoring as well as biological field surveys conducted in October 2020 in and around Pads B, C, and D, which covered about 23 acres (referred to as the biological survey area) (Veolia, 2020). **Table 3.5-1** and **Figure 3.5-1** present vegetation communities and distribution within and surrounding CITRC. Nearly 67 percent of vegetation within CITRC is composed of shrublands, 25 percent is grasslands, and 7 percent is disturbed.

Sagebrush steppe habitat is the dominant type of shrubland and covers about 466 acres (464 acres in the ecological review area and 2.2 acres in the biological survey area). Sagebrush steppe habitats are composed of a diverse assemblage of big sagebrush (*Artemisia tridentate*), green rabbit brush (*Chrysothamnus viscidiflorus*), gray rabbit brush (*Ericameria nauseosa*), and plains prickly pear (*Opuntia polyacantha*). Native forbs observed within sagebrush habitat include flatspine stickseed (*Lappula occidentalis*), Hood's phlox (*Phlox hoodii*), and needle and thread grass (*Hesperostipa comata*). Introduced species are a minor component of the plant community though non-native cheatgrass (*Bromus tectorum*) contributes to the total vegetation cover. Within Pads B, C, and D, there are five vegetation community classes and four anthropogenically defined layers such as roads and infrastructure (see **Figure 3.5-2**, **Figure 3.5-3**, and **Figure 3.5-4**). During the October 2020 survey, a total of 26 native and 11 introduced plant species were documented at Pad B, 21 native and 10 introduced plant species at Pad C, and 26 native and 9 introduced plant species at Pad D (Veolia, 2020).

Table 3.5-1. Vegetation Communities Within the Proposed Project Area

Vegetation Community	*Biological Survey Area [a] (acres)*	*Ecological Review Area [b] (acres)*	*Conservation Status Rank*
Big Sagebrush – Green Rabbitbrush (Threetip Sagebrush) Shrubland	2.24	411.15	G5, G2G3, G3G5, G4,G3 GNR, G3Q, G2G4, G5
Green Rabbitbrush/Thickspike Wheatgrass Shrub Grassland and Needle and Thread Grassland	0	30.85	GNR, G1, G2, G24,
Green Rabbitbrush/Desert Alyssum (Cheatgrass) Ruderal Shrubland	2.45	408.57	GNA
Crested Wheatgrass Ruderal Grassland	2.23	372.48	GNA, GNR
Cheatgrass Ruderal Grassland	0	14.94	GNA
Previously Disturbed/Facilities	15.42	32.49	GNA
Borrow Sources/Disturbed	0.55	33.02	GNA
Exposed Rock/Cinder	0	5.78	GNA
Paved Road	0.3	10.02	GNA
Approximate Total Acres	**23.19**	**1,319.32**	

Sources: (Veolia, 2020; INL, 2019a)

Key: G1 = critically imperiled, G2 = imperiled, G3 = vulnerable, G4 = apparently secure, G5 = secure, GNR = not yet ranked, GNA = not applicable

Note:

[a] Biological survey area = Pads B, C, and D and a 30-meter (98-foot) radius buffer

[b] Ecological review area = 0.5-mile (805-meter) radius buffer that extends beyond the construction fence surrounding Pads B, C, and D at CITRC.

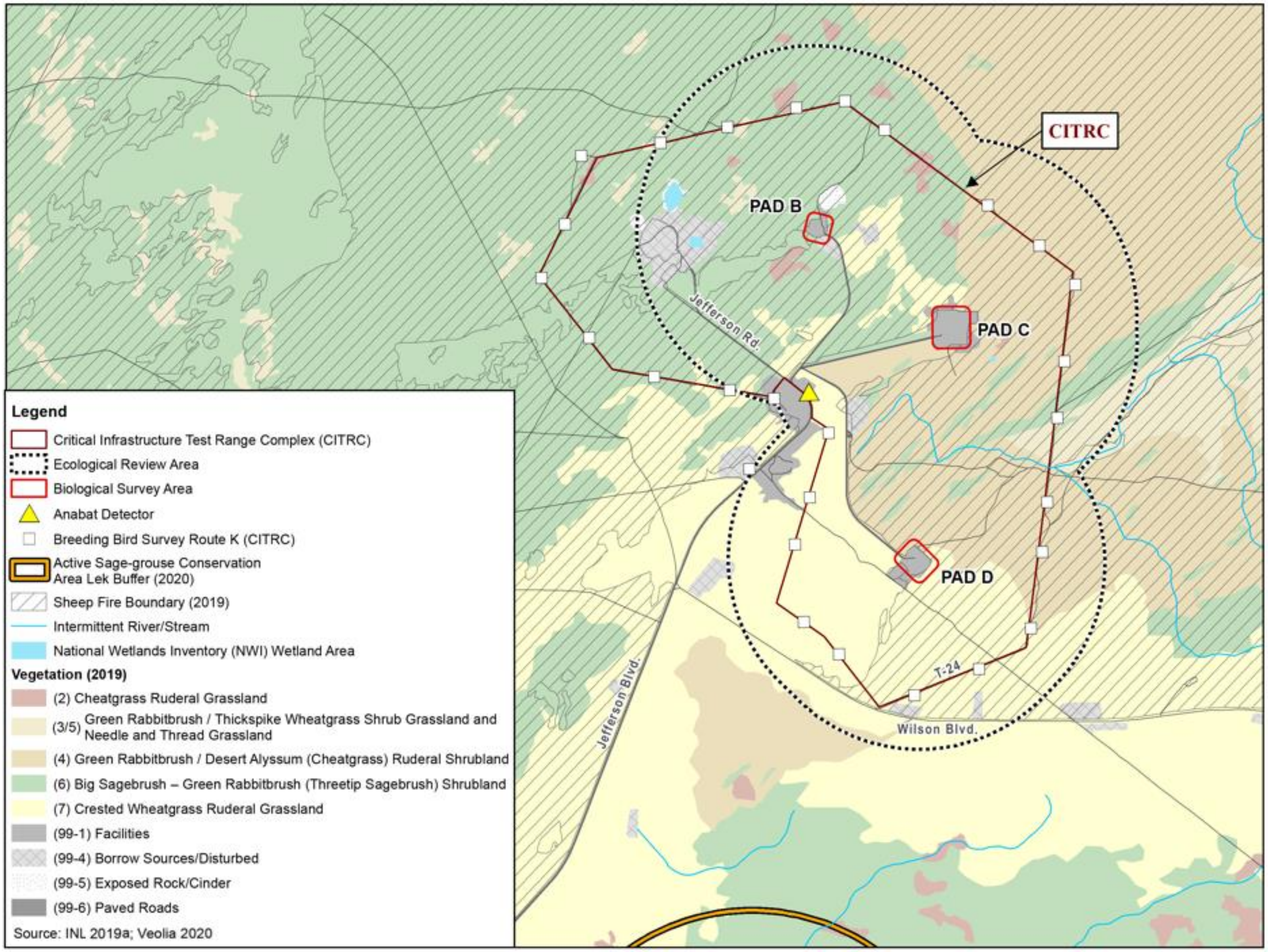


Figure 3.5-1. Biological Resources Within the Proposed Project Area at the INL Site

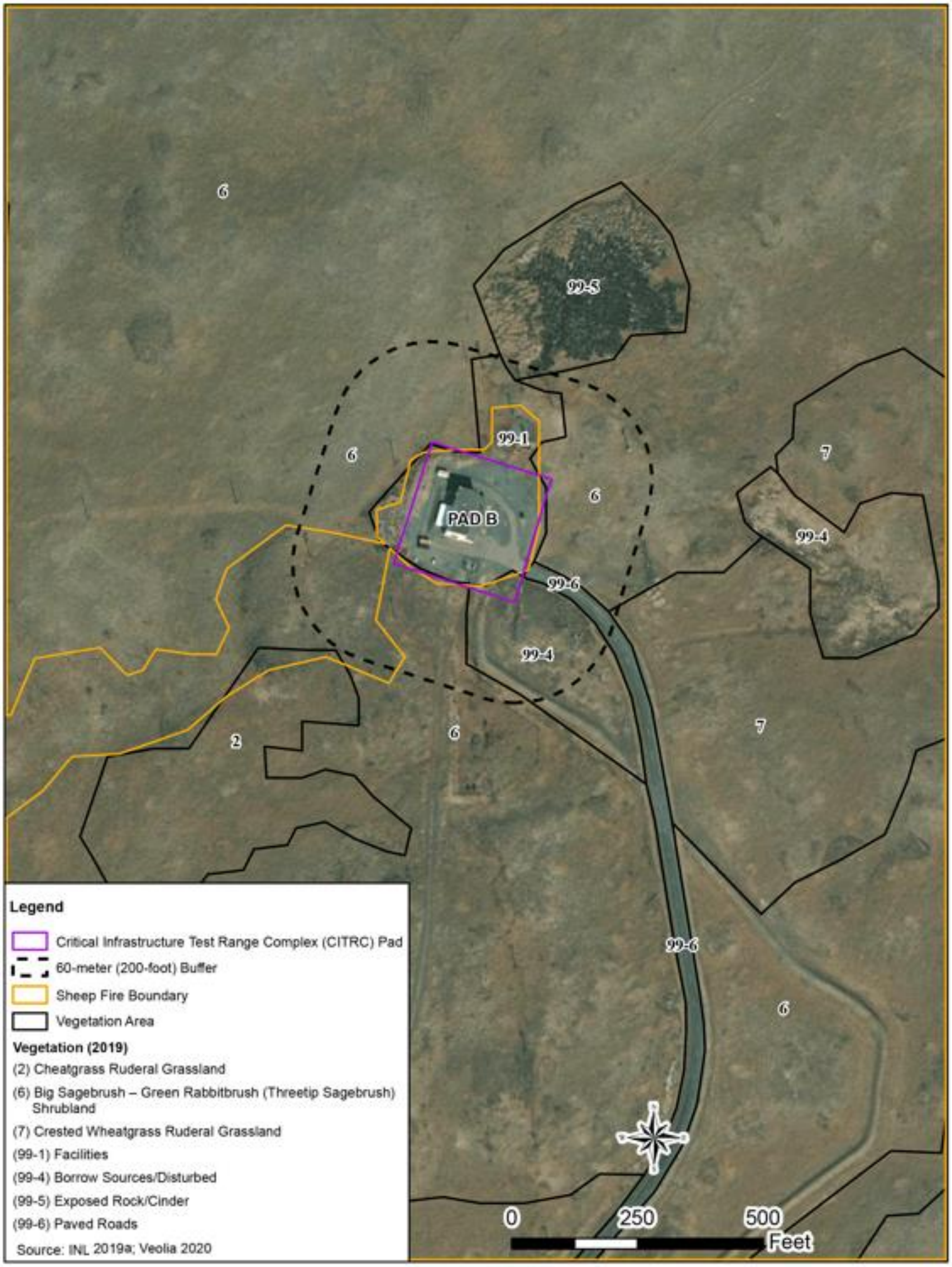


Figure 3.5-2. Biological Resources Within the Proposed Project Area at Pad B

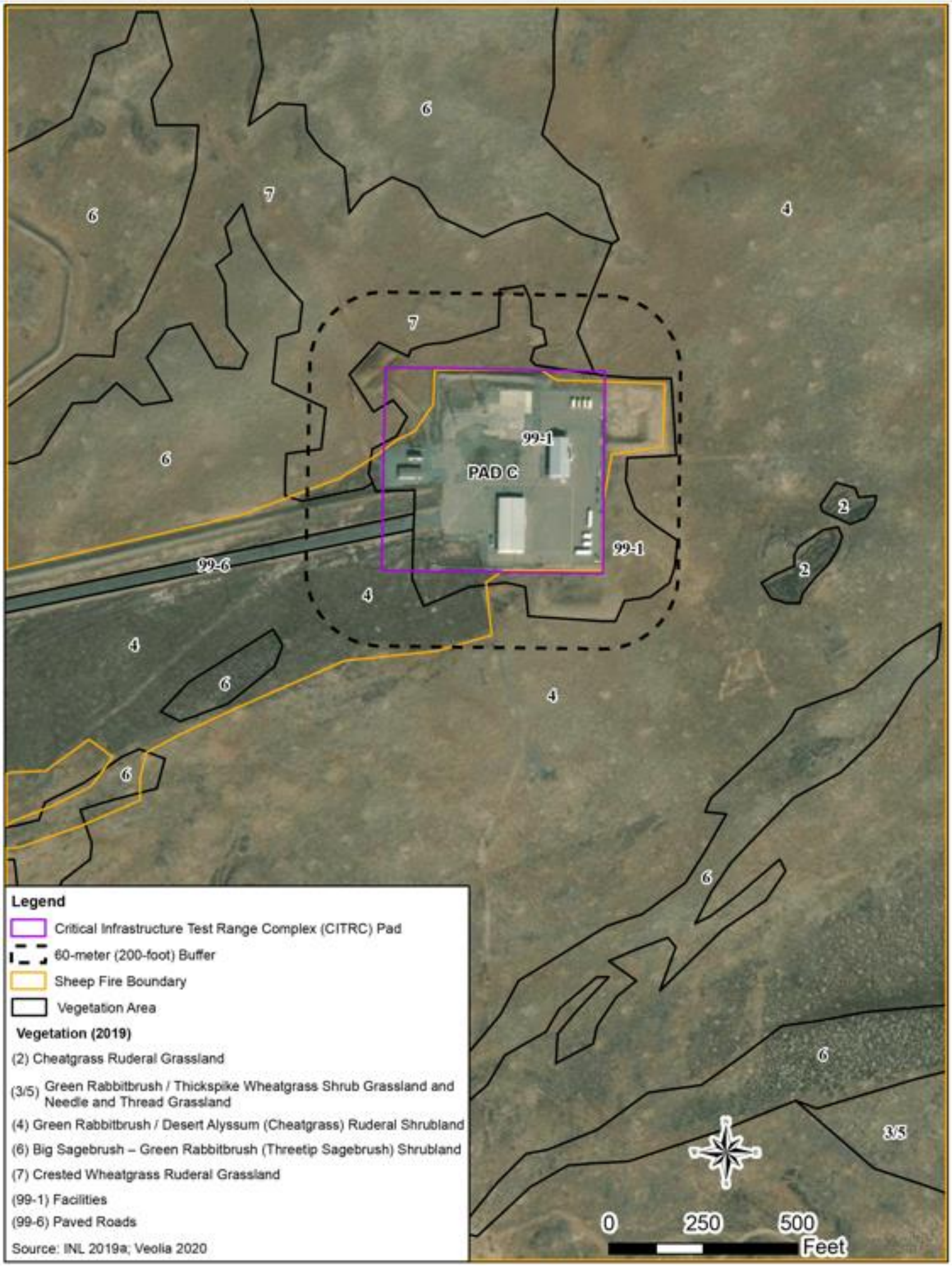


Figure 3.5-3. Biological Resources Within the Proposed Project Area at Pad C

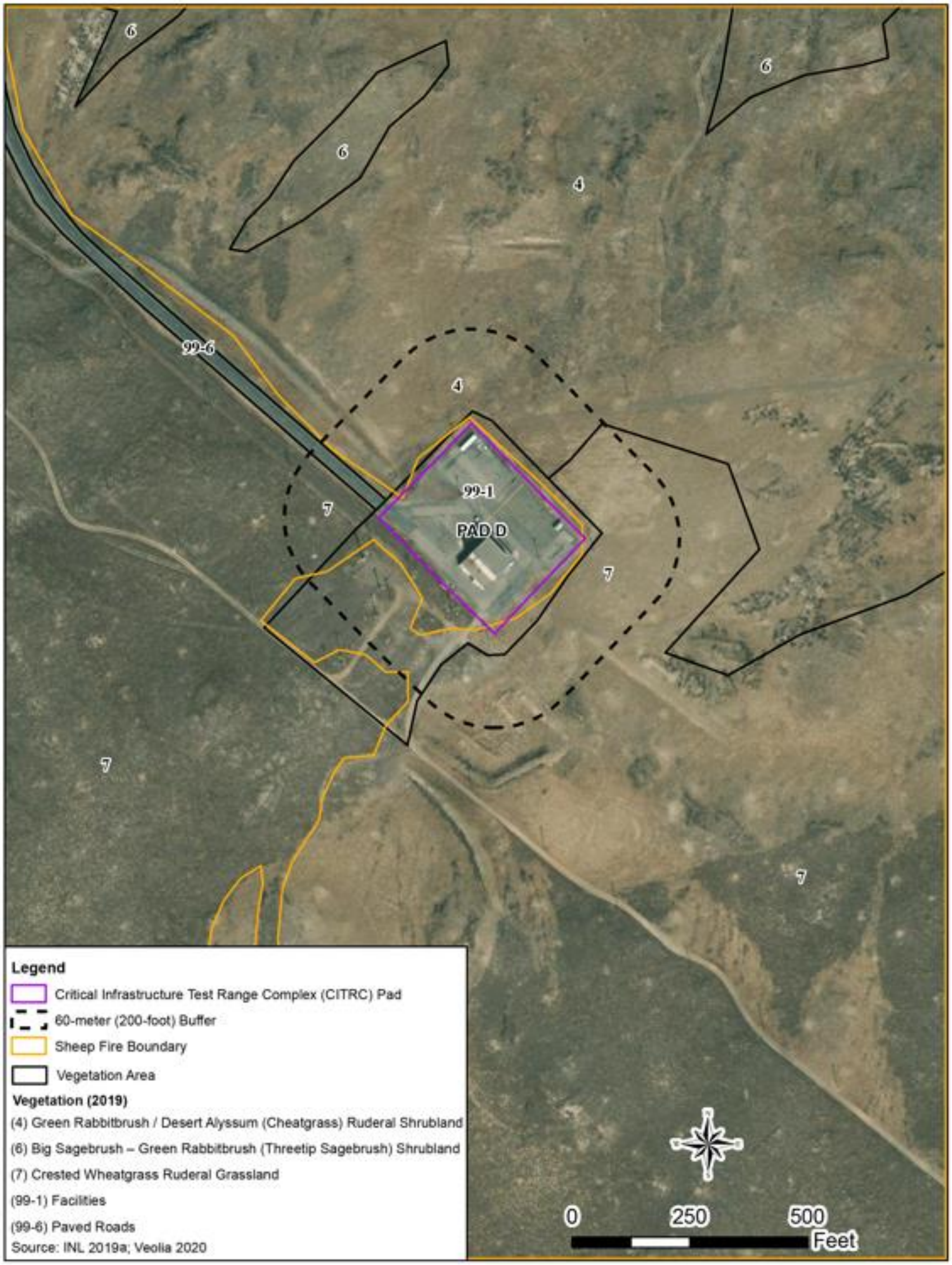


Figure 3.5-4. Biological Resources Within the Proposed Project Area at Pad D

Sagebrush resources at the INL Site are managed in partnership by the BLM and DOE, and together the agencies employ the INL *Sagebrush-Steppe Ecosystem Reserve Plan* with input from IDFG, USFWS, and Native American Tribes (INL, 2020c). The Sagebrush-Steppe Ecosystem Reserve, located about 12.4 miles north of the proposed project area, covers about 115 square miles (73,600 acres) in the northwest corner of the INL Site. The reserve was designated to ensure that this portion of the ecosystem receives special consideration and remains undisturbed. Ethnobotanical important species are present throughout the INL Site. Nearly 60 percent of the plant species identified within Pads B, C, and D have ethnobotanical importance, including uses as food, medicine, clothing, cordage, dyes, fuel, and gum (Veolia, 2020).

Invasive Plant Species

Invasive plants are those species whose introduction does or is likely to cause economic or environmental harm or harm to human health. Per the Executive Order 13112, *Invasive Species*, the Idaho Department of Agriculture mandates the official noxious weed list of introduced, invasive, and harmful plants. At the INL Site, the Noxious Weed Program develops site-wide policy and guidance to ensure compliance with the state and Federal regulatory requirements. According to the *Weeds of the Idaho National Engineering and Environmental Laboratory* report, a total of 13 Idaho invasive weed species have been identified on the INL Site (INL, 2020c). Battelle Energy Alliance administers invasive plant species control, with support from the ESER program.

A number of introduced species were documented within the biological survey area for Pads B, C, and D (Veolia, 2020). The biological survey identified one observed Statewide Containment Noxious Weed species, the rush skeletonweed (*Chondrilla juncea*), within Pads B, C, and D listed under the *State of Idaho's Rules Governing Invasive Species and Noxious Weeds* (Idaho Department of Agriculture, 2009). This creates a regulatory obligation to eradicate or contain rush skeletonweed to prevent it from spreading.

3.5.2 Wildlife

Sagebrush steppe ecosystems at the INL Site provide habitat for a variety of terrestrial wildlife species. Common small mammals include the bushy-tailed woodrat (*Neotoma cinerea*), black-tail jackrabbit (*Lepus californicus*), mountain cottontail (*Sylvilagus nuttallii*), sagebrush vole (*Lemmiscus curtatus*), North American deer mouse (*Peromyscus maniculatus*), Merriam's shrew (*Sorex merriami*), and American badger (*Taxidea taxus*). Large mammal species include coyote (*Canis latrans*), bobcat (*Lynx rufus*), pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), moose (*Alces americanus*), mountain lion (*Puma concolor*), and elk (*Cervus canadensis*) (INL, 2020c). A list of mammal species documented on the INL Site is available on the ESER website.

During the October 2020 biological surveys of Pads B, C, and D coyote, mule deer, pronghorn, and fresh elk sign were observed (Veolia, 2020). Several small mammal burrows were also noted and appeared to be active, though additional survey would be required to determine the species that occupy these burrows.

The extensive sagebrush steppe ecosystem provides foraging and roosting habitat for a variety of resident and transient bat species. In 2011, ESER initiated a comprehensive INL Site-wide bat monitoring program, which has documented 11 bat species, including several species with heightened conservation concern (refer to Section 3.5.3, *Special Status Species*). For the proposed project, long-term bat call data from the *INL Site Bat Protection Plan* (DOE-ID, 2018a; ESER, 2020) and data collected in 2020 from the CITRC long-term acoustic monitoring station were used in this analysis. In 2020, 19,269 files of bat call were collected over a total of 91 detector nights from May to October (Veolia, 2020). Eight species of bats occur near CITRC as either summer residents or transients. Bat species recorded include: western small-footed myotis (*Myotis ciliolabrum*), big brown bat (*Eptesicus fuscus*), hoary bat (*Lasiurus cinereus*), little brown myotis (*Myotis lucifugus*), silver-haired bat (*Lasionycteris noctivagans*), Townsend's big-eared bat (*Corynorhinus townsendii*), western long-eared myotis (*M. evotis*), and western small-footed myotis (*M. ciliolabrum*) (Veolia, 2020).

Common reptiles observed at the INL Site include the sagebrush lizard (*Sceloporus graciosus*), short-horned lizard (*Phrynosoma douglassii*), Great Basin rattlesnake (*Crotalus oreganus lutosus*), western terrestrial garter snake (*Thamnophis elegans*), and gopher snake (*Pituophis catenifer*) (INL, 2020c). These species could occur at CITRC.

Fish species reported on the INL Site are limited to the Big Lost River during years when water flow is sufficient. The Great Basin spadefoot toad (*Spea intermontana*) is a common amphibian species across the INL Site. There are about 2.8 acres of freshwater ponds and 2.7 acres of riverine habitat in the ecological survey area of CITRC.

In an effort to monitor bird populations on the INL Site, breeding bird surveys (BBSs) have been conducted almost annually since 1985. Surveys occur along five BBS routes that are part of a nationwide survey administered by the USGS and eight additional routes near INL Site facilities (DOE-ID, 2021c). In 2018, about 2,840 birds representing 53 species were documented during the BBSs across the INL Site. Commonly identified bird species include the horned lark (*Eremophila alpestris*), western meadowlark (*Sturnella neglecta*), sage thrasher (*Oreoscoptes montanus*), sagebrush sparrow (*Artemisiospiza nevadensis*), Brewer's sparrow (*Spizella breweri*), common raven (*Corvus corax*), and mourning dove (*Zenaida macroura*) (ESER, 2019). The 2018 breeding bird surveyors observed eight species considered by the IDFG to be Species of Greatest Conservation Need (SGCN) on the INL Site.

One BBS route occurs along the perimeter of CITRC (see **Figure 3.5-1**). Surveys have documented 46 species of birds, including several SGCN (refer to Section 3.5.3, *Special Status Species*). This survey is conducted once per year, and species that are nocturnal (e.g., barn owl [*Tyto alba*]) or not vocal during this time period (e.g., sage-grouse [*Centrocercus urophasianus*]) may be present. CITRC also contains power distribution structures that are known to be resting and hunting perches for raptors (hawks, falcons, eagles, and owls), ravens, and songbirds.

Each spring, the ESER Program surveys nearly all INL Site infrastructure and trees at facilities for raptor and raven nests as part of its monitoring program associated with the Candidate Conservation Agreement (CCA) for greater sage-grouse (DOE-ID & USFWS, 2014). Common raven nested on a structure at Pad C, and in 2017 a common raven nest was observed at Pad D. A stand of juniper trees within CITRC has been known to be important nesting habitat for multiple species. From 2014 to 2020, great-horned owls (*Bubo virginianus*) maintained nests there in all but 1 year, and a common raven pair maintained a nest for a brief time in 2020 (Veolia, 2020).

3.5.3 Special Status Species

Special status species include federally listed (USFWS) threatened and endangered species, state-designated (IDFG) sensitive species, and their habitats. Applicable laws include the ESA (16 U.S.C. 1532 et seq.), the Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703-712), the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c), and the Idaho Fish and Game statutes (Title 36 of Idaho Statutes).

The USFWS's Information for Planning and Consultation (IPaC) online system was accessed to identify current USFWS trust resources with potential to occur within the proposed project area. On May 18, 2021, the USFWS Idaho Fish and Wildlife Office provided an automated *Official Species List* via a letter submitted per ESA Section 7 (USFWS, 2021b). No federally listed species under the ESA have been observed or documented within the INL Site, and there is no designated critical habitat (USFWS, 2021b).

Although the INL Site has no documented federally listed plant species, there are several rare and/or sensitive species (i.e., those that have a global or state ranking identified by the Idaho Natural Heritage

Program) that are known to occur and have the potential to occur on-site. Seven plant species have the potential to occur at CITRC based on suitable habitat present on and around the pads. Of these seven species, three have been confirmed to occur on the INL Site (Hooker's buckwheat [*Eriogonum hookeri*], naked gymnosteris [*Gymnosteris nudicaulis*], and middle butte blatterpod [*Lesquerella obdeltata*]), two have been observed, but identifications have not been confirmed (plains milkvetch [*Astragalus gilviflorus*] and hidden phacelia [*Phacelia inconspicua*]), one has a confirmed population adjacent to the INL Site boundary (desert dodder [*Cuscuta denticulata*]), and one has never been confirmed to grow on or near the INL Site (king bladderpod [*Lesquerella kingii* ssp. *cobrensis*]) (Veolia, 2020). Based on known range and distribution, hidden phacelia has the highest potential to occur (Veolia, 2020). None of these sensitive species are known or have been documented within CITRC, although targeted species surveys have not been conducted (Veolia, 2020).

The IDFG *Idaho State Wildlife Action Plan* (IDFG, 2017) prioritizes SGCN by three tiers (1, 2, and 3) based on relative conservation priority (see **Table 3.5-2**). According to historical surveys, a number of SGCN wildlife and special status species have been reported on the INL Site (see **Table 3.5-2**). Sensitive species occurrences and known habitat distribution documented within CITRC is presented in **Figure 3.5-1**. Focused surveys that target peak identification periods for sensitive species have not been conducted for CITRC.

Table 3.5-2. Special Status Species Known to Occur at the INL Site and Potential to Occur Within CITRC

Common Name	*Scientific Name*	*Status State Global*	*Status Federal*	*Potential for Occurrence within CITRC*
Mammals				
Townsend's Big-eared Bat [a]	*Corynorhinus townsendii*	SGCN [b] Tier 3, S3, G4	-	Yes, confirmed to occur on the INL Site.
Big Brown Bat	*Eptesicus fuscus*	S3, G5	-	Yes, confirmed to occur on the INL Site.
Silver-haired Bat [c]	*Lasionycteris noctivagans*	SGCN Tier 2, S3, G3G4	-	Yes, confirmed to occur on the INL Site.
Hoary Bat [c]	*Lasiurus cinereus*	SGCN Tier 2, S3, G3G4	-	Yes, confirmed to occur on the INL Site.
California Myotis	*Myotis californicus*	S3, G5	-	No. Species not detected during on-site surveys.
Western Small-footed Myotis [d]	*M. ciliolabrum*	SGCN Tier 3, S3, G5	-	Yes, confirmed to occur on the INL Site.
Western Long-eared Myotis	*M. evotis*	S3, G4	-	Yes, confirmed to occur on the INL Site.
Fringed Myotis [e]	*M. thysanodes*	S2, G4G5	-	No. Species not detected during on-site surveys.
Yuma Myotis	*M. yumanensis*	S3, G5	-	No. Species not detected during on-site surveys.
Little Brown Myotis [a, c, d]	*M. lucifugus*	SGCN Tier 3, S3, G5	-	Yes, confirmed to occur on the INL Site.
Pygmy Rabbits	*Brachylagus idahoensis*	SGCN Tier 2, S3, G4	-	Yes, confirmed to occur on the INL Site.
Birds				
Greater Sage-grouse	*Centrocercus urophasianus*	SGCN, G3G4	-	Potential suitable habitat present, but no known leks within the Proposed Action area (see greater sage-grouse discussion below).
Brewer's Sparrow	*Spizella breweri*	BCC	MBTA	Potential suitable habitat available.

Table 3.5-2. Special Status Species Known to Occur at the INL Site and Potential to Occur Within CITRC (Continued)

Common Name	*Scientific Name*	*Status State Global*	*Status Federal*	*Potential for Occurrence within CITRC*
Golden Eagle	*Aquila chrysaetos*	BCC	BGEPA, MBTA	Possible flyover. No nesting habitat within the Proposed Action area.
Long-billed Curlew	*Numenius americanus*	BCC	MBTA	Potential suitable habitat available.
Sage Thrasher	*Oreoscoptes montanus*	BCC	MBTA	Potential suitable habitat available.
Willet	*Tringa semipalmata*	BCC	MBTA	Possible flyover or transient species. No suitable habitat within the Proposed Action area.
Plants				
Plains Milkvetch	*Astragalus gilviflorus*	S2, G5	-	Yes, potential suitable habitat may be present.
Desert Dodder	*Cuscuta denticulata*	S1, G4G5	-	Yes, potential suitable habitat may be present.
Hooker's Buckwheat	*Eriogonum hookeri*	S1, G5	-	Yes, confirmed to occur on the INL Site.
Naked Gymnosteris	*Gymnosteris nudicaulis*	S3, G4	-	Yes, confirmed to occur on the INL Site.
King Bladderpod	*Lesquerella kingii* ssp. *cobrensis*	S3, G5	-	Yes, potential suitable habitat may be present.
Middle Butte Bladderpod	*Lesquerella obdeltata*	S2, G2	-	Yes, confirmed to occur on the INL Site.
Hidden Phacelia	*Phacelia inconspicua*	S1, G2	-	Yes, potential suitable habitat may be present.

Sources: (Veolia, 2020); (IDFG, 2005); (IDFG, 2021a; IDFG, 2021b; IDFG, 2021c; IDFG, 2021d; IDFG, 2021e; IDFG, 2021f; IDFG, 2021g; IDFG, 2021h; IDFG, 2021i; IDFG, 2021j); (IDFG, 2021k; IDFG, 2021l)

Global: G = global conservation status rank; G1 = critically imperiled, G2 = imperiled, G3 = vulnerable; G4 = apparently secure; G5 = secure

Federal: BGEPA = Bald and Golden Eagle Protection Act; MBTA = Migratory Bird Treaty Act

State: State = Idaho Department of Fish and Game, S = subnational conservation status rank; S1 = critically imperiled; S2 = imperiled; S3 = vulnerable; BCC= Birds of Conservation Concern; SGCN = Species of Greatest Conversation Need

Key: CITRC = Critical Infrastructure Test Range Complex; INL = Idaho National Laboratory

Notes:

[a] Confirmed in the 2020 dataset using AnalookW but not from historical data. May be somewhat transient in the project area.

[b] Tier 1 SGCN are species of the highest priority or covered by the Idaho State Wildlife Action Plan and represent species with the most critical conservation needs. The plan includes an early warning list of taxa that have a highest probability of being listed under the ESA in the near future. Tier 2 SGCN are species with high conservation needs and longer-term vulnerabilities or patterns suggesting management intervention is needed, but the species is not necessarily facing imminent extinction or having the highest management profile. Tier 3 SGCN are relatively common, yet long-term monitoring surveys indicate they are rapidly declining throughout the species' range.

[c] Tree bat species occurring as both summer resident and seasonal migrant within the project area.

[d] Produces generalized calls in the 40-kilohertz frequency band that may be confusable with little brown myotis, especially in clutter.

[e] Kaleidoscope identifications were either big brown bat approach calls or western long-eared myotis calls. Despite low maximum likelihood estimation value, species was not detected in 2020.

Habitat for the eight special status bat species within the INL Site includes lava tube caves, fractured rock outcrops, talus-flanked buttes, and juniper uplands (DOE-ID, 2018a; ESER, 2020). Bats are known to use the proposed project area, and there are abundant roosting sites and foraging habitat. CITRC, like other facilities on the INL Site, presents an island of vertical structures (e.g., trees, buildings, equipment) in a vast ocean of shrub steppe vegetation. Vertical structure is attractive to bats, particularly transient bats seeking temporary roosts (Veolia, 2020). Additionally, pygmy rabbits (*Brachylagus idahoensis*), a SGCN Tier 2, have been observed throughout the INL Site as well as within the proposed project area (ESER, 2007). Pygmy rabbits are dependent on sagebrush for food and shelter throughout the year. They use the dense stands of big sagebrush growing in deep loose soils to dig burrows (NatureServe, 2019).

The greater sage-grouse is a widespread, sagebrush-obligate species that has become an icon and symbol for conserving sagebrush across the western United States. Sage-grouse is known to occupy various areas at the INL Site (INL, 2020c). In 2014, DOE voluntarily entered into a CCA with USFWS to protect the greater sage-grouse and its habitats on the INL Site, while allowing DOE flexibility in conducting its current and future missions (DOE-ID & USFWS, 2014). Although the sage-grouse does not warrant protection under the ESA, DOE and USFWS continue to collaborate on sage-grouse protection at the INL Site.

The INL Site establishes a *Sage-grouse Conservation Area* (SGCA) that limits infrastructure development and human disturbance in remaining sagebrush-dominated communities. The INL Site conservation framework protects lands within a 0.6-mile radius of all known active leks (sage-grouse communal breeding ground). The INL Site sage-grouse population is assessed according to baseline conditions from 2011. In 2013, a sage-grouse population monitoring task was designed to annually track abundance trends on the INL Site and provide information to DOE and USFWS regarding the direction of trends relative to the projected baseline population. A total of 27 leks have been identified within the SGCA (DOE-ID, 2021c). As of 2019, 40 active leks were recorded on or near the INL Site (DOE-ID, 2021c; VNSFS, 2020).

CITRC is not within the established SGCA, and there are no documented active or inactive leks. The closest known documented lek site is about 1.2 miles south of CITRC. Suitable habitat for greater sage-grouse occurs in CITRC, but no focused surveys have been conducted (Veolia, 2020). CITRC is subject to DOE's policy to produce no net loss of sagebrush habitat on the INL Site.

Additionally, several species identified as Birds of Conservation Concern (BCC) under the MBTA or as SGCN under State of Idaho regulations occur at the INL Site. The USFWS maintains a regional list of designated migratory birds known to occur in the United States. The BCC list is a subset of MBTA-protected species identified by the USFWS as those in the greatest need of additional conservation action to avoid future listing under the ESA. BCC species have been identified at three geographic scales: National, USFWS Regions, and Bird Conservation Regions. The INL Site is located within Bird Conservation Region 9 (Great Basin) and there are 28 BCC species listed (USFWS, 2008). Additionally, the USFWS IPaC system identified five migratory bird species with potential to occur in the proposed project area: golden eagle (*Aquila chrysaetos*), Brewer's sparrow, long-billed curlew (*Numenius americanus*), sage thrasher, and willet (*Tringa semipalmata*) (USFWS, 2021b). Several SGCN have been reported around the perimeter of CITRC, such as sagebrush sparrow (*Artemisiospiza nevadensis*), sage thrasher, Brewer's sparrow, grasshopper sparrow (*Ammodramus savannarum*), common nighthawk (*Chordeiles minor*), golden eagle, ferruginous hawk (*Buteo regalis*), and short-eared owl (*Asio flammeus*) (Veolia, 2020).

3.5.4 Aquatic Resources

As stated in Section 3.3.1.1, *Natural Water Features*, an unnamed intermittent waterway flows west between Pads C and D, and three seasonally flooded freshwater ponds and one riverine wetland associated with the unnamed intermittent stream occurs within CITRC. Due to the arid environment and seasonal flooding, suitable aquatic habitat does not exist to support most species of aquatic life within these features. No aquatic habitat has been identified within the vicinity of the CITRC pads. In general, water flow patterns are typically intermittent within the shallow creeks. The sagebrush steppe terrain is typically flat or gently rolling (NWF, 2019).

Wetlands within the vicinity of CITRC are classified as riverine and palustrine, are seasonally flooded and have either unconsolidated substrates, or have been excavated. All wetlands are located outside of Pad B (about 1,638 feet away), Pad C (about 470 feet away), and Pad D (about 1,315 feet away) (see **Figure 3.3-1**). Refer to Section 3.3.1.1, *Natural Water Features*, for additional information about wetlands.

3.5.5 Wildfire

Wildfire in Idaho is fairly common due to the landscape's arid conditions and dry vegetation. Wildland fire management is employed at the INL Site to prevent the loss of big sagebrush habitat and to protect sensitive species (ESER, 2019) unique to the area. Restrictions are in place to minimize the potential for human-caused fires when vegetation is most susceptible to fire (DOE-ID, 2021c). For more information on recent wildfires and past fire scars, refer to the Wildfire Recovery Reports available on the ESER website.

A majority of CITRC has been previously burned from wildfires on-site. These fires have resulted in the loss of sagebrush habitat and increased the abundance of other native shrublands (such as green rabbitbrush) and native grasses (bluebunch wheatgrass [*Pseudoroegneria spicata*], bottlebrush squirreltail [*Elymus elymoides*], and Sandberg bluegrass [*Poa secunda*]) (Veolia, 2020). Additionally, the 2019 Sheep Fire burned about 1,050 acres (79 percent) of CITRC; including about 88 percent of the vegetation within Pad B, 89 percent in Pad C, and 61 percent in Pad D (Veolia, 2020).

3.6 Cultural and Paleontological Resources

This discussion of cultural resources includes prehistoric and historic archaeological sites; historic buildings, structures, and districts; and physical entities and human-made or natural features important to a culture, a subculture, or a community for traditional, religious, or other reasons (see Chapter 9, *Glossary*).

The ROI for cultural resources evaluation is the same as the area of potential effects (APE), as defined by National Historic Preservation Act (NHPA) implementing regulations 36 CFR 800.16(d). The APE was determined by the scope of the current undertaking, including all potential direct and indirect impacts associated with project activities. The APE for cultural resources includes 44.80 acres at CITRC and 8.54 acres (three buildings and three structures) at MFC for a total of 53.34 acres. New construction would occur at CITRC (Phase 4) and either the RSWF or the ORSA (Phase 6). The APE at CITRC consists of 44.80 acres, including a 200-foot buffer around the proposed security fences at CITRC to allow for pad construction (Pads B, C, and D), including pouring of one new concrete pad for the mobile microreactor, site preparations, laydown areas, defensible security buffers, and egress during construction. The APE of RSWF and ORSA is within the MFC APE.

In determining the APE at MFC, visual, auditory, and atmospheric effects from the proposed undertaking on architectural properties within MFC were considered. MFC consists of a 90-acre developed area, which includes an undeveloped security perimeter. Structures include analytical laboratories and other facilities that tend to be one- or two-story, block concrete buildings interspersed with towers and holding tank structures. The APE includes six distinct areas of MFC, encompassing a total of 8.54 acres: RSWF (main structure area), RSWF Staging/Storage Area, ORSA, DOME, TREAT, and HFEF (see **Figure 2.3-6**, Mobile Microreactor Configuration of CONEX Containers at the DOME, and **Figure 2.3-9**, Mobile Microreactor Located at CITRC Test Pad D). Combining CITRC and MFC, the APE totals 53.34 acres.

3.6.1 Ethnographic Resources

The Shoshone-Bannock Tribes have a long and traditional association with the area of the Proposed Action, as detailed in the following sections.

Native American Cultures

Coupled with numerous recorded and yet to be identified properties within MFC and across the INL Site, the Shoshone-Bannock Tribes document the past, long-term use of the area. Representatives from the Shoshone-Bannock Tribes Heritage Tribal Office have indicated to DOE that pre-contact archaeological sites, native plants and animals, water, and other natural landscape features across the INL Site continue to fill important roles in Tribal heritage and ongoing cultural traditions. Pre-contact sites, located throughout the INL Site, and oral histories establish the importance of the area in the seasonal round of the Shoshone and Bannock people. Much of the area now encompassing the INL Site served as a travel route within their traditional territory, providing access to the Birch Creek and Little Lost River valleys as well as the Camas Prairie and beyond. The Big Lost River, Big Southern Butte, and Howe Point served as seasonal base camps providing fresh water, food, and obsidian (volcanic glass) for tool making and trade. The Shoshone and Bannock people depended on a variety of plants and animals for food, medicines, clothing, tools, and building materials (NRC, 2004).

The importance of plants, animals, water, air, and land resources on the ESRP to the Shoshone and Bannock peoples is reflected in the sacred reverence in which they hold the resources. Specific places in the ESRP have sacred and traditional importance to the Shoshone and Bannock people, including buttes, caves, and other natural landforms on or near the INL Site (NRC, 2004). Not only do the Shoshone and Bannock peoples value tangible resources (e.g., archaeological sites, plants, animals, water, etc.), but the intangible is also of great importance (e.g., the feeling and association of a place). There are several places on the INL Site that hold special and sacred feelings that remain significant to the Shoshone and Bannock peoples.

Native American and Euro-American Interactions

The influence of Euro-American culture and loss of aboriginal territory and reservation land severely impacted the aboriginal subsistence cultures of the Shoshone and Bannock people. Settlers began establishing homesteads in the valleys of southeastern Idaho in the 1860s, increasing the conflicts with aboriginal people and providing the motivation for treaty-making by the Federal Government. The Fort Bridger Treaty of 1868 and associated Executive orders designated the Fort Hall Reservation for mixed bands of Shoshone and Bannock people. A separate reservation established for the Lemhi Shoshone was closed in 1907, and the Native Americans were forced to migrate to the Fort Hall Reservation across the area now occupied by the INL Site.

The original Fort Hall Reservation, consisting of 1.8 million acres, has been reduced to about 544,000 acres through a series of cessions to accommodate the Union Pacific Railroad and the growing city of Pocatello. Other developments, including the flooding of portions of the Snake River bottoms by the construction of the American Falls Reservoir, have also reduced the Shoshone-Bannock Tribes' land base.

The creation of the INL Site had an impact on the Shoshone and Bannock subsistence culture. Prior to the creation of the INL Site, the Shoshone and Bannock peoples were able to travel freely to and from the Fort Hall Reservation to all of their hunting, gathering, and ceremonial areas, which was their inherent right and also a Treaty Right. This access was restricted during World War II when the U.S. Navy began munitions testing, and instituted land withdrawals, which were continued by the Atomic Energy Commission during the Cold War. A substantial amount of Shoshone-Bannock history was left behind on the INL Site—including burials, tools, sacred sites—even as some of that history was destroyed by munitions testing. In addition, initial construction of facilities on the INL Site may have impacted cultural resources of importance to the Tribes, including traditional and sacred areas and artifacts (NRC, 2004).

Contemporary Cultural Practices and Resource Management

The efforts of the Shoshone-Bannock Tribes to maintain and revitalize their traditional cultures are dependent on having continual access to aboriginal lands, including some areas on the INL Site. DOE accommodates Tribal member access to areas on the INL Site for subsistence and religious uses. Also, Tribal members continue to hunt big game, gather plant materials, and practice religious ceremonies in traditional areas that are accessible on public lands adjacent to the INL Site. The historical record described in the *INL Cultural Resources Management Plan* (INL, 2016b) supports the conclusion that the INL Site is located within a large, traditional territory of the Shoshone and Bannock people and there are archaeological and other cultural resources that reflect the importance of the INL Site area to the Tribes. DOE recognizes the unique interest the Shoshone-Bannock Tribes have in the management of resources on the INL Site and continues to consult with the Tribes concerning Federal undertakings and management of cultural and natural resources (see Appendix C, *Tribal Coordination*).

The maintenance of pristine environmental conditions, including native plant communities and habitats, natural topography, and undisturbed vistas, is critical to continued viability of the Shoshone and Bannock culture. Contamination from past and ongoing operations at the INL Site has the potential to affect plants, animals, and other resources that Tribal members continue to use and deem significant (NRC, 2004). Much of the APE area has been heavily disturbed due to building construction, asphalt and concrete paving, road construction, storm water pond and industrial waste pond excavation, power line installation, and wildland fire (DOE-ID, 2021d).

3.6.2 Cultural Resources

The INL Site and surrounding areas are rich in cultural resources, including pre-contact and early historic archaeological artifacts and features left by the Shoshone and Bannock people, as well as artifacts and features left by early pioneers, homesteaders, and ranchers who also frequented the area. Historic uses of the area include attempts at homesteading and as a route for cattle drives and settlers traveling west. The most recent use of the area facilitated the nuclear technology age with research and development of nuclear power. Descendants of pioneers who crossed the INL Site on Goodale’s Cutoff, homesteaders who attempted to scrape an existence from the desert soils, and employees who participated in the initial operations on the INL Site retain a special connection to the land.

To date, numerous cultural resource surveys have been conducted at the INL Site (INL, 2016b). These surveys have identified many archaeological properties and properties associated with the historic built environment. Cultural resources on the INL Site represent nearly 13,500 years of human occupation and land use. Many archaeological sites, buildings, and structures are significant and are either unevaluated for eligibility or eligible for listing in the National Register of Historic Places (NRHP). Cultural resources in the vicinity of the project are discussed below.

Archaeological Resources

Archaeological resources encompass Native American occupation sites and late 19th and early 20th century Euro-American cultural resources associated with mining, canal and railroad construction, emigration and homesteading, agriculture, and ranching. Archaeological surveys and investigations conducted in southeastern Idaho have provided evidence of human use of the ESRP for at least 13,500 years, which is supported by radiocarbon dates on excavated materials from Owl Cave at the Wasden Site located on private land near the INL Site. Numerous collapsed lava tubes and caves on the INL Site provide evidence of pre-contact occupation. Recognizing the importance of these resources, Aviator’s Cave was listed in the NRHP in 2010.

The area of ground disturbance for the proposed Project Pele facility construction is at CITRC (Phase 4) and either the RSWF or ORSA (Phase 6). CITRC was subject to intensive pedestrian archaeological survey, which identified four pre-contact cultural resources. Three of the cultural resources were determined to not meet the threshold of significance to be recommended as eligible for listing in the NRHP (DOE-ID, 2021d). The fourth cultural resource is highly significant to the Shoshone-Bannock Tribe and is provided the same protections given to sites listed on the NRHP. The entire CITRC area is treated as culturally sensitive due to past discoveries that have revealed subsurface cultural deposits in soils with depths unhindered by near-surface exposures of basalt and that often have special significance to the Tribes. (DOE-ID, 2021d)

The cultural survey performed in support of Project Pele at MFC and CITRC does not cover constructing a concrete pad or shed within the fenced boundaries at ORSA or RSWF for temporary storage of the microreactor system at INL. The RSWF and ORSA areas of the APE were not surveyed for archaeological resources because an exact location for the temporary storage has not been selected yet. The necessary NHPA Section 106 survey and review will be performed later when an exact location has been selected.

Historic Resources

Resources within the built environment consist of modern roads, railroad tracks, irrigation canals, and transmission and telephone lines, along with buildings and landscape features associated with the Arco Naval Proving Ground and the National Reactor Testing Station's nuclear energy research beginning in 1949.

MFC was initially established as Argonne National Laboratory – West (ANL-W) and was operated by the University of Chicago from 1949 to 2005. Prior to the development of the former EBR-II (now referred to as the DOME) at ANL-W, researchers and operators successfully demonstrated the creation of usable quantities of electricity at Experimental Breeder Reactor I (EBR-I) for the Atomic Energy Commission. EBR-I, located over 18 miles west of MFC, was designated as a National Historic Landmark by President Lyndon B. Johnson in 1966 for its outstanding historical significance in reactor development and design. Following decontamination, the Reactor Building and associated Office Annex were opened as a public Visitor Center in 1975.

MFC, which is located about 38 miles west of Idaho Falls in Bingham County, is in the southeastern corner of the INL Site. MFC is about 90 acres (inside the MFC fence) and about 2.7 miles from the southern INL Site boundary. MFC is engaged in advanced nuclear power research and development, spent fuel and waste treatment technologies, national security programs, and projects that support space exploration. Since it was established in 1949, MFC's primary mission has been to take nuclear power systems through the steps from design to demonstration.

Six distinct areas of MFC have been proposed for use to support Project Pele: the RSWF main structure area, RSWF Staging/Storage Area, ORSA, DOME, HFEF, and TREAT.

Table 3.6-1 lists the NRHP status of the six existing facilities within MFC that are proposed for use in development and operations of Project Pele, including testing of project materials, startup and transient testing and evaluation of the constructed mobile microreactor.

CITRC, formerly known as the Power Burst Facility, was built in the 1950s. During original construction, a perimeter fence was built to surround the five developed areas and paved roads were constructed to connect them. Overhead house powerlines and associated service roads were also built to supply power to the facilities through a dedicated CITRC substation. Above and underground utilities (potable and fire water, sewer, and communications) were also installed during original construction.

By the 1980s, the original missions that CITRC was built to support had been decommissioned and many of the original CITRC buildings and other equipment and infrastructure were repurposed for other missions. Significant demolition of obsolete structures began at this time and continued through the 1990s. An architectural inventory of all remaining non-temporary buildings and structures within CITRC has been completed and determined that none are eligible for the NRHP (DOE-ID, 2021d).

Table 3.6-1. Materials and Fuels Complex Facilities Proposed for Use in Project Pele

Facility Name	*Facility Number*	*Year Built*	*NRHP Eligibility*	*Proposed Action*
Demonstration of Operational Microreactor Experiments (DOME)	MFC-767	1963	Eligible	Indoor testing/fueling
Hot Fuels Examination Facility (HFEF)	MFC-785	1972	Eligible	Indoor fueling
Radioactive Scrap and Waste Facility (RSWF) Main Structure Area and Staging/Storage Area	MFC-771	1965	Not Eligible	Storage
Outdoor Radioactive Storage Area (ORSA)	MFC-797	1985	Not Eligible	Storage
Transient Reactor Test Facility (TREAT)	MFC-720	1959	Eligible	Possible location for final assembly and fuel loading

Key: MFC = Materials and Fuels Complex; NRHP = National Register of Historic Places

3.6.3 Paleontological Resources

Paleontological resources are fossils of plants or animals from a former geologic age used to investigate prehistoric biology and ecology. Survey and evaluation for paleontological remains within the INL Site boundaries have identified several fossils that suggest that the region contains varied paleontological resources. Analyses of these materials and site locations suggest that these types of resources are found in areas of basalt flows, particularly in sedimentary interbeds or lava tubes within local lava flows, and in some wind and sand deposits. Other and more specific areas in which these resources are likely to occur are in the deposits of the Big Lost River, Little Lost River, Birch Creek, and Lake Terreton and playas. Vertebrate and invertebrate animals, pollen, and plant fossils have been discovered in caves, in lake sediments, and in alluvial gravels along the Big Lost River, where 24 paleontological localities have been identified in published data. Vertebrate fossils include mammoth and camel remains, as well as a horse fossil identified in a borrow source near the CFA (NRC, 2004). Paleontological resources are not governed by the same set of laws that apply to cultural resources, but are managed in the same way under the *INL Cultural Resources Management Plan* (INL, 2016b).

3.7 Infrastructure

Site infrastructure includes those resources and services required to support planned construction and operation activities and the continued operation of existing facilities. For the purposes of this EIS, infrastructure is defined as electricity, fuel, water, and sewage. The ROI for infrastructure includes those items and their distribution systems located at MFC and CITRC. This section describes infrastructure applicable to the proposed Project Pele.

Table 3.7-1 summarizes capacities and characteristics of the INL Site's utility infrastructure. Sections 3.9, *Waste and Spent Nuclear Fuel Management*, and 3.13, *Traffic*, separately address waste management and transportation infrastructure, respectively.

Table 3.7-1. INL Site-wide Infrastructure Characteristics

Resource	Site Usage	Site Capacity
Electricity		
Energy Consumption (megawatt-hours per year)	186,255	481,800 [a]
Peak Load (megawatts)	36	55 [a]
Fuel		
Natural Gas (cubic feet per year)	3,149,227	Not limited [b]
Fuel Oil for Heating (gallons per year)	902,001	Not limited [b]
Diesel Fuel (gallons per year)	571,028	Not limited [b]
Gasoline (gallons per year)	262,909	Not limited [b]
Propane (gallons per year)	627,007	Not limited [b]
Water (gallons per year)	754,699,070	11,400,000,000 [c]

Source: (DOE, 2020a)

Notes:

[a] Limited by contract with the Idaho Power Company. Site capacity is currently under negotiation; once finalized, peak load capacity is expected to be in excess of 100 megawatts.

[b] Capacity is limited only by the ability to ship resources to the site.

[c] Water right allocation.

3.7.1 Electricity

Commercial electric power is delivered by contract with the Idaho Power Company to supply the operating areas of the INL Site by way of an extensive power transmission and distribution system (see **Figure 3.7-1**). Off-site power is provided via two 230-kV transmission lines from Rocky Mountain Power's Antelope substation. At the Antelope substation, the voltage is stepped down to 138 kV, then transmitted to the DOE-owned Scoville substation via two redundant feeders. The Antelope substation feeds the Scoville substation via three different transformers, a pair of 161- to 138-kV transformers, and a single 230- to 161-kV transformer. The Scoville substation is the starting and end point of the 138-kV INL Site loop (DOE, 2020a).

The INL Site power system consists of nine substations, with one more scheduled for construction, and nearly 70 miles of aboveground 138-kV-rated high-voltage transmission lines with a distribution system ranging in voltage from 13.8 to 2.4 kV. Much of the system is looped, which provides a reliable and redundant source of power and a loop capacity of 50 megawatts (MW) (INL, 2015b; INL, 2021e).

The current contract between the INL Site and Idaho Power Company allows for a total power demand of up to 50,000 kW (50 MW), but can be increased to 55,000 kW (55 MW) if advance notice is provided. Power demand in excess of this would need to be negotiated with the Idaho Power Company.

Electrical energy available to the INL Site is about 481,800 megawatt-hours (MWh) per year, based on the contract load limit of 55,000 kW (55 MW) for 8,760 hours per year. Current electrical energy consumption at the INL Site is 186,255 MWh annually and the recorded peak load was about 39 MW (DOE, 2020a).

Electricity at MFC and CITRC is supplied by the INL Site's transmission loop system. Annual electric consumption at MFC is just over 35.4 MWh with a peak demand of 9,302 kW. Annual electric consumption at CITRC is just over 2.4 MWh, with a peak demand of 700 kW (INL, 2021a). Facility specific electricity consumption is not available for CITRC, as individual sites do not have electric meters.

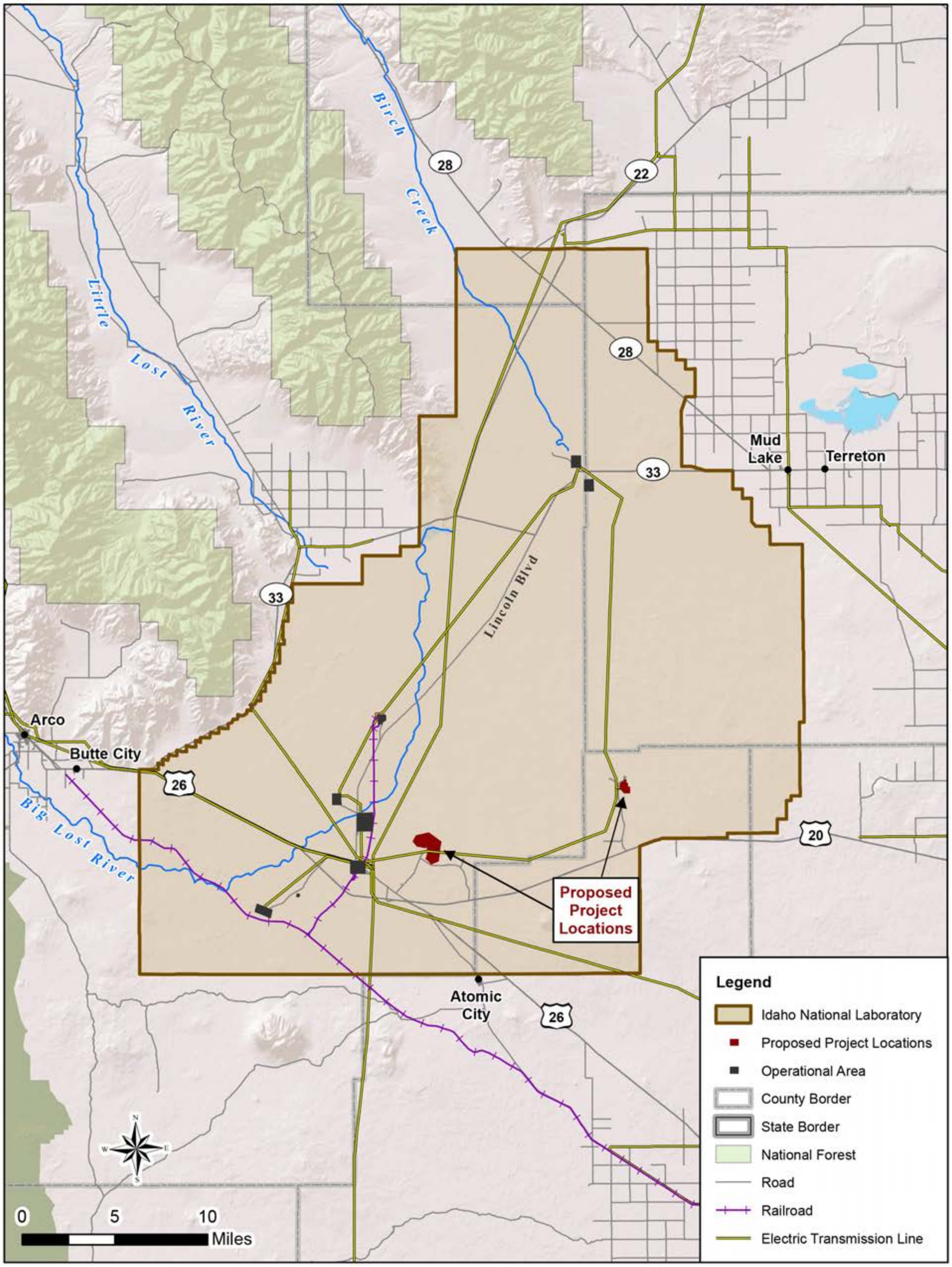


Figure 3.7-1. Idaho National Laboratory Infrastructure

3.7.2 Fuel

Fuel consumed at the INL Site includes natural gas, fuel oil, diesel fuel, gasoline, and propane. All fuels are transported to the site for use and storage. There are no gas or oil lines on the INL Site, although individual facilities may utilize propane or fuel storage tanks (INL, 2015b). Fuel storage is provided for each facility and inventories are restocked as needed. In 2019, INL Site-wide natural gas consumption was about 3,149,200 cubic feet, total fuel oil consumption was about 902,000 gallons, total diesel fuel consumption was about 571,000 gallons, total gasoline consumption was about 262,900 gallons, and total propane consumption was about 627,000 gallons (see **Table 3.7-1**) (DOE, 2020a).

3.7.3 Water

The SRPA supplies all water used at the INL Site. The two wells at MFC withdrew 26,754,578 gallons, or about 3.5 percent of the total water withdrawn across the INL Site (INL, 2018). Typically, well water is pumped to a 400,000-gallon primary storage tank and then through the distribution system for potable, service, and fire-protection use. A second 400,000-gallon water storage tank, reserved for fire protection, is maintained at full capacity. Accurate potable water flow information is difficult to determine. MFC's water supply demands average 50 to 60 gallons per minute and the system flows from 20 to 225 gallons per minute throughout the year. Water demand spikes are most likely due to firewater testing (INL, 2019b).

The existing firewater supply system for MFC consists of a looped network of buried 6-, 8-, 10-, 12-, and 14-inch diameter fire mains. The lead-ins to the buildings are typically 6 inches in diameter. Piping materials differ depending on the era of installation and includes cast iron, ductile iron, cement-lined ductile iron, and polyvinyl chloride. The system is designed so that if any segment of the firewater main is isolated, water can be supplied through an alternate flow path (INL, 2019b).

CITRC's water supply system is pulled from two deep wells housed in buildings PER-602 and PER-614. These deep wells can be pumped at 400 gallons per minute and 550 gallons per minute, respectively. The two pumps feed a 416,000-gallon water tank (PER-768) and the CITRC buildings through an underground combined main. Water usage at CITRC totaled about 5.1 million gallons in both 2019 and 2020 (INL, 2021a).

3.7.4 Sanitary Sewer

MFC has an existing sanitary sewer system to collect and treat domestic wastewater from the facilities. The majority of the facilities are served by a collection system consisting of gravity sewers and several lift stations and force mains. Collected wastewater is conveyed to one of two lift stations that pump the wastewater through a 4-inch high-density polyethylene force main to three total containment sewage lagoons for final evaporation and disposal. Some small areas of MFC are served by local on-site subsurface disposal systems (i.e., drain fields) and are independent from the primary collection system. The existing MFC wastewater lagoons were designed for flows of about 14,950 gallons per day. Based on information provided by MFC staff in 2017, the average daily flow to the lagoons was about 7,840 gallons per day (INL, 2019b). CITRC does not have a central sanitary sewer system, but has three operating septic tanks with drainage fields that are not metered (INL, 2021a).

3.7.5 Industrial Wastewater

MFC operates an industrial wastewater collection system consisting of gravity pipelines, ditches, and structures located throughout MFC. Collected wastewater is conveyed to an industrial wastewater pond, permitted by IDEQ, located outside the perimeter security fence near the northwest corner of the facility. MFC currently generates 7 to 8 million gallons of industrial wastewater per year; the permit from the IDEQ for the existing industrial wastewater pond allows 17 million gallons per year (INL, 2019b). There are no industrial wastewater discharges at CITRC (INL, 2021a).

3.8 Noise

The ROI for noise includes the proposed construction area at CITRC and a 0.5-mile zone from the edge of the proposed construction area. As stated in Section 3.0, *Introduction*, activities planned at MFC (final assembly, reactor fueling activities, startup testing, PIE, and temporary storage) would occur within existing facilities and infrastructure that are currently utilized for similar activities and would not require facility improvements or generate noise levels outside of the existing noise environment within these locations.

Existing Noise Environment

The Noise Control Act of 1972 (42 U.S.C. 4901) directs Federal agencies to comply with applicable Federal, state, interstate, and local noise control regulations. The primary responsibility of addressing noise pollution has shifted to state and local governments. In 1974, EPA published its document entitled *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, which evaluated the effects of environmental noise with respect to health and safety (EPA, 1974). The document provides information for state and local agencies to use in developing their ambient noise standards. As set forth in the publication, the day-night average sound level of 55 A-weighted decibels (dBA) outdoors and 45 dBA indoors is the threshold above which noise could cause interference or annoyance (EPA, 1974). Except for the prohibition of nuisance noise, neither the State of Idaho nor local governments have established any regulations that specify acceptable community noise levels applicable to the INL Site.

Noise sources within the INL Site include industrial facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, intercom paging systems, construction and materials-handling equipment, and vehicles). The noise level at the INL Site ranges from 10 dBA for the rustling of grass to 115 dBA, the upper limit for unprotected hearing exposure established by Occupational Safety and Health Administration (OSHA), from the combined sources of industrial operations, construction activities, and vehicular traffic, including aircraft (INL, 2021a). Most INL Site industrial facilities are far enough from the INL Site boundary that noise levels from these sources are not measurable or are barely distinguishable from background levels at the boundary (DOE, 2020a). Of these noise sources, the primary existing noise at the INL Site results from transportation-related activities, including transportation of people and materials to and from the site via buses, trucks, private vehicles, helicopters, and freight trains. During a typical workweek, the majority of the employees are transported to various work areas at the INL Site by buses covering about 70 routes. Approximately 1,200 private vehicles also travel to and from the INL Site daily. Rail transport for the INL Site typically occurs no more than one train per day and usually less than one train per week. Homeland Security's occasional explosive tests at the INL Site and detonation of unexploded ordnance also contribute to the noise at the INL Site (DOE, 2020a). Noise measurements were obtained in the spring season of 2020 at 23 different locations outside of facilities that could provide support for Project Pele operations. Noise readings ranged from 42.3 dBA to 65.9 dBA and were relatively consistent throughout the day (INL, 2021a).

CITRC is about 5.9 miles from the INL Site boundary. The Bingham County parcel data indicates the land directly adjacent to this portion of the INL Site border is owned by BLM. Analysis of aerial imagery indicates that the land is uninhabited (Google Earth, 2021). Noise measurements performed at CITRC ranged from 60 to 62 dBA, which was expected for ambient noise levels in remote areas without equipment or other noise sources (DOE, 2020a). The closest noise-sensitive receptors include a small development of home sites in Atomic City, which is about 6.5 miles from CITRC. Atomic City includes the Atomic Motor Raceway and is located 1.0 mile from US-26. The closest Federal or state park within 50 miles is the Craters of the Moon National Monument and Preserve at about 23 miles west southwest of CITRC. The Big Southern Butte is a nearby recreational area within about 12 miles of CITRC.

3.9 Waste and Spent Nuclear Fuel Management

This section describes the current average annual "baseline" generation rates and management practices for the type of waste that would be generated as a result of the Proposed Action. The ROI for waste management includes areas within the INL Site boundaries where waste is generated and managed prior to shipment off-site for disposition. Off-site disposition at non-INL Site facilities have been previously addressed through permitting and other regulatory documentation. There would be no additional impacts, including exposure to the off-site public or on-site workers associated with waste sent from the INL Site to these locations for disposition beyond those previously analyzed. All waste disposition actions would comply with the licenses, permits, and waste acceptance criteria applicable to the facilities. Small quantities of LLW, MLLW, and transuranic waste are expected to be generated by the Proposed Action, as well as minimal amounts of nonhazardous solid waste and recyclable materials. Additionally, while not defined as a waste under regulations, SNF would also be generated and is discussed further in this section. No high-level radioactive waste (HLW) or hazardous waste would be generated from the Proposed Action.

3.9.1 Low-Level Radioactive Waste

DOE Order 435.1, *Radioactive Waste Management*, was issued to ensure that all DOE radioactive waste is managed in a manner that protects the environment, worker, public safety, and health. Change 3 of this order, effective January 11, 2021, includes the requirements that must be met by DOE in managing radioactive waste. LLW is generated as a result of current activities at the INL Site, including those related to D&D. GTCC-like radioactive waste, considered a form of LLW, is anticipated to be generated at the ATR Complex in 2021 from the Cybercore Integration Center, and be managed and stored at the INL Site. GTCC-like waste is not generated often at the INL Site, but has been generated in small amounts in the past. Currently, there is no disposal pathway identified for GTCC-like waste stored at the INL Site, which was pre-approved by DOE in accordance with DOE Order 435.1. The INL Site ships most of its LLW off-site to commercial disposal facilities or the NNSS for disposal. On-site disposal facilities are used for LLW that meet very specific criteria; the Idaho CERCLA Disposal Facility only receives wastes from qualified cleanup actions and the Remote-Handled LLW Disposal Facility receives only remote-handled waste (with a package dose rate greater than 200 millirem per hour) in specific types of stainless-steel packaging. In many cases when packaging LLW that is in liquid form, more durable packaging for storage and shipment is used than when packaging LLW in a solid state. All future LLW scrap shipments from the Naval Reactor Facility will go to the Remote-Handled LLW Disposal Facility. **Table 3.9-1** presents the latest available 5-year annual generation of LLW at the INL Site.

Table 3.9-1 Five-Year Annual "Baseline" Generation of Low-Level Radioactive Waste (LLW) at Idaho National Laboratory (2015–2019)

Year	***Annual LLW Generation (Cubic Meters)***
2015	9,900
2016	12,000
2017	4,300
2018	6,900
2019	10,000
Average LLW Generated	**8,600**

Source: (INL, 2020d)

Note: As a result of the global pandemic in 2020, Idaho National Laboratory LLW generation was substantially lower in 2020 than in previous years and was not used because it was not representative of the normal historic values.

3.9.2 Mixed Low-Level Waste

The Federal Facilities Compliance Act (FFCA) requires the preparation of site treatment plans for the treatment of mixed waste stored at DOE facilities for greater than 1 year. Mixed waste contains both hazardous and radioactive components. INL's FFCA Site Treatment Plan was approved by the State of Idaho on November 1, 1995, and is updated annually. That plan outlines DOE's proposed treatment strategy for the INL Site's mixed-waste streams. The Mixed Waste Management Plan specifies the requirements for management of the MLLW in accordance with the State of Idaho requirements for Resource Conservation and Recovery Act (RCRA) hazardous constituents and DOE requirements for the radiological constituents. MLLW is characterized and packaged, consistent with the applicable waste acceptance criteria and shipped in accordance with DOT requirements. MLLW is shipped off-site through commercial waste processing vendors for treatment and then to the Energy*Solutions* LLW Disposal Facility near Clive, Utah, Waste Control Specialists or the DOE NNSS (located 65 miles northwest of Las Vegas, Nevada) for disposal. (Waste processing vendors could include Energy*Solutions* LLW and Waste Control Specialists as they have some waste processing capability contiguous to their disposal facilities.) **Table 3.9-2** lists the volume of MLLW generated over the latest 5 years of data availability.

Table 3.9-2. Five-Year Annual "Baseline" Generation of Mixed Low-Level Radioactive Waste (MLLW) at Idaho National Laboratory (2015–2019)

Year [a]	*Annual MLLW Generation (cubic meters)*
2015	2,800
2016	3,300
2017	8,700
2018	4,700
2019	3,700
Average MLLW Generated	**4,600**

Source: (INL, 2020d)
Note:
[a] As a result of the global pandemic in 2020, Idaho National Laboratory MLLW generation was substantially lower in 2020 than in previous years and was not used because it was not representative of the normal historical values.

3.9.3 Transuranic Waste

On October 16, 1995, DOE, the U.S. Navy, and the State of Idaho entered into an agreement (the Idaho Settlement Agreement) that guides management of SNF and radioactive waste at the INL Site (DOE et al., 1995). The agreement limited shipments of DOE and Naval SNF into the state and set milestones for shipments of SNF and radioactive waste out of the state. The FFCA Site Treatment Plan requires DOE to process and ship all waste stored as TRU waste on the INL Site as of October 17, 1995. All of these wastes were to be shipped out of Idaho by December 31, 2018. In February 2014, the shipment of TRU waste was curtailed due to the suspension of WIPP operations in Carlsbad, New Mexico. During that time, INL personnel continued to characterize and package TRU waste for shipment and disposal. In April 2017, shipments resumed to the WIPP facility.

The Idaho Cleanup Project manages and operates a number of projects to facilitate the disposition of radioactive waste as required by the Idaho Settlement Agreement and FFCA Site Treatment Plan. The Idaho Cleanup Project performs retrieval, characterization, treatment, packaging, and shipment of TRU waste currently stored at the INL Site. The vast majority of the waste processed at the INL Site resulted from the manufacture of nuclear components at DOE's Rocky Flats Plant in Colorado. This waste is contaminated with TRU radioactive elements (primarily plutonium). **Table 3.9-3** lists the volume of TRU generated over the latest 5 years of data availability.

Table 3.9-3. Five-Year Annual "Baseline" Generation of Transuranic Waste (TRU) at Idaho National Laboratory (2015–2019)

Year [a]	*Annual TRU Generation (cubic meters)*
2015	1,700
2016	1,600
2017	870
2018	740
2019	650
Average TRU Generated	**1,100**

Source: (INL, 2020d)
Note:
[a] As a result of the global pandemic in 2020, Idaho National Laboratory transuranic waste generation was substantially lower in 2020 than in previous years and was not used because it was not representative of the normal historical values.

3.9.4 Spent Nuclear Fuel

SNF is currently generated and stored at the INL Site. SNF is managed by the Idaho Environmental Coalition, the Idaho Cleanup Project contractor at INTEC; the Naval Nuclear Propulsion Program at the Naval Reactors Facility; and Battelle Energy Alliance, the INL Site's contractor at the ATR Complex and MFC. All SNF is managed and stored in compliance with applicable regulations, requirements, and other agreements. The 1995 Idaho Settlement Agreement (DOE, 1995a) put into place milestones for the management of radioactive waste and SNF at the INL Site.

3.9.5 Nonhazardous Solid Waste and Recyclable Materials

Nonhazardous solid waste and recyclable materials are routinely generated as a result of current routine and D&D activities. Nonhazardous solid waste is primarily disposed of at the INL Site's CFA Landfill Complex. The INL Site's CFA Landfill Complex is operated in accordance with State of Idaho regulations. The remaining capacity of the INL Site's CFA Landfill Complex is about 3.4 million cubic meters. Nonhazardous solid waste items that cannot be disposed at the INL Site's CFA Landfill Complex are sent off-site to a commercial disposer. As much as possible, recyclable materials are segregated from the solid waste stream in accordance with waste minimization and pollution prevention protocols.

3.10 Human Health – Normal Operations

The impact on human health during normal facility operations addresses the potential impacts from exposure to ionizing radiation and chemicals. Potential human health impacts from exposure to radiation from normal operational conditions is considered for both an individual and the population as a whole for both the public and site workers; this constitutes the ROI. For the existing environment, the public population is considered to be all people living within 50 miles of the operational areas at the INL Site. The MEI (i.e., the maximally exposed individual) is considered to be a hypothetical person who could receive the maximum possible dose from releases at the INL Site. In addition, for workers, the potential human health impacts associated with exposure to workplace chemicals are considered.

3.10.1 Radiation Exposure and Risk

DOE monitors radiation in the environment and exposure of workers and calculates the radiation doses of members of the off-site general public and on-site workers from operations at the INL Site. **Table 3.10-1** presents data on radiation doses to the public for the years 2014 through 2019. The maximum radiation dose to an off-site member of the public during this period as a result of on-site facility operations was estimated to be 0.53 millirem per year (DOE-ID, 2016). The risk of developing a latent cancer fatality (LCF) from this dose is extremely small, less than 1 in a million. The calculation of this total dose considers the maximum dose to an individual from air emissions and from the consumption of wildlife harvested in the vicinity of the INL Site. The maximum dose to an off-site individual does not include a contribution from drinking water. Although tritium has been detected in three USGS monitoring wells along the southern INL Site boundary, there are no drinking water wells near this location. This groundwater contamination does not contribute to a public dose, either individually or collectively. The average annual dose to an individual from INL Site operations is much less than 1 percent of the average dose of 382 millirem per year from exposure to natural background radiation (e.g., cosmic gamma, internal, and terrestrial radiation) for someone living on the Snake River Plain (DOE-ID, 2021c).

Two dose limits are relevant to the exposure of an individual member of the public near a DOE site. As shown in **Table 3.10-1**, all of the doses to the MEI from the operations at the INL Site are well below the DOE dose limit for a member of the general public, which is 100 millirem per year from all pathways, as prescribed in DOE Order 458.1 (DOE, 2020b). The table also shows that the dose from the air pathway is well below the NESHAP dose limit for emissions from DOE facilities of 10 millirem per year (40 CFR 61, Subpart H).

Table 3.10-1. Annual Radiation Doses to the Public from Idaho National Laboratory Operations, 2014–2019

Year	*Maximally Exposed Individual*				*Population* [g]		
	Dose (millirem per year)			*LCF Risk*	*Estimated Population Dose (person-rem)*	*LCFs* [b]	*Estimated Dose from Background (person-rem)*
	Airborne Radionuclides [a]	*Consumption of Waterfowl*	*Total*	*Total* [b]			
2019	0.056	0.004	0.06	c	0.048	0 (3×10^{-5})	131,000
2018	0.01	0.016	0.026	c	0.0075	0 (5×10^{-6})	129,000
2017	0.008	0.046	0.054	c	0.011	0 (7×10^{-6})	127,000
2016	0.014	NA [d]	0.014	c	0.044	0 (3×10^{-5})	126,000
2015	0.033	0.49	0.53	c	0.61	0 (4×10^{-4})	125,000
2014	0.037	0.032	0.069	c	0.61	0 (4×10^{-4})	124,000
Average [h]	**0.026**	**0.12** [e]	**0.15** [e]	c	f	f	

Sources: (DOE-ID, 2015; DOE-ID, 2016; DOE-ID, 2017; DOE-ID, 2018b; DOE-ID, 2019e; DOE-ID, 2021c)

Key: LCF = latent cancer fatality; NA = not available

Notes:

[a] DOE (DOE, 2020b) and the EPA (40 CFR 61 Subpart H) limit the dose to a member of the public from airborne radionuclides to 10 millirem per year.

[b] Calculated using a dose conversion factor of 6×10^{-4} (i.e., 0.0006) LCF per rem. See Chapter 9, *Glossary*, for an explanation of scientific notation (e.g., 3×10^{-5}).

[c] The probability of this individual contracting a fatal cancer is less than 1 in a million.

[d] No data was collected for waterfowl in 2016.

[e] The average is calculated without year 2016 data because consumption of waterfowl was not included in that year.

[f] An average is not presented because the results for individual years are not all calculated on the same basis.

[g] The population within 50 miles of the INL Site (as identified in the Annual Site Environmental Reports) was assumed to be 318,528 in 2014, increasing to 342,761 in 2019.

[h] Due to rounding, sums and products may not equal those calculated from table entries.

The population dose is the sum of average individual doses to the entire population within 50 miles of the INL Site. **Table 3.10-1** shows that over the years 2014 through 2019, the population dose from operations at the INL Site ranged from 0.011 to 0.61 person-rem.[46] No LCFs would be expected from these doses. The decrease in population dose between 2015 and 2016 is primarily due to a change in the way population doses were estimated. Prior to 2016, the highest dose to an individual within an area (a Census division) was applied to all individuals within the area. From 2016 on, the average dose to a person within an area was applied to the total population of the area. Population doses from background sources of radiation are also presented in **Table 3.10-1**. The doses from INL Site operations are a small fraction of

[46] rem = roentgen equivalent man (a measure of radiation)

the background doses. Changes in the estimated dose from background are the result of the population growth within 50 miles of the INL Site, from an estimated 318,528 in 2014 to 342,761 in 2019 (DOE-ID, 2015; DOE-ID, 2021c).

Worker doses at the INL Site during 2019 (DOE, 2021b-A) result from:

- Work at the ATR Complex, including experiment system operations, plant maintenance and modifications, routine ATR power and outage operations, and Research and Development Operations/Laboratory support;
- Activities at MFC including maintenance and upgrades at the analytical and radiochemistry laboratories, treatment and storage for waste repackaging, benchtop and glovebox operations, decontamination efforts; and
- Waste handling, consolidation and shipment, decontamination work, and radiography operations.

Of the workers at the INL Site—6,836 in April of 2020 (DOE, 2020c)—less than 20 percent received a measurable (detectable) dose during the period from 2014 through 2019 (DOE, 2015a; DOE, 2018b; DOE, 2019b; DOE, 2021b-A). The average collective worker dose during this time was 90.6 person-rem per year with no LCFs expected (calculated value of 0.05). Considering only the workers who received a measurable dose (on average 1,254 per year and ranging between 1,174 and 1,368 workers each year), the average annual dose to a worker was 72 millirem. No single worker received a dose greater than 750 millirem during this period (DOE, 2015a; DOE, 2017a; DOE, 2018b; DOE, 2019b; DOE, 2021b-A; DOE, 2016d). To protect workers from impacts from radiological exposure, 10 CFR 835 imposes an individual dose limit of 5,000 millirem in a year. In addition, worker doses must be monitored and controlled below the regulatory limit to ensure that individual doses are less than an administrative limit of 2,000 millirem per year (DOE, 2017b), and maintained as low as reasonably achievable. **Table 3.10-2** presents the INL Site worker dose information for the years 2014 to 2019.

Table 3.10-2. Annual Radiation Doses to Idaho National Laboratory Workers from Operations, 2014–2019

Year	***Collective Dose (person-rem)***	***Workers with a Measurable Dose***	***Exposed Worker Population LCF Risk [a]***	***Average Dose Among Workers with a Measurable Dose (rem) [b]***
2019	76.5	1,203	0 (0.05)	0.064
2018	86.3	1,368	0 (0.05)	0.063
2017	78.9	1,177	0 (0.05)	0.067
2016	92.7	1,273	0 (0.06)	0.073
2015	123.2	1,331	0 (0.07)	0.093
2014	86.2	1,174	0 (0.05)	0.073
Average [b]	**90.6**	**1,254**	**0 (0.05)**	**0.072**

Sources: (DOE, 2015a; DOE, 2018b; DOE, 2019b; DOE, 2021b-A)
Key: LCF = latent cancer fatality, rem = roentgen equivalent man
Notes:
[a] Calculated using a dose conversion factor of 6×10^{-4} (i.e., 0.0006) LCF per person-rem. Values in parentheses are calculated values. A value of less than 0.5 is considered to result in no LCFs.
[b] Due to rounding, sums and products may not equal those calculated from table entries.

Some INL Site workers potentially receive a dose from consumption of drinking water from wells supporting the CFA. The primary source of contamination in these wells is due to waste disposal at upgradient facilities. Each of the 500 CFA workers served by these wells in 2019 could receive a dose of 0.131 millirem (DOE-ID, 2021c), which is well below the EPA standard of 4 millirem per year from drinking water systems.

3.10.2 Nonradiological Health and Safety

Nonradiological exposures at the INL Site are controlled through programs intended to protect workers from normal industrial hazards. These programs are controlled by the safety and health regulations for DOE contractor workers governed by 10 CFR 851, which establishes requirements for worker safety and health programs to ensure that DOE contractor workers have a safe work environment. Included are provisions to protect against occupational injuries and illnesses, accidents, and hazardous chemicals.

DOE monitors worker safety through the Computerized Accident Incident Reporting System. The system is a computerized database used to collect and analyze DOE reports of injuries, illnesses, and accidents that occur during facility operations. Two metrics generated for the tracking of injury, illness, and accident rates are the "days away, restricted or on-the-job transfer" (DART) rate and the Total Recordable Cases (TRC) rate. The DART rate is an indication of the instances of injuries, illnesses, and accidents that result in, at worst, lost work days or days lost due to transfer or worker job restrictions. The TRC rate is an indication of the total number of work-related injuries or illnesses that resulted in death, days away from work, job transfer or restriction, or recordable case as identified in the OSHA Form 300. For the years 2016 through 2020, the INL Site DART and TRC rates (incidents per 200,000 work hours or the equivalent of 100 full-time workers) were 0.62 and 1.16, respectively. For the years 2016 through 2020, the DART and TRC rates for all DOE facilities were a combined average 0.42 and 0.86, respectively (DOE, 2021c-B).

3.10.3 Regional Cancer Rates

The National Cancer Institute publishes national, state, and county incidence rates for various types of cancer (National Cancer Institute, 2021). The published information does not provide an association of these rates with their causes (e.g., specific facility operations and human lifestyles). **Table 3.10-3** presents incidence rates for the United States, Idaho, and the counties that account for most of the population within 50 miles of the INL Site. Additional information about cancer profiles in the vicinity of the INL Site is available in State Cancer Profiles, Incidence Rates Tables (National Cancer Institute, 2021). Not all types of cancer are presented in this table; totals for individual cancers will not sum to the all cancer values.

Table 3.10-3. Cancer Incidence Rates for the United States, Idaho, and Counties Adjacent to Idaho National Laboratory, 2013–2017

Region	*Cancer Incidence Rates [a]*						
	All Cancers	*Thyroid*	*Breast (female)*	*Lung and Bronchus*	*Leukemia*	*Prostate*	*Colon and Rectum*
United States	449	14.3	126	58.3	14.2	104.5	38.4
Idaho	442	15.1	127	49.5	16.5	105.3	35.3
Bannock County	372	11.0	109	37.2	16.2	76.9	29.2
Bingham County [b]	416	29.0	108	37.8	14.4	96.0	38.6
Blaine County	426	c	146	30.8	18.8	123	22.0
Bonneville County [b]	440	29.5	122	37.2	16.8	117	34.3
Butte County [b]	477	c	c	c	c	c	c
Clark County [b]	c	c	c	c	c	c	c
Jefferson County [b]	407	28.6	76	38.8	c	123	36.0
Madison County	375	31.4	101	c	19.2	107	38.4
Power County	364	c	128	35.5	c	75.4	c

Source: (National Cancer Institute, 2021)

Notes:

[a] Age-adjusted incidence rates; cases per 100,000 persons per year.

[b] Portions of the INL Site are located in Bingham, Bonneville, Butte, Clark, and Jefferson Counties. The Materials and Fuels Complex (MFC) is in Bingham County, the Critical Infrastructure Test Range Complex (CITRC) is in Butte County.

[c] Data have been suppressed by the National Cancer Institute to ensure the confidentiality and stability of rate estimates when the annual average count is three or fewer cases.

3.11 Human Health – Facility Accidents

3.11.1 Emergency Preparedness

This section discusses the emergency management program at DOE sites including the INL Site. This program has been developed and maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. Emergency management programs address emergency planning, training, preparedness, and response for both on- and off-site personnel.

DOE Order 151.1D, *Comprehensive Emergency Management System,* describes detailed requirements for emergency management that DOE must implement (DOE, 2016e). Each DOE site, facility, and activity, including the INL Site, establishes and maintains a documented emergency management program that implements the requirements of applicable Federal, state, and local laws, regulations, and ordinances for fundamental worker safety programs (e.g., fire, safety, and security). In addition, each DOE site, facility, and activity containing hazardous materials, such as radioactive materials or certain chemicals that do not fall under the purview of fundamental worker safety programs, establishes and maintains an Emergency Management Hazardous Materials Program. Finally, each site that receives or initiates shipments managed by the Office of Secure Transportation must be prepared to manage an emergency involving such a shipment, should that emergency occur on-site.

As required in DOE Order 151.1D, each DOE site, facility, and activity must establish and maintain an emergency management program that complies with the Emergency Management Core Program requirements. In addition to the requirements of the Emergency Management Core Program, the applicable emergency management program requirements contained in attachments to DOE Order 151.1D must be implemented. These requirements involve providing specialized training and equipment for local fire departments and hospitals, state public safety organizations, and other government entities that may participate in response actions, as well as specialized assistance teams. These requirements also provide for notification of local governments whose constituencies could be threatened in the event of an accident. Broad ranges of drills and exercises from facility-specific exercises to regional responses are conducted to ensure the systems are working properly. In addition, there are internal and external audits of the emergency management program. Lessons learned from exercises and audits are used to continuously strengthen INL's emergency management program.

The emergency management system at the INL Site includes emergency response facilities and equipment, trained staff, and effective interface and integration with off-site emergency response authorities and organizations. INL personnel maintain the necessary apparatus, equipment, and a state-of-the-art Emergency Operations Center in Idaho Falls to respond to emergencies, not only at the INL Site, but throughout the local communities. The DOE-Idaho (DOE-ID) Emergency Management Program administrator is responsible for coordinating federal assets and overseeing the INL Offsite Emergency Planning Program (INL, 2020e).

A readiness review will be completed prior to operating the microreactor to demonstrate that there is a reasonable assurance that operations are performed safely and provide adequate protection of workers, the public, and the environment. This assessment includes, but is not limited to, an evaluation of safety management programs; operational interfaces; selection, training, and qualification of operations and support personnel; implementation of facility safety documentation; programs to confirm and periodically reconfirm the condition and operability of all safety and support systems; procedures; emergency management; and conduct of operations processes.

3.11.2 Accident History

This section discusses the accident history at the INL Site specific to nuclear reactor accidents. Accident details are only presented when the accident injured personnel or involved a gas-cooled reactor. One event included an incident involving fuel melting at the EBR-I, but the event did not injure personnel and EBR-I was a sodium-cooled reactor.

The only nuclear reactor accident that occurred at the INL Site (called the National Reactor Testing Station at the time of the accident) and that met the above criteria involved the Stationary Low-Power Reactor Number One (SL-1) in 1961. The SL-1 reactor was a U.S. Army experimental nuclear power reactor. The purpose of the reactor was to provide electrical power and heat for remote military facilities. The SL-1 reactor generated electricity for the first time on October 24, 1958. The reactor would be operated for periods ranging between 1 and 6 weeks and then shut down for repairs and installation of improvements. During a shutdown that began on December 23, 1960, the control rods were disconnected from the control rod drive mechanisms. In the evening of January 3, 1961, the crew was to reconnect the control rods to the control rod drive mechanisms. While attempting to reconnect the control rods, the center control rod was improperly withdrawn and the reactor underwent a steam explosion and meltdown. Details of the accident are described in the report *Proving the Principle: A History of the Idaho National Engineering and Environmental Laboratory, 1949-1999* (Stacy, 2000). Some emergency planning had been done for the National Reactor Testing Station but the plans had not considered an event like the SL-1 accident. Considerable improvements were made in emergency planning as a result of the SL-1 accident. Current emergency planning for DOE facilities is under the direction of DOE Order 151.1D (DOE, 2016e).

3.12 Human Health – Transportation

Section 3.13, *Traffic*, discusses the affected environment for INL Site-specific traffic conditions, including regional transportation infrastructure that would be used to transport project components. Human health considerations associated with transport of components of Project Pele are evaluated in Section 4.12, *Human Health – Transportation*.

3.13 Traffic

3.13.1 Transportation Infrastructure

The ROI for the transportation infrastructure includes two U.S. interstate highways, two U.S. routes, three Idaho state highways, and the INL Site on-site road systems.

Road performance is measured using level of service (LOS) ratings. LOSs are qualitative measures used to relate the quality of motor vehicle traffic services. LOS analyzes roadways and intersections by categorizing traffic flow and assigning quality levels of traffic based on performance measures like vehicle speed, density, and congestion. LOS ratings range from “A” to “F,” with “A” being the best travel conditions and “F” being the worst. LOS is an average service rather than a constant state. For example, a highway could be at LOS D for the morning (a. m.) peak hour, have traffic consistent with LOS C most days, and come to a halt once every few weeks under LOS E or F (DOE, 2020a).

Regional

- U.S. Interstate 15 (I-15), a north-south route, connects several cities along the Snake River and is located about 25 miles east of the INL Site.
- I-86 intersects I-15 about 40 miles south of the INL Site and provides a primary linkage from I-15 to points west.

- US-20 is one of two main access routes to the southern portion of the INL Site and MFC.
- US-26 is the second of two main access routes to the southern portion of the INL Site.
- Idaho State Highways 22, 28, and 33 pass through the northern portion of the INL Site, with State Route 33 providing access to the northern INL Site facilities (DOE, 2016c).

The majority of road segments in the vicinity of the INL Site operate at LOS D or better, but the I-15 and US-20 interchange and a portion of US-26 (north of E Street in Idaho Falls) exceed LOS D threshold at certain times.

Table 3.13-1 provides the weighted average daily traffic data for selected segments of routes in the vicinity of the INL Site. The weighted average of each route is calculated by taking each segment of road from the beginning to the end (the total mileage of the segment) and dividing it by the total mileage of the total route.

Table 3.13-1. Annual Average Daily Traffic on Routes in the Vicinity of Idaho National Laboratory

Route	*Daily Traffic Number of Vehicles (weighted average)*
U.S. Highway 20 – Idaho Falls to the INL Site	2,500
U.S. Highway 26 – Blackfoot to the INL Site	1,200
State Route 33 – West from Mud Lake	1,600
U.S. Highway 20/26 – East from Arco to INL Site	1,900

Source: (ITD, 2020)
Key: INL = Idaho National Laboratory; U.S. = United States

INL On-Site Road Systems

MFC is in the southeastern corner of the INL Site, about 38 miles west of Idaho Falls in Bingham County. MFC is about 2.7 miles from the southern INL Site boundary and is accessed via Taylor Boulevard from US-20 (DOE, 2020a). CITRC is located in the south-central portion of the INL Site, approximately 12 miles southwest of MFC, and is accessed via Jefferson Boulevard and East Portland Avenue from US-20 and/or US-26.

The INL Site contains an on-site road system of about 170 miles of paved roads. The on-site road system also includes 18 miles of service roads that are closed to the public. Some of the paved roads are highways that pass through the INL Site and are used by the public, but security personnel and fencing strictly control public access to facilities at the INL Site. Most of the roads are adequate for the current level of normal transportation activity and could handle an increase in traffic volume.

The multipurpose haul road is a 13-mile-long nonpublic road connecting MFC and other developed areas at the INL Site. It provides a road for limited year-round use with the ability for trucks traveling in opposite directions to pass. The multipurpose haul road is currently utilized for shipments between MFC and other areas of the INL Site and could be used to ship the mobile microreactor from MFC to the selected CITRC test pad.

The INL Site contains an on-site railroad system of about 22 miles of rail. Union Pacific Railroad's main line to the Pacific Northwest follows the Snake River across southern Idaho. This line handles as many as 30 trains per day. Union Pacific Railroad provides service to the INL Site from Blackfoot into the southern portion of the INL Site where it terminates. This branch connects with a DOE-owned spur line that extends to the Naval Reactor Facility (DOE, 2020a). The rail does not extend to MFC. Rail shipments to and from the INL Site are usually limited to bulk commodities, Naval SNF, and radioactive waste.

3.13.2 Traffic Volumes and Trends

Employee Traffic

The most recent employment data at the INL Site, as of spring 2020, is 6,836 workers (DOE, 2020c). Current daily traffic into and out of MFC and CITRC is approximately 250 to 300 vehicles, with more than 95 percent of that associated with MFC (DOE, 2020a).

MFC currently employs 1,043 persons, all of which are daily commuters to the site. Of these, 131 have reported carpooling. A total of 791 people at MFC have claimed to ride the buses at least some of time; the daily average of commuters riding the bus is about 300. The balance of employees commute alone. There are approximately 70 bus routes utilized by INL employees (INL, 2021a).

There are currently no resident employees of CITRC. A total of 10 to 20 personnel per day are associated with the CITRC test pads. All of these employees drive to the site as there is not a direct bus route for CITRC employees (INL, 2021a).

Both MFC and CITRC have one primary entrance and exit road that accesses US-20. Peak travel times for employees at MFC and CITRC is from 6 to 7 a.m. for arrival and 5 to 6 p.m. for departure (INL, 2021a). Some congestion occurs during peak travel times to/from MFC and CITRC.

Materials and Waste

Based on historical data, an average of 40 trucks per week (processed through either Supply Operations or Logistics Services) arrive at the INL Site. This is consistent with shipments at the INL Site's ATR. Many of these carriers made deliveries as well as received tendered material for outgoing shipments (INL, 2021a).

Baseline waste transportation data was obtained from the INL Integrated Waste Tracking System (IWTS). A report titled *IWTS Waste Shipment/Disposal Status* for MFC, MFC–D&D, and MFC Labs, for the time period of January 1, 2017, through December 31, 2019, was generated to establish the baseline waste transportation characteristics (INL, 2021f). The generated report included data for a total of 1,014 containers shipped from MFC within the specified 3-year time period (INL, 2021f).

Shipments of material or waste to or from CITRC are minimal (INL, 2021f).

3.14 Socioeconomics

Socioeconomic characteristics described for the INL Site include population and housing, employment and the regional economy, and community services. The socioeconomic environment can be affected by changes in employment, income, and population which, in turn, can affect area resources such as housing and community services.

This section summarizes current socioeconomic conditions and local community services within the seven-county socioeconomics ROI (or region) associated with the INL Site: Bannock, Bingham, Bonneville, Butte, Clark, Jefferson, and Madison Counties. Five of the counties border the INL Site: Bingham, Bonneville, Butte, Clark, and Jefferson Counties. Bannock County is included in the ROI as it includes Pocatello, which is one of the two largest cities within 50 miles (commuting distance) of the INL Site; the other large city is Idaho Falls, located in Bonneville County. Madison County is also included in the ROI because most of the population surrounding the INL Site lies to the east, including Madison County, and nearly 2 percent of the INL Site workforce resides in this county (INL, 2021h). **Figure 2.3-1**, INL Site General Location Map, shows the counties in the ROI, surrounding towns, and major transportation routes.

Population and Housing

The ROI population totaled 326,901 in 2019, which represented a growth of 8.9 percent since 2010; this compared to a growth rate of 14 percent between 2010 and 2019 for the State of Idaho. Within the ROI, Bonneville and Jefferson Counties experienced the largest increases at 14.2 and 14.3 percent respectively, while Butte and Clark County population decreased by 10.2 and 14 percent, respectively. The two major cities in the ROI, Pocatello and Idaho Falls, had populations of 56,637 and 62,888, respectively, in 2019 (USCB, 2021a). Other population centers in the region include Rexburg and Blackfoot (greater than 10,000) and several smaller cities/communities.

Regarding the capacity of the ROI to absorb any new housing demand from the project, of the 119,395 housing units available in the ROI during 2019, 12,419 (10.4 percent) were vacant. Rental units made up 31.6 percent (33,753) of the occupied housing units in the ROI. In comparison, the total number of housing units in the State of Idaho in 2019 was 723,594, of which 93,586 (12.9 percent) were vacant (USCB, 2021b).

Employment and Income

From 2010 to 2020, the ROI experienced an average annual growth rate in the civilian labor force of just over 1 percent (from 145,027 to 162,691 jobs). The 2020 annual average unemployment rate of 4 percent for the ROI represents a significant drop from 2010 (7 percent), although it is slightly higher than in 2018 (2.5 percent), which was the lowest unemployment rate in decades. The slight increase in 2020 was likely due to the job losses associated with the COVID-19 pandemic. The 2020 average annual unemployment rate ranged from 2.7 percent in Madison County to 4.9 percent in Bannock County (Bureau of Labor Statistics, 2021).

During fiscal year (FY) 2020, INL[47] directly employed 6,836 people (DOE, 2020c), making it Idaho's seventh largest private employer and tenth largest employer when compared to all public and private businesses. INL's total impact grew by more than $336 million—a 13.2 percent increase—between FY 2019 and FY 2020. Secondary effects from INL employment in Idaho accounted for an additional 9,291 jobs for a total of 14,313 jobs, a 2.4 percent increase from 2019. INL total employment impacts increased by 55.1 percent between 2014 and 2020. INL brought funding into Idaho and generated additional value-added output of more than $1.6 billion (INL, 2021h).

Approximately 1,094 employees currently work at MFC, including government employees, subcontractors, contractors, and service employees, part-time seasonal, temporary, and occasional workers (DOE, 2020a). Based on the distribution of INL employees' residences, the largest percentage (60.4 percent) resides within Bonneville County, followed by 14.9 percent in Bingham County. Another 1.5 percent live outside of the ROI (INL, 2021h).

The INL Site is a major economic contributor to the southeastern Idaho economy. The average base salary of an INL employee was $104,157 in FY 2020. INL increased personal income to the state by $1.14 billion. INL economic impacts accounted for 1.4 percent of all personal income in the state; and INL impacts resulted in an estimated $110.8 million in state and local tax revenue (INL, 2021h). This compares to an average per capita personal income of $39,932 for the ROI in 2019, which represented a 35.4 percent increase from the 2010 level of $29,482. The 2019 average per capita personal income ranged from a low

[47] ***INL versus INL Site —*** When used alone in this EIS, the term *INL* refers to the Idaho National Laboratory as a management entity. The term *INL Site* refers to the DOE Idaho Site location, which is the physical location where the Proposed Action would take place.

of $28,780 in Madison County to a high of $50,114 in Bonneville County. The per capita income in Idaho was $45,968 in 2019 (Bureau of Economic Analysis, 2020).

Community Services

Table 3.14-1 presents a summary of education, public safety, and health care characteristics in the ROI (DOE, 2020a).

Table 3.14-1. Community Services Characteristics Summary for the Region of Influence

Community Services	*Description*
Education	29 public school districts and 12 private schools; 68,393 schoolchildren in the region (2019-2020 school year)
Police	544 law enforcement officers, including 202 sworn police officers and 342 civilians associated with the county sheriffs' departments in 2019; staffing levels in the two largest cities (Pocatello and Idaho Falls combined): 268 employees, including 179 sworn officers
Firefighters	231 full-time, 334 part-time, and 115 volunteer firefighters within 37 fire stations and 22 fire departments in the ROI; INL Fire Department provides 24-hour coverage for the INL Site; staff includes 68 firefighters, 11 lead firefighters, and 7 division chiefs, with no less than 16 on each shift
Medical	58 hospital-based practices, the majority found in Bannock and Bonneville Counties. The largest hospitals in the region include Eastern Idaho Regional Hospital in Idaho Falls (291 beds), Mountain View Hospital in Idaho Falls (41 beds), Portneuf Medical Center in Pocatello (165 beds), Bingham Memorial Hospital in Blackfoot (85 beds), and Madison Memorial Hospital in Rexburg (65 beds). In addition, the closest hospital to the INL Site is the Lost Rivers Medical Center (14 beds), located 8 miles from the INL Site border in Arco, Idaho; this results in a total bed count of 661 in the ROI.

Sources: (National Center for Education Statistics, 2021; American Hospital Directory, 2021; DOE, 2020a; FBI, 2021a; FBI, 2021b; FireDepartment.net, 2021)
Key: INL = Idaho National Laboratory; ROI = Region of Influence

3.15 Environmental Justice

The ROI for environmental justice is the area within a 50-mile radius of CITRC at the INL Site. The 50-mile radius was selected because it is consistent with the ROI for radiological emissions and focuses on the project areas where impacts could potentially occur. The potentially affected area for environmental justice includes parts of 14 counties throughout Idaho.

Consideration of environmental justice in NEPA analysis is driven by Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, and further supported by Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad* (see Chapter 7, *Laws, Regulations, and Other Requirements*), as well as accompanying CEQ guidance (CEQ, 1997). The executive orders effectively direct Federal agencies to identify disproportionately high and adverse human health or environmental effects of Federal programs, policies, and activities on minority and low-income populations, and take steps to address such impacts. This EIS uses definitions of minority, low-income, and minority and low-income populations that are consistent with the definitions within the executive orders and guidance (DOE, 2020a).

In evaluating potential impacts on populations in closer proximity to CITRC, radial distances of 5, 10, 20, and 50 miles were analyzed at the Census block group level (which is the smallest geographic area for which the USCB provides consistent sample data and generally contains a population between 600 and

3,000 individuals). Minority and low-income populations are evaluated using an absolute 50 percent and a relative meaningfully greater[48] percentage criteria for potentially affected block groups within 50 miles of CITRC. If a block group's percentage of minority or low-income individuals exceeded 50 percent of the entire ROI, or was more than 1.2 times the percentage of the total minority population within the 14-county comparison population (defined as the meaningfully greater criteria for this EIS), then the block group was identified as having a minority or low-income population. **Table 3.15-1** shows the minority and low-income composition of the potentially affected area surrounding CITRC at each of these distances. No populations reside within the 5-mile radius of CITRC.

The total population residing in the 14-county comparison population is 392,909, of which 18.8 percent would be considered members of a minority population; therefore, the meaningfully greater criterion for minority populations is 22.6 percent. Of the 164 block groups within the ROI, 11 block groups have individual racial group minority populations or aggregate minority populations that meet the 50 percent criterion, and 47 block groups meet the meaningfully greater criterion for one or more racial groups. The overall composition of the projected populations within every radial distance is predominantly nonminority. Minority populations in the ROI are predominantly White Hispanic and Other Minority. The concentration of minority populations is greatest within the 20-mile radius. American Indian or Alaska Native populations comprise 2 percent of the population within the 50-mile radius, because the Fort Hall Reservation of the Shoshone-Bannock Tribes lies largely within the ROI (USCB, 2021c).

Table 3.15-1. Minority and Low-Income Populations within the 50-Mile Radius of CITRC

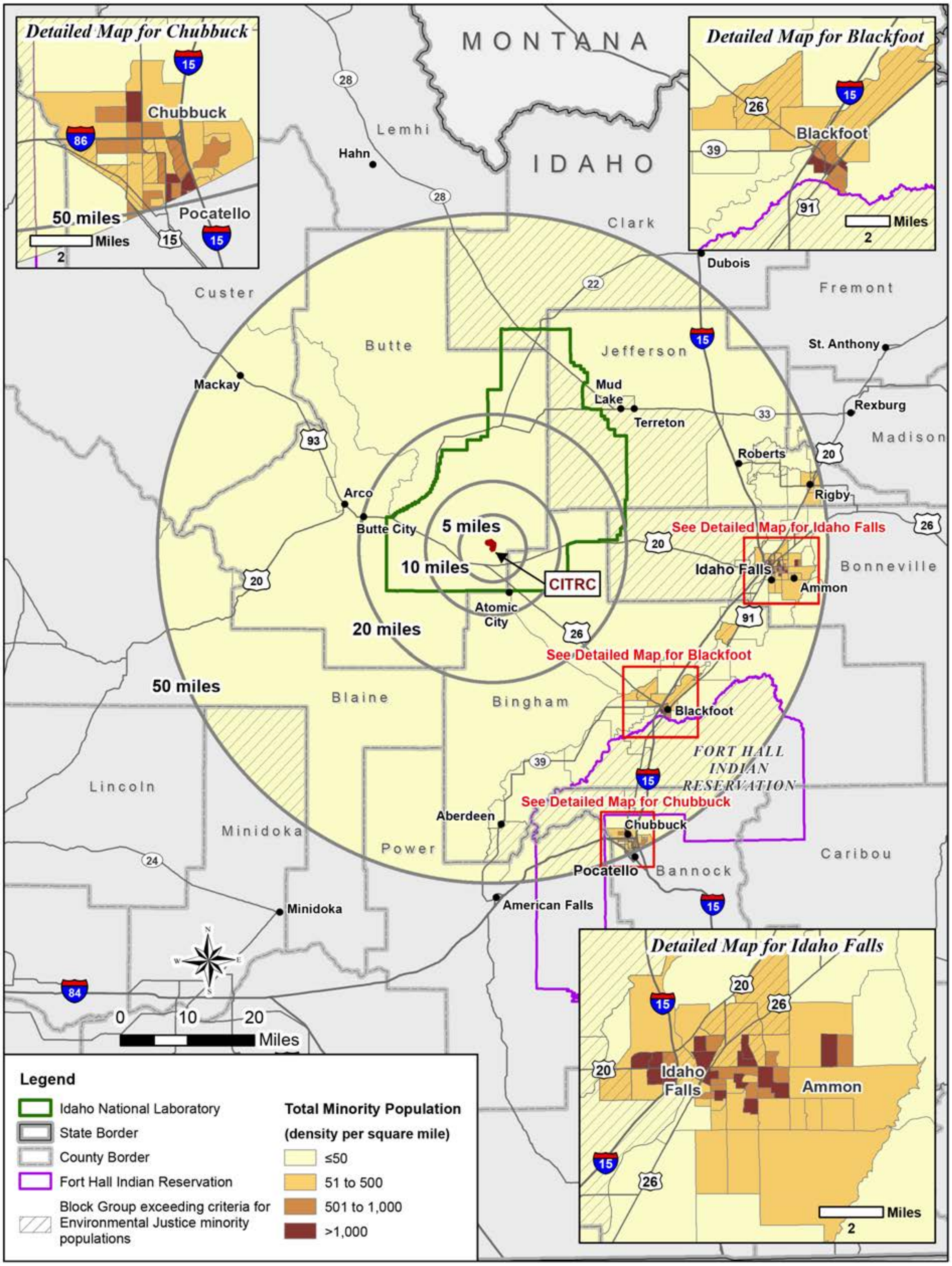
Population Group	*Within 10 Miles*		*Within 20 Miles*		*Within 50 Miles*	
	Population	*Percent of Total*	*Population*	*Percent of Total*	*Population*	*Percent of Total*
Total Population	110	100.0	1,520	100.0	221,520	100.0
Nonminority	97	88.2	1,313	86.4	180,569	81.5
Total Minority	13	11.8	207	13.6	40,951	18.5
White - Hispanic/Latino	6	5.5	89	5.9	14,379	6.5
Black/African American [a]	1	0.9	20	1.3	917	0.4
American Indian or Alaska Native	0	0.0	0	0.0	4,918	2.2
Other Minority [a, b]	6	5.5	98	6.4	20,737	9.4
Low Income	15	13.6	195	12.8	24,783	11.2

Source: (USCB, 2021c; USCB, 2021d)
Key: CITRC = Critical Infrastructure Test Range Complex; MFC = Materials and Fuels Complex
Notes:
[a] Includes persons who also indicated Hispanic or Latino origin.
[b] Other Minority includes all combined individuals of Asian, Native Hawaiian and Other Pacific Islander, Some Other Race, or Two or More Races.

Of the total population living in the 14-county comparison population, about 15.2 percent are identified as living below the poverty line. Therefore, the meaningfully greater criterion for low-income populations is 18.4 percent. Of the 164 block groups within the ROI, no block groups have a low-income population that exceeds the 50 percent criterion, and a total of 36 block groups meet the meaningfully greater criterion for low-income populations (USCB, 2021d).

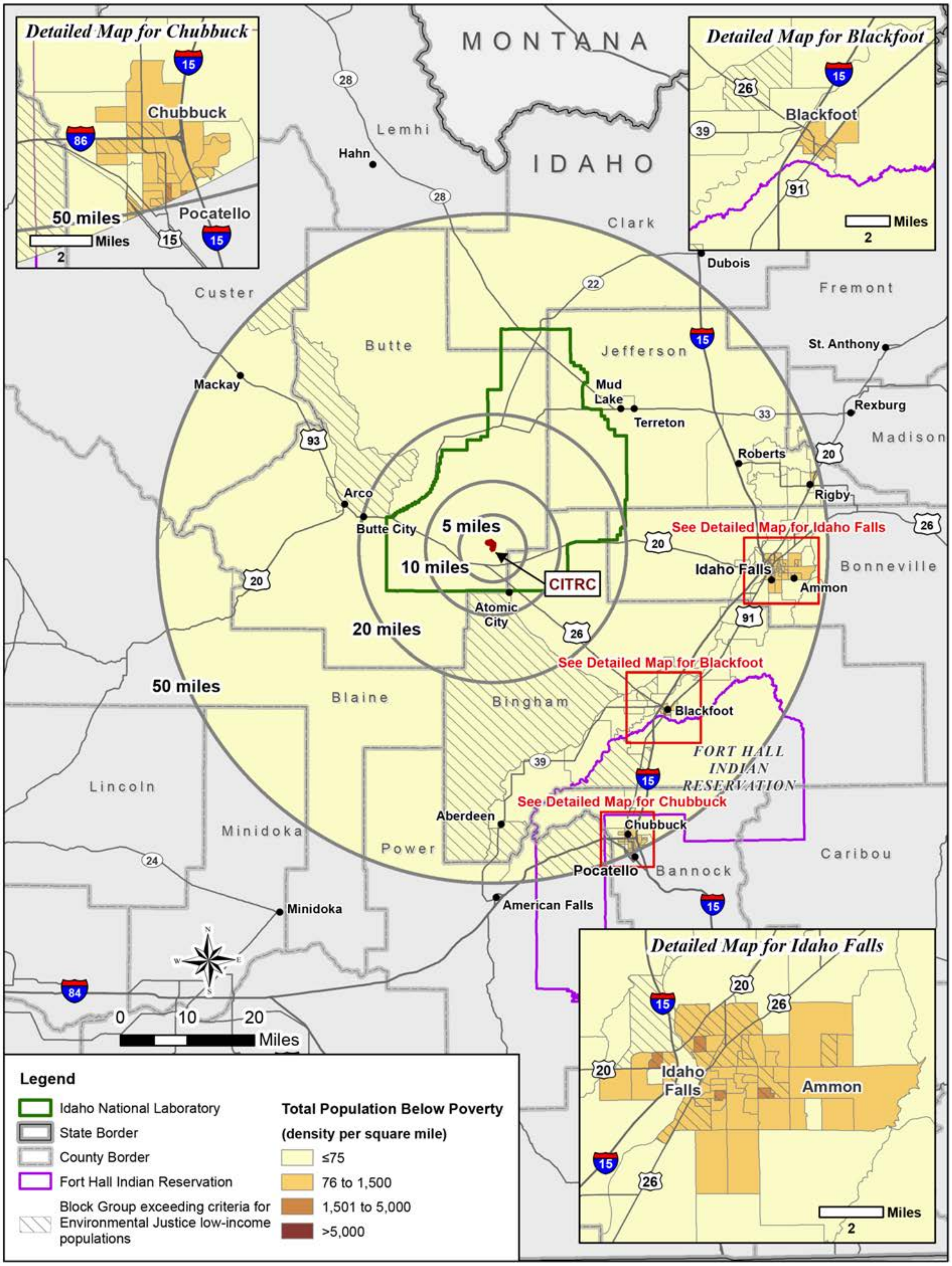
Figure 3.15-1 and **Figure 3.15-2** display the block groups identified as meeting the criteria for environmental justice minority populations and low-income populations, respectively, surrounding CITRC, as well as population density of minority and low-income populations within each block group.

[48] Meaningfully greater is defined as a minority or low-income population percentage in a block group within the ROI that is 1.2 times the percentage of the total minority or low-income population within the 14-county comparison.



Key: CITRC = Critical Infrastructure Test Range Complex

Figure 3.15-1. Locations of Block Groups Meeting the Criteria for Environmental Justice Minority Populations



Key: CITRC = Critical Infrastructure Test Range Complex

Figure 3.15-2. Locations of Block Group Tracts Meeting the Criteria for Environmental Justice Low-Income Populations

This page left blank intentionally.

Chapter 4
Environmental Consequences

This page left blank intentionally.

4 ENVIRONMENTAL CONSEQUENCES

4.0 Introduction

This section discusses the potential environmental consequences from Project Pele on the resource areas described in Chapter 3, *Affected Environment*. CEQ regulations encourage NEPA analyses to be as concise and focused as possible (40 CFR 1500.4). Consistent with the NEPA and CEQ regulations, the detailed impact analysis for a resource in this chapter focuses on those phases of Project Pele with the potential for adverse and beneficial effects to the specific resources under consideration. **Table 4.0-1** provides information on the potential for environmental consequences associated with each phase. Each phase was thoroughly evaluated for its potential to result in environmental consequences with respect to each resource analyzed in this chapter. Any phase that was determined to have no or a minimal incremental potential for environmental consequences to a resource based on the phase's characteristics is not discussed further within that specific resource's discussion in this chapter. Evaluation of the potential for environmental consequences included all INL Site and industry-standard construction BMPs, standard operating procedures and processes, as well as all applicable regulatory and permit requirements as integral parts of the Proposed Action.

As discussed in Section 2.3.1, *Mobile Microreactor Fabrication*, fuel fabrication and activities related to Project Pele at the BWXT facilities are covered by previous NEPA documentation, which is summarized below and incorporated by reference (also refer to Section 1.5, *Related NEPA Documents*). The NRC completed the EA and FONSI for renewing Materials License SNM-42 (NRC, 2005). The renewal of Materials License SNM-42 authorizes BWX Technologies, Inc. to possess nuclear materials, manufacture nuclear fuel components, fabricate research and university reactor components, fabricate compact reactor fuel elements, perform research on spent fuel performance, and handle the resultant waste streams, including recovery of scrap uranium. As documented in the EA, gaseous airborne effluents released through stacks and liquid effluents released would be well below regulatory limits. The radiological dose associated with the exposure to these effluents for exposed individuals would be less than 1 percent of the NRC 1.0 millisievert (100 millirem) annual limit established by the NRC in 10 CFR 20.1301 and occupational doses would be well below regulatory limits. The environmental impacts of the proposed action of the EA were evaluated in accordance with the requirements presented in 10 CFR 51. The NRC completed the Final EA and FONSI for renewing Materials License SNM-124 for Nuclear Fuel Services, Inc. (NRC, 2011a). The renewal of Materials License SNM-124 authorizes Nuclear Fuel Services to produce nuclear reactor fuel using HEU; perform enrichment blending of HEU with natural uranium to produce blended low-enriched uranium materials; convert HEU hexafluoride to other uranium compounds; convert low-enriched uranyl nitrate to uranium dioxide powder; recover ammonia by converting ammonium diuranate liquid into ammonium hydroxide; recover uranium from scrap generated internally or received from other facilities; perform general services, laboratory support, and waste management; and conduct research and development. Nuclear Fuel Services is also authorized under its NRC license to conduct specified on-site decommissioning activities. Based on the review relative to the requirements set forth in 10 CFR 51, the NRC staff determined that renewal of Materials License SNM-124 would not significantly affect the quality of the human environment. The impacts of ongoing and planned construction actions, including those related to the physical protection and safeguarding of licensed materials, are not expected to significantly affect the quality of the human environment. Gaseous emissions and liquid effluents generated by the Nuclear Fuel Services facility are controlled and monitored by permit and would continue to be required to meet regulatory limits for nonradiological and radiological components. Public and occupational radiological dose exposures that would be generated by continued Nuclear Fuel Services facility operations would continue to be required to meet 10 CFR 20 regulatory limits. Given the separate location and the lack of environmental impacts, the fuel fabrication activities do not contribute to environmental impacts beyond those discussed below.

Mobile microreactor components could be fabricated at other existing commercial reactor component manufacturing facilities. These existing facilities operate under all applicable Federal, state, and local regulatory and permit requirements. Potential environmental consequences from operations of these existing facilities are negligible for full operations, and mobile microreactor component fabrication would represent a very small portion of their overall production operations. Therefore, the associated potential impacts from the fabrication of mobile microreactor components would also be negligible. As with the fuel fabrication activities, given the separate location and the lack of environmental impacts, the mobile microreactor fabrication activities do not contribute to environmental impacts beyond those discussed below.

Current project plans indicate that activities at MFC, including final assembly, microreactor fueling, startup testing, and PIE, would occur in existing facilities currently utilized for similar activities; therefore, MFC would not require facility improvements (Section 2.3.3, *Demonstration Activities at the INL Site*). Additionally, existing road infrastructure would not require improvements for transport.

Thus, analysis of environmental consequences for most resources focuses on construction of the concrete pad and fencing at the CITRC for mobile microreactor operations and construction of a storage pad at either the RSWF or ORSA for temporary storage of the mobile microreactor.

Because the actual selection and location of activities at Pads B, C, and D for CITRC site preparation are not known at this time, where applicable, the impacts analysis considers the potential for disturbance from site preparations anywhere within the pad boundary and a 30-meter (98-foot) buffer. The maximum disturbance footprint associated with site preparations for the required 200-foot by 200-foot concrete pad and associated fencing would total approximately 1.6 acres, assuming the fence would be placed within 30 feet of the concrete pad. The concrete pad and fencing would only be required at one of the three pads (Pad B, C, or D) for the mobile microreactor demonstration; the two remaining pads could require minor grading of previously disturbed areas to house the load banks and diesel generators. The impacts analysis also assumes that construction access, staging, and parking would be restricted to existing developed areas within the pads.

No Action Alternative

As described in Chapter 2, Section 2.4, under the No Action Alternative, SCO would not proceed with the proposed Project Pele at the INL Site. Activities at the INL Site would continue under present-day operations, and Project Pele would not be implemented. Therefore, impacts from the No Action Alternative are not discussed further in this EIS. Conditions at the INL Site would remain as described in Chapter 3, *Affected Environment*, for each of the 15 resource areas.

Table 4.0-1. Chapter 4 Potential Environmental Consequences Analysis by Phase for Resource Areas

Project Pele Phase	*Phase Characteristics*	*Resources with No or Minimal Potential for Environmental Consequences (Not Discussed Further in Chapter 4)*	*Justification for Dismissal from Detailed Analysis*	*Resources Discussed Further in Chapter 4 (Section)*
Mobile Microreactor Fabrication	This activity occurs prior to arrival at the INL Site and involves fabrication of both the mobile microreactor and fuel as described in Section 2.3.1, *Mobile Microreactor Fabrication.*	• Land Use and Aesthetics • Geology and Soils • Air Quality • Water Resources • Biological Resources • Cultural and Paleontological Resources • Noise • Infrastructure • Waste and SNF • Human Health – Normal Operations • Human Health – Transportation • Human Health – Facility Accidents • Traffic • Socioeconomics • Environmental Justice	These activities occur in facilities already designed for fabrication and covered under existing NEPA documentation. No additional impacts are anticipated to resources.	None
Mobile Microreactor and Fuel Transport to the INL Site	This activity involves transport of both the mobile microreactor and fuel to the INL Site as described in Section 2.3.2, *Transport of Reactor and Fuel to INL Site*.	• Land Use and Aesthetics • Geology and Soils • Air Quality • Water Resources • Biological Resources • Cultural and Paleontological Resources • Noise • Infrastructure • Waste and SNF • Human Health – Normal Operations	Transport would use standard CONEX containers and existing highway infrastructure. No additional impacts are anticipated to resources.	• Human Health – Transportation (4.12)

Table 4.0-1.Chapter 4 Potential Environmental Consequences Analysis by Phase for Resource Areas (Continued)

Project Pele Phase	***Phase Characteristics***	***Resources with No or Minimal Potential for Environmental Consequences (Not Discussed Further in Chapter 4)***	***Justification for Dismissal from Detailed Analysis***	***Resources Discussed Further in Chapter 4 (Section)***
		• Human Health – Facility Accidents • Traffic • Socioeconomics • Environmental Justice		
Phase 1: Fuel Mobile Microreactor (TREAT or HFEF)	The existing TREAT and HFEF can accommodate Project Pele final assembly and fueling phase. This phase is compatible with existing designated uses and infrastructure and would require no new construction. See Section 2.3.3.1, *Fuel Mobile Microreactor at MFC,* for additional details on activities at TREAT and HFEF.	• Land Use and Aesthetics • Geology and Soils • Water Resources • Biological Resources • Cultural and Paleontological Resources • Noise	Phase 1 activities would occur in existing developed areas of TREAT or HFEF. No impacts would occur to geology and soils, water resources, biological resources, or cultural and paleontological resources as these resources are not present within Phase 1 locations, nor does this phase require ground disturbance that could affect these resources. In addition, activities associated with Phase 1 would be compatible with existing land use and no changes would occur to aesthetics. This phase would not generate noise levels at TREAT or HFEF greater than existing levels.	• Air Quality (4.4) • Infrastructure (4.7) • Waste and SNF (4.9) • Human Health – Normal Operations (4.10) • Human Health – Facility Accidents (4.11) • Human Health – Transportation (4.12) • Traffic (4.13) • Socioeconomics (4.14) • Environmental Justice (4.15)
Phase 2: Mobile Microreactor Startup Testing (MFC or CITRC)	The existing MFC or CITRC can accommodate Project Pele startup testing phase. This phase is compatible with existing designated uses. Startup testing at MFC would require no new construction. Construction impacts at CITRC (if selected for startup testing) are described in subsections of the Phase 4 analysis. See Section 2.3.3.2, *Mobile*	• Land Use and Aesthetics • Geology and Soils • Water Resources • Biological Resources • Cultural and Paleontological Resources • Noise	Phase 2 activities would occur in existing developed areas of MFC. No impacts would occur to geology and soils, water resources, biological resources, or cultural and paleontological resources as these resources are not present within MFC. Proposed startup testing activities at either MFC or CITRC associated with Phase 2 would be compatible with existing land use and no changes would occur to aesthetics. This phase would not generate noise levels at MFC or CITRC	• Air Quality (4.4) • Infrastructure (4.7) • Waste and SNF (4.9) • Human Health – Normal Operations (4.10) • Human Health – Facility Accidents (4.11) • Human Health – Transportation (4.12) • Traffic (4.13) • Socioeconomics (4.14) • Environmental Justice (4.15)

Table 4.0-1.Chapter 4 Potential Environmental Consequences Analysis by Phase for Resource Areas (Continued)

Project Pele Phase	***Phase Characteristics***	***Resources with No or Minimal Potential for Environmental Consequences (Not Discussed Further in Chapter 4)***	***Justification for Dismissal from Detailed Analysis***	***Resources Discussed Further in Chapter 4 (Section)***
	Microreactor Initial Startup Testing, for additional details on activities at MFC and Section 2.3.3.4, *Mobile Microreactor Operations at CITRC*, for additional details on CITRC.		greater than existing levels. The power conversion module would be located outside of the DOME at MFC but noise levels would remain consistent with existing conditions. Any development and site improvement activities at CITRC required to place the mobile microreactor for Phase 2 are discussed in detail for all resources within the Phase 4 Mobile Microreactor Operations at CITRC Chapter 4 discussions.	
Phase 3: Mobile Microreactor Disassembly and Transport (at CITRC or from MFC to CITRC)	The existing infrastructure at the INL Site can accommodate Project Pele transport to CITRC. No new construction or infrastructure improvements are required. See Section 2.3.3.3, *Disassembly and Transport*, for additional details on disassembly and transport routes.	• Land Use and Aesthetics • Geology and Soils • Water Resources • Biological Resources • Cultural and Paleontological Resources • Noise	Phase 3 activities would occur in existing developed areas at CITRC and MFC and transport of the mobile microreactor would use the existing road network. No impacts would occur to geology and soils, water resources, biological resources, or cultural and paleontological resources as these resources are not present within Phase 3 locations, nor does this phase require ground disturbance that could affect these resources. In addition, activities associated with Phase 3 would be compatible with existing land use and no changes would occur to aesthetics. This phase would not generate noise levels at CITRC, MFC, or along the existing road network greater than existing levels.	• Air Quality (4.4) • Infrastructure (4.7) • Waste and SNF (4.9) • Human Health – Normal Operations (4.10) • Human Health – Facility Accidents (4.11) • Human Health – Transportation (4.12) • Traffic (4.13) • Socioeconomics (4.14) • Environmental Justice (4.15)
Phase 4: Mobile Microreactor Operations at CITRC	All resources require analysis due to new construction at CITRC to accommodate Project Pele. See Section 2.3.3.4,	None	None	All resources (4.1 – 4.15)

Table 4.0-1.Chapter 4 Potential Environmental Consequences Analysis by Phase for Resource Areas (Continued)

Project Pele Phase	*Phase Characteristics*	*Resources with No or Minimal Potential for Environmental Consequences (Not Discussed Further in Chapter 4)*	*Justification for Dismissal from Detailed Analysis*	*Resources Discussed Further in Chapter 4 (Section)*
	Mobile Microreactor Operations at CITRC, for additional details on activities at CITRC.			
Phase 5: Mobile Microreactor Disassembly at CITRC and Transport to Temporary Storage (RSWF or ORSA)	Similar to Phase 3, the existing infrastructure at the INL Site can accommodate Project Pele transport to temporary storage. No new construction or infrastructure improvements are required.	• Land Use and Aesthetics • Geology and Soils • Water Resources • Biological Resources • Cultural and Paleontological Resources	Phase 5 activities would occur in existing developed areas of CITRC and RSWF or ORSA and transport of the mobile microreactor would use the existing road network. No impacts would occur to geology and soils, water resources, biological resources, or cultural and paleontological resources as these resources are not present within Phase 5 locations, nor does this phase require ground disturbance that could affect these resources. In addition, activities associated with Phase 5 would be compatible with existing land use and no changes would occur to aesthetics.	• Air Quality (4.4) • Infrastructure (4.7) • Noise (4.8) • Waste and SNF (4.9) • Human Health – Normal Operations (4.10) • Human Health – Facility Accidents (4.11) • Human Health – Transportation (4.12) • Traffic (4.13) • Socioeconomics (4.14) • Environmental Justice (4.15)
Phase 6: Mobile Microreactor Temporary Storage (RSWF or ORSA)	The existing RSWF or ORSA facilities can accommodate the Project Pele temporary storage phase, although storage of the mobile microreactor would require construction of a 50-foot by 50-foot (2,500 square feet) reinforced concrete pad and shed within a previously disturbed area. See Section 2.3.3.6, *Temporary Storage at INL*, for additional details on activities at RSWF and ORSA.	• Water Resources • Biological Resources	No disturbance would occur to water resources or biological resources as neither are present within the RSWF or ORSA.	• Land Use and Aesthetics (4.1) • Geology and Soils (4.2) • Air Quality (4.4) • Cultural and Paleontological Resources (4.6) • Infrastructure (4.7) • Noise (4.8) • Waste and SNF (4.9) • Human Health – Normal Operations (4.10) • Human Health – Facility Accidents (4.11)

Table 4.0-1.Chapter 4 Potential Environmental Consequences Analysis by Phase for Resource Areas (Continued)

Project Pele Phase	***Phase Characteristics***	***Resources with No or Minimal Potential for Environmental Consequences (Not Discussed Further in Chapter 4)***	***Justification for Dismissal from Detailed Analysis***	***Resources Discussed Further in Chapter 4 (Section)***
				• Human Health – Transportation (4.12) • Traffic (4.13) • Socioeconomics (4.14) • Environmental Justice (4.15)
Phase 7: Mobile Microreactor and Spent Nuclear Fuel Post Irradiation Examination and Disposition	This phase would not require construction of new facilities or infrastructure; existing facilities and procedures would be able to accommodate PIE and disposal. See Section 2.3.3.7, *Post-Irradiation Examination and Disposition,* for additional details on PIE and disposition activities.	• Land Use and Aesthetics • Geology and Soils • Water Resources • Biological Resources • Cultural and Paleontological Resources • Noise	Phase 7 activities would occur in existing developed areas designated for PIE and disposition. No impacts would occur to geology and soils, water resources, biological resources, or cultural and paleontological resources as these resources are not present within Phase 7 locations, nor does this phase require ground disturbance that could affect these resources. In addition, activities associated with Phase 7 would be compatible with existing land use and no changes would occur to aesthetics. This phase would not generate noise levels at Phase 7 locations greater than existing levels.	• Air Quality (4.4) • Infrastructure (4.7) • Noise (4.8) • Waste and SNF (4.9) • Human Health – Normal Operations (4.10) • Human Health – Facility Accidents (4.11) • Human Health – Transportation (4.12) • Traffic (4.13) • Socioeconomics (4.14) • Environmental Justice (4.15)

Key: CITRC = Critical Infrastructure Test Range Complex; CONEX = container express (shipping container); HFEF = Hot Fuel Examination Facility; INL = Idaho National Laboratory; MFC = Materials and Fuels Complex; ORSA = Outdoor Radioactive Storage Area; PIE = post-irradiation examination; RSWF = Radioactive Scrap and Waste Facility; SNF = spent nuclear fuel; TREAT = Transient Reactor Test Facility

4.1 Land Use and Aesthetics

This section discusses the potential environmental consequences on land use and aesthetics that could result from Project Pele, with a focus on phases of the project with potential for adverse effects. Land use would be affected if the Proposed Action is incompatible with surrounding land uses, if the Proposed Action results in a change to current land-use designation, or if a significant percentage of land were disturbed for development. The Proposed Action would impact aesthetics if it resulted in, or introduced, a deterioration of the visual landscape, either through obstruction of natural viewscapes from man-made structures or contributed to the degradation of the visual character of an area (e.g., from light pollution to the night sky).

As described in Section 4.0, *Introduction*, most phases of Project Pele would not result in additional land disturbance and would be compatible with existing land use activities, and therefore, would have no impacts on land use. Those phases of Project Pele are not discussed in this section. Only site preparation for mobile microreactor startup testing and operation at CITRC (Phase 4) and site preparation for mobile microreactor temporary storage at RSWF or ORSA (Phase 6) could result in impacts to land use and, therefore, are discussed in this section.

Overall minor impacts to land use would occur from the disturbance of less than 2 (up to about 1.6) acres during construction activities at CITRC. Less than an additional 0.1 acre would be disturbed at the temporary storage site. No additional land would be disturbed during operations. Localized and temporary visual impacts could result from construction equipment (e.g., cranes), but only in areas within line of sight of CITRC and the temporary storage location during construction. Regarding aesthetics, construction and other related activities at CITRC would be limited to daylight hours with very limited or nonexistent nighttime or weekend work and thus would not contribute to any local or regional night sky impacts. New facilities associated with the mobile microreactor demonstration would be designed to minimize, to the extent practicable, new sources of light pollution.

4.1.1 Phase 4: Mobile Microreactor Operations at CITRC

Land Use

Construction could result in ground disturbance associated with site clearing, excavation, and grading conducted as part of constructing concrete pads, parking areas, laydown areas, and fencing. As discussed in Section 4.0, *Introduction*, about 1.6 acres would be disturbed at one of the three pads (Pad B, C, or D) for construction of the 200-foot by 200-foot concrete pad and surrounding fence for mobile microreactor demonstration at CITRC. Construction laydown areas outside the 1.6-acre area would be minimal. No other construction is anticipated for this phase of the project. Areas at CITRC that could be disturbed have already been impacted by human-surface interactions, and below-ground disturbances would be limited to localized areas and minimized as much as reasonable.

Because the 1.6-acre area of disturbed land at CITRC represents a small fraction of the 569,600 acres of the INL Site, and the buildings and facilities associated with the project are consistent with the existing land use at CITRC, minimal impacts to land use would be expected. The use of BMPs during construction would reduce the potential for impacts to land use at CITRC. For example, disturbed areas not used for building footprints or impervious surfaces would be revegetated per DOE/ID-12114, *Guidelines for Revegetation of Disturbed Sites at the Idaho National Engineering Laboratory* (DOE, 1989).

Aesthetics

Proposed facilities would be similar to the type and appearance of structures already present on CITRC. For any of the three pad locations under consideration for mobile microreactor demonstration at CITRC (Pad B, C, or D), the CONEX containers and shielding that would be placed on the concrete pad would be no more than 30 feet high and would not substantially differ in type or size from other structures at CITRC. The remaining two pads may host load banks, diesel generators, and other devices, none of which would differ visually from other structures already present at CITRC. Additionally, the pad locations chosen would not substantially increase the overall footprint of developed areas at CITRC. Therefore, the existing visual character of CITRC would not be substantially altered. Localized and temporary visual impacts could result from construction equipment (e.g., cranes), but only in areas within line of sight of CITRC. As the mobile microreactor would only be present at the INL Site for approximately 3 years, once the project ends, all above-grade structures constructed for Project Pele would be removed and the site would be returned to previous (pre-project) conditions.

Existing facilities at the INL Site have been identified as contributing to light pollution in the night sky as seen from various locations of Craters of the Moon National Monument and Preserve (USDOI, 2021). Construction and other related activities at CITRC would be limited to daylight hours with very limited or non-existent nighttime or weekend work and, thus, would not contribute to any local or regional night sky impacts. Facilities associated with mobile microreactor demonstration would minimize, to the extent possible, sources of light pollution, per existing INL guidelines and standards (DOE, 2020a). Outdoor lighting associated with operations during this phase would be minimal and would include lighting for the CONEX containers, walkways, and a mobile office trailer. BMPs for any outdoor lighting associated with the Proposed Action would include limiting lighting to safety and security requirements and the utilization of lighting design guidelines in compliance with International Dark-Sky Association-approved fixtures. Impacts on Craters of the Moon National Monument and Preserve would not be expected from exterior or other lighting required for construction and operation activities for Project Pele.

4.1.2 Phase 6: Mobile Microreactor Temporary Storage (RSWF or ORSA)

Land Use

As described in Section 2.3.3.6, *Temporary Storage at the INL Site*, a 50-foot by 50-foot concrete pad and shed would need to be constructed for temporary storage of the mobile microreactor at RSWF or ORSA at MFC. Areas at RSWF and ORSA that could be used for this activity have been previously disturbed. A total of less than 0.1 acre would be disturbed for construction of the concrete pad, and construction laydown areas outside the less than 0.1-acre area would be minimal and would be on previously disturbed land.

Similar to Phase 4, minimal impacts to land use would be expected. The total area of less than 0.1 acre of total disturbed land at MFC represents a small fraction of the 569,600 acres of the INL Site, and the buildings and facilities associated with the project are consistent with the existing land use at MFC.

Aesthetics

Because of the density, type, and height of existing industrial structures at MFC, the placement of a concrete pad and shed for temporary storage of the mobile microreactor at RSWF or ORSA at MFC would not be expected to significantly impact aesthetics at or within the viewshed of MFC. Similar to Phase 4, localized and temporary visual impacts could result from construction equipment (e.g., cranes), but only in areas within line of sight of MFC construction. Limiting construction and related activities to daylight hours with very limited or non-existent nighttime or weekend work, and the use of outdoor lighting BMPs, would limit local or regional night sky impacts.

4.2 Geology and Soils

This section discusses the potential environmental consequences on geology and soils that could occur during activities associated with Project Pele. Geology and soils would be affected if the Proposed Action involves rock or soil excavation, site grading, or disturbance to soils through compaction or placement of an impervious surface. As described in Section 4.0, *Introduction*, most phases of Project Pele would not result in additional land disturbance, would not use local geologic and soils resources, and would not discharge contaminants to soils and, therefore, would have no impacts on geology and soils. Those phases of Project Pele are not discussed in this section. Only site preparation for Phase 4 and Phase 6 could result in impacts to geology and soils and, thus, are discussed in this section. Total impacts to soils from Phase 4 and Phase 6 as described below in Section 4.2.1, *Phase 4: Mobile Microreactor Operations at CITRC*, and Section 4.2.2, *Phase 6: Mobile Microreactor Temporary Storage (RSWF or ORSA)*, would be approximately 1.7 acres, which is a small fraction of the 569,600 acres of the INL Site. The volume of excavated materials (about 4,200 cubic yards) and required rock/gravel (about 3,200 cubic yards) needed during construction would represent small percentages of regionally plentiful resources and are unlikely to adversely impact geology and soil resources.

As described in Section 3.2, *Geology and Soils*, no prime or unique farmland soils have been designated at the INL Site. As a result, the Proposed Action would have no effects on prime or unique farmland soils; therefore, this topic is not discussed further. Additionally, Section 4.10, *Human Health – Normal Operations*, discusses the potential estimated human health impacts of radiological releases, which includes evaluation of potential soil exposure pathways. The total human health impacts would be very small, and the soil exposure pathways would represent a small fraction of the total impacts. Therefore, radiological releases are not expected to result in soil contamination; thus, this topic is not discussed further.

There would be no impacts on local rare or valuable geologic and soil resources, including fossil fuels (e.g., oil, gas, and coal) and minerals, because as described in Section 3.2, *Geology and Soils*, none are present at the INL Site. Therefore, this topic is also not discussed further.

Geologic hazards (such as earthquakes, volcanoes, and slope instability) with the potential to affect facilities at the INL Site are described in Section 3.2, *Geology and Soils*. All activities, including construction and operation of the mobile microreactor, would be conducted in compliance with all applicable Federal, State, and local requirements and standards established to protect public and worker health and safety and the environment. DOE Order 420.1C, *Facility Safety*, requires that nuclear and non-nuclear facilities at DOE sites be designed, constructed, and operated so that the public, workers, and environment are protected from adverse impacts of natural phenomena hazards, including earthquakes. The potential for geologic hazards such as earthquakes to cause accidents, and the impacts on public and worker health and safety, are discussed in in Section 4.11, *Human Health – Facility Accidents*.

4.2.1 Phase 4: Mobile Microreactor Operations at CITRC

Rock and soil disturbance could result from site clearing, excavation, and grading conducted as part of constructing the concrete pad, parking area, laydown areas, and fencing.

Site clearing and excavation required for construction would remove the vegetative cover, destroy the structure of the native soils, and possibly impact underlying rock. As described in Section 4.1, *Land Use and Aesthetics*, about 1.6 acres would be disturbed for construction of the 200-foot by 200-foot concrete pad and surrounding fence for mobile microreactor demonstration at CITRC. Construction laydown areas outside the 1.6-acre area would be minimal. Because the 1.6 acres of disturbed land would be a small fraction of the 569,600 acres of the INL Site, and BMPs would be used to limit soil erosion, minimal impacts on soils at the INL Site are expected. Leveling of the additional gravel pads that would be used to house the load banks and diesel generators would not disturb additional land and, therefore, would have minimal impacts on geology and soils.

As described in Section 3.2, *Geology and Soils*, CITRC is relatively flat with little elevation change and the thickness of surficial soils ranging from 1.6 feet to more than 5 feet. Construction activities are estimated to result in the removal of 4,000 cubic yards of soil to excavate the foundation for the 40,000-square foot, 8-inch-thick, concrete pad overlying a 2-foot-thick base of crushed rock. Construction of the concrete pad would require about 3,000 cubic yards of base material (e.g., crushed rock). In addition, soil may be placed in HESCO® bags to provide shielding around the microreactor. At the conclusion of operations at CITRC, any soil determined to be LLW would be removed and the test pad area would be returned to a state allowing unrestricted access and use (INL, 2021f).

Sources of geologic and soils materials for construction would include soil stockpiled during site excavation; soil from INL Site borrow sources; and crushed stone, sand, gravel, and soil supplied by off-site commercial operations. As discussed in Section 3.2, *Geology and Soils*, a number of active borrow sources at the INL Site have been identified for ongoing and future activities at the INL Site. The nearest borrow source, Ryegrass Flats, is about 2 miles south of CITRC. The total quantities of geologic and soil materials needed during construction would represent small percentages of regionally plentiful resources and are unlikely to adversely impact geology and soil resources. Any excess soil or rock would either be stockpiled at one of the INL Site borrow sources for other on-site uses or disposed of locally.

4.2.2 Phase 6: Mobile Microreactor Temporary Storage (RSWF or ORSA)

Rock and soil disturbance could be associated with site clearing, excavation, and grading conducted as part of constructing the concrete pad and shed, and laydown areas. As described in Section 2.3.3.6, *Temporary Storage at the INL Site*, a 50-foot by 50-foot concrete pad and shed would need to be constructed for temporary storage of the mobile microreactor at RSWF or ORSA at MFC. The areas at RSWF and ORSA that could be used for this activity have already been disturbed and are covered with crushed rock.

Site clearing and excavation required for construction of the concrete storage pad would destroy any remaining structure of the native soils and possibly impact underlying rock. As described in Section 4.1, *Land Use and Aesthetics*, less than 0.1 acre would be disturbed for construction of the concrete pad. Construction laydown areas outside this disturbed area would be minimal. Because these areas have already been disturbed, the disturbed land would be a tiny fraction of the 569,600 acres of the INL Site, and BMPs would be used to limit soil erosion, minimal impacts on soils at the INL Site are expected.

As described in Section 3.2, *Geology and Soils*, MFC is relatively flat with little elevation change and the thickness of surficial soils ranging from 0.5 to 26 feet. Construction activities are estimated to result in the removal of 250 cubic yards of soil to excavate the foundation for the 2,500-square foot, 8-inch-thick, concrete pad overlying a 2-foot-thick base of crushed rock. Construction of the storage pad would require about 200 cubic yards of base material (e.g., crushed rock) for the concrete pad.

Sources of geologic and soil materials for construction would include soil stockpiled during site excavation; soil from INL Site borrow sources; and crushed stone, sand, gravel, and soil supplied by off-site commercial operations. As discussed in Section 3.2, *Geology and Soils*, a number of active borrow sources at the INL Site have been identified for ongoing and future activities at the INL Site. The nearest borrow source, Ryegrass Flats, is about 11 miles southwest of MFC. The total quantities of geologic and soil materials needed during construction would represent small percentages of regionally plentiful resources and are unlikely to adversely impact geology and soil resources. Any excess soil or rock would be stockpiled at one of the INL Site borrow sources for other on-site uses, or disposed of locally.

4.3 Water Resources

This section discusses the potential environmental consequences to water resources that could occur during activities associated with Project Pele. As stated in Section 4.0, *Introduction*, construction and operation of Project Pele are not expected to change existing conditions at MFC. As such, MFC is not discussed in this section. Per **Table 4.0-1**, the only phase with the potential to impact water resources is

Phase 4, Mobile Microreactor Operations at CITRC. No impacts to water resources would be anticipated during construction or operation of any of the other six proposed project phases, and thus, those phases are not analyzed in this section.

Water resources would be affected if actions associated with the Proposed Action caused a physical disturbance to the resource or increased any of the following parameters:

- Constituents in industrial wastewater or stormwater (regulated by wastewater reuse permits and NPDES permits)
- Industrial wastewater or stormwater discharge volumes (regulated by wastewater reuse permits)
- Constituents in groundwater (regulated by Federal MCLs and state primary/secondary constituent standards)
- Groundwater use (regulated by Federal Reserved Water Rights)

Unless wastewater reuse permit limits, NPDES permit limits, water right limits, or water system infrastructure capabilities are exceeded, impacts would be expected to be small. Impacts on water resources are assessed for two general categories: water quality and water use. Water quality is evaluated through constituents in and volume of process and sanitary wastewater discharges, constituents in and volume of stormwater discharges, and potential for discharges to eventually impact groundwater. Water use is evaluated through workforce, process, and other needs for potable and non-potable water. Overall impacts to surface water and groundwater are anticipated to be minimal.

4.3.1 Phase 4: Mobile Microreactor Operations at CITRC

The impacts on water resources from construction activities are presented below in terms of increases over the baseline described in Section 3.3.1, *Surface Water*. Section 4.3.1.1, *Surface Water*, discusses stormwater management in relation to surface water and groundwater quality. Section 4.3.1.2, *Groundwater*, discusses groundwater use in relation to water availability and groundwater rights.

4.3.1.1 Surface Water

Construction

No surface water features are located within the disturbance footprints of Project Pele; therefore, no direct disturbance from grading activities and site improvements would occur. Stormwater runoff would discharge across the previously graded ground surface during construction, and specific stormwater drainage plans for construction would be finalized in later stages of design. Additional assessment would be required during the final design prior to any ground disturbance to assess the full scale of impacts and determine appropriate mitigation strategies, as necessary. Minimally, this would include wetland delineations to verify the absence of wetlands and surface waters within the project development footprint (USACE, 1987). The implementation of low-impact construction techniques and appropriate BMPs contained within a site-specific stormwater management plan would reduce or avoid the discharge of stormwater and wastewater to the three seasonally flooded freshwater ponds and one riverine wetland identified within the ROI for water resources. As such, only potential negligible impacts to the volume, flow, and quality of these surface water features would be expected during construction of Phase 4.

Low-impact techniques would also be used to keep stormwater runoff on the construction site and prevent groundwater pollution. For example, the construction area would be graded, and all construction activities would occur at or above grade. Local infiltration at the construction site would be used for stormwater management prior to establishment of paved areas or roofs. Silt and debris in stormwater runoff from construction areas would be captured by sediment control devices such as silt fencing. Established BMPs would continue to be used to minimize sediment and chemical constituents in stormwater runoff. No activities are expected to add to or change the constituents in the stormwater discharge during construction. Therefore, the construction period would have no impact on stormwater quality.

Equipment washing would generate routine wastewater throughout the construction phase. Construction equipment would either be taken to the CFA to be washed in an established maintenance area or washed in a temporary wash area to prevent greases, oil, or material residues from contacting the ground surface and migrating to stormwater runoff or into the subsurface.

See Section 7.2, *Applicable Permits*, for a discussion of the INL Site's existing Clean Water Act, IPDES, and wastewater reuse permits and any modifications potentially required by the Proposed Action.

Operations

Normal operations of Phase 4 would require about 167,000 gallons of water over the expected 2.5-year phase. This volume includes the water needed to support office work and the water used to fill the bladders which would provide neutron shielding. Water would be drawn from groundwater (see Section 4.3.1.2, *Groundwater*), but sanitary wastewater would ultimately be discharged to septic tanks with drainage fields. No operational industrial wastewater discharge location currently exists at CITRC.

Sanitary wastewater from the workforce would be handled by existing on-site systems. Specifically, about 95,000 gallons of sanitary wastewater would be discharged to septic tanks with drainage fields over the 3-year site preparation and demonstration period (Appendix B, *Environmental Resources*). Sanitary discharge volumes would therefore increase during activities at CITRC, but as the existing system was originally designed for a higher number of employees than currently served, it has the capacity to accommodate the expected demand. As such, expected impacts due to the increased discharge of sanitary wastewater would remain negligible. Because required water volumes would be drawn from groundwater, no changes to surface water use would be expected during Phase 4.

4.3.1.2 Groundwater

Construction

During construction of Phase 4, potable water for construction workforce consumption would be drawn from existing drinking water wells that access the SRPA, and the water would be treated through the existing CITRC potable water system. Additional water would be required for construction activities, such as dust control and backfill. Phase 4 would require construction of a concrete pad; excavation activities would be minimal for a pad measuring 2 to 4 feet thick. Excavation during construction is not expected to reach groundwater.

Potential pathways of groundwater contamination also include wastewater and stormwater discharges to unlined infiltration basins or the ground and uncontrolled spills of chemicals or petroleum products. Spill prevention and cleanup programs, the wastewater discharge management plan, and waste management programs control contaminants in these pathways. These plans and programs conform to applicable Federal and state requirements, and some are subject to Federal and state compliance inspections. Examples of BMPs used to protect groundwater include reducing soil erosion and stormwater runoff by using silt fencing, hay bales, or rills that catch sediment or confining runoff to designated areas (e.g., infiltration basins). BMPs also include using the minimum effective quantity of chemicals, considering the use of "greener" alternatives when available, and applying practicable and careful management of hazardous materials and wastes. Specific BMPs to help reduce effects to groundwater from the concrete pouring activities required under the Proposed Action could include designating a "wash out area" that is as far as possible from storm drain inlets or drainage ditches and located in a low-lying area to allow wash water and storm water to pool and infiltrate the ground surface. Alternatively, a container may be used to collect washout water, which can then be transported off-site for proper disposal. Small amounts of excess wet concrete may also be discharged to the wash out area or container (PACE Partners, 2018).

Constituent concentrations in on-site groundwater are expected to remain similar to existing baseline conditions during the construction period. Therefore, construction would not impact groundwater quality compared to baseline conditions described in Section 3.3, *Water Resources*.

Operations

Water used during operations of Phase 4 would be drawn from groundwater but discharged into septic tanks with drainage fields, as discussed in Section 4.3.1.1, *Surface Water*. The shield water used to fill the water bladders proposed to provide temporary neutron shielding would be purged and disposed of as LLW. The 167,000 total estimated gallons of water required for Phase 4 represents about 0.0015 percent of the INL Site's Federal Reserved Water Right of 11.4 billion gallons per year. Negligible impacts to groundwater quantity and no impacts to groundwater quality would be expected during operation of Phase 4. See Section 4.7, *Infrastructure*, for additional information on water usage by project phase.

4.4 Air Quality

Activities associated with Project Pele would result in air emissions of criteria pollutants, HAPs, and GHGs. The following evaluates projected emissions relative to air quality conditions within the project region and its applicable Federal, state, and local air pollution standards and regulations. Since the INL Site region is classified as being in attainment for all NAAQS, the analysis compared estimates of project annual emissions to the EPA PSD permitting threshold of 250 tons per year (EPA, 2019a). The comparison was then used to make an initial determination of the significance of potential impacts on air quality. The PSD permitting threshold represents the level of potential new emissions below which a new stationary source can emit without triggering the requirement to obtain a PSD permit. If the annual emissions increases for the project are below a PSD threshold, the indication is that air quality impacts would be insignificant for that pollutant.

If project emissions would exceed an indicator threshold mentioned above, further analysis was conducted to predict whether impacts would be significant. In such cases, if emissions would not contribute to an exceedance of an ambient air quality standard, then impacts would not be significant. None of the proposed operations would produce substantial air emissions. The combined annual emissions from all sources would be well below annual indicator thresholds.

Air quality impacts of nonradiological HAPs from project activities were evaluated in terms of whether they would produce adverse impacts on the public. The analysis used the major source threshold definition of 10 tons per year for a single HAP or 25 tons per year for any combination of HAPs as indicators of the significance of projected human health impacts. If project activities generate HAPs emissions that remain below these thresholds, then potential health impacts to the public would not be significant. Additionally, the analysis estimated project GHG and radiological air emissions. Section 5.3.7, *Global Commons – Climate Change*, presents the cumulative impact analysis of project GHGs. Section 4.10, *Human Health – Normal Operations*, through Section 4.12, *Human Health – Transportation*, present estimates of the health effects from potential radiological air emissions.

4.4.1 All Project Phases

Air quality impacts from project activities would result from (1) combustive emissions due to the use of fossil-fuel-powered equipment, trucks, and worker commuter vehicles and (2) fugitive dust emissions (PM_{10} and $PM_{2.5}$) due to the operation of equipment on exposed soil during site preparation and restoration at CITRC. Equipment and vehicle activity data developed by INL staff were used to estimate projected combustive and fugitive dust emissions (Appendix B, *Environmental Resources*). The analysis estimated calendar year air emissions from project activities for purposes of comparison to the applicable PSD indicator threshold.

Factors needed to derive project source emission rates were obtained from EPA's Motor Vehicle Emission Simulator (MOVES2014b) model for nonroad equipment and on-road vehicles (EPA, 2021e) and Western Regional Air Partnership's Fugitive Dust Handbook for fugitive dust sources (Countess Environmental, 2006). Factors needed to estimate emissions for propane-fired equipment also were obtained from the EPA NONROAD2008 model (EPA, 2010). The analysis assumes that DOE would implement protective measures to minimize the generation of fugitive dust during construction and comply with Sections 650 and 651 (Rules for Control of Fugitive Dust) of the Rules for the Control of Air Pollution in Idaho. Implementation of these measures would reduce fugitive dust emissions from active disturbed areas by up to 74 percent compared to uncontrolled levels (Countess Environmental, 2006). In addition, use of the diesel-powered electric generator (700 horsepower) during microreactor operations at CITRC would be subject to the permit to construct requirements outlined in Sections 58.01.01.200 through 228 of the Rules for the Control of Air Pollution in Idaho. The generator would operate about 500 hours over a 3-year period of mobile microreactor operations.

Table 4.4-1 lists estimates of calendar year emissions that would occur from activities under Project Pele. Due to the minor amount of project activities that would occur during years 2026 through 2028, emissions during this period are grouped into one category, "Post-2025." These data show that the combined annual emissions from all sources would be well below the annual indicator thresholds. Therefore, annual emissions from Project Pele would not result in adverse air quality impacts. Operation of the diesel-powered electric generator (nonroad source type) during mobile microreactor operations at CITRC would be the largest source of air emissions from years 2023 through 2025.

Table 4.4-1. Calendar Year Nonradiological Emissions – Project Pele

Calendar Year/Source Type	*Air Pollutant Emissions [a]*						
	VOCs (tons)	*CO (tons)*	*NO_x (tons)*	*SO_2 (tons)*	*PM_{10} (tons)*	*$PM_{2.5}$ (tons)*	*CO_2e (metric tons)*
Year 2022							
On-Site On-Road Sources	0.00	0.13	0.01	0.00	0.00	0.00	17
On-Site Nonroad Sources	0.01	0.18	0.11	0.00	0.01	0.01	54
On-Site Fugitive Dust					0.22	0.02	
2022 On-Site Emissions	**0.01**	**0.31**	**0.12**	**0.00**	**0.23**	**0.03**	**72**
Off-Site On-Road Sources	0.01	0.83	0.09	0.00	0.03	0.01	104
Total 2022 Emissions	**0.02**	**1.14**	**0.23**	**0.00**	**0.25**	**0.03**	**176**
Year 2023							
On-Site On-Road Sources	0.00	0.16	0.02	0.00	0.00	0.00	22
On-Site Nonroad Sources	0.01	0.11	0.22	0.00	0.01	0.01	98
On-Site Fugitive Dust					1.09	0.11	
2023 On-Site Emissions	**0.02**	**0.27**	**0.24**	**0.00**	**1.11**	**0.12**	**120**
Off-Site On-Road Sources	0.01	1.03	0.16	0.00	0.04	0.01	146
Total 2023 Emissions	**0.03**	**1.30**	**0.40**	**0.00**	**1.15**	**0.13**	**267**
Year 2024							
On-Site On-Road Sources	0.00	0.17	0.01	0.00	0.00	0.00	21
On-Site Nonroad Sources	0.01	0.09	0.20	0.00	0.01	0.01	102
2024 On-Site Emissions	**0.01**	**0.25**	**0.21**	**0.00**	**0.02**	**0.01**	**123**

Table 4.4-1. Calendar Year Nonradiological Emissions – Project Pele (Continued)

Calendar Year/Source Type	*Air Pollutant Emissions [a]*						
	VOCs (tons)	*CO (tons)*	*NO_x (tons)*	*SO_2 (tons)*	*PM_{10} (tons)*	*$PM_{2.5}$ (tons)*	*CO_2e (metric tons)*
Off-Site On-Road Sources	0.01	1.08	0.07	0.00	0.03	0.01	123
Total 2024 Emissions	**0.02**	**1.33**	**0.28**	**0.00**	**0.05**	**0.02**	**246**
Year 2025							
On-Site On-Road Sources	0.00	0.16	0.01	0.00	0.00	0.00	25
On-Site Nonroad Sources	0.02	0.14	0.35	0.00	0.02	0.02	206
On-Site Fugitive Dust					0.15	0.02	
2025 On-Site Emissions	**0.02**	**0.30**	**0.36**	**0.00**	**0.18**	**0.04**	**230**
Off-Site On-Road Sources	0.01	1.02	0.07	0.00	0.03	0.01	126
Total 2025 Emissions	**0.03**	**1.33**	**0.44**	**0.00**	**0.21**	**0.04**	**356**
Post-2025							
On-Site On-Road Sources	0.00	0.12	0.01	0.00	0.00	0.00	19
On-Site Nonroad Sources	0.02	1.19	0.26	0.01	0.02	0.02	163
Post-2025 On-Site Emissions	**0.02**	**1.31**	**0.27**	**0.01**	**0.02**	**0.02**	**181**
Off-Site On-Road Sources	0.01	0.79	0.12	0.00	0.03	0.01	126
Total Post-2025 Emissions	**0.03**	**2.10**	**0.39**	**0.01**	**0.05**	**0.02**	**307**
Annual Indicator Thresholds	250	250	250	250	250	250	NA
Exceed Threshold?	No	No	No	No	No	No	NA

Key: CO = carbon monoxide; CO_2e = carbon dioxide equivalent; NA = not applicable; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

Notes: Values less than 0.005 is shown as 0.00.

[a] Due to rounding, sums might not equal those calculated from table entries.

Combustion of fossil fuels in equipment, trucks, and worker commuter vehicles also would emit nonradiological HAPs. Combined HAPs from diesel-powered internal combustion engines compose about 15 and 3 percent, respectively, of total volatile organic compounds and PM_{10} emissions (California Air Resources Board, 2021). The main HAPs emitted from these sources, in order of decreasing mass are formaldehyde, acetaldehyde, benzene, toluene, and propionaldehyde. The analysis estimated that on-site HAPs emissions from the project would peak in year 2025 at 0.004 ton per year. These minimal amounts of HAPs would disperse to inconsequential concentrations once transported about 3 miles from the CITRC to the nearest location of the INL Site boundary. In addition, the intermittent operation of project trucks and worker commuter vehicles on public roads would contribute to low concentrations of HAPs at these off-site locations. As a result, HAP concentrations generated by the project would not result in adverse air quality impacts on the public.

Air emissions from Project Pele would have the potential to affect the Craters of the Moon National Monument and Preserve PSD Class I area, the nearest border of which is about 34 miles southwest of CITRC (see **Figure 2.3-1**). The mobile and/or intermittent operation of project emission sources would result in dispersed concentrations of air pollutants at locations outside the INL Site. The transport of these emissions to the nearest boundary of the Craters of the Moon National Monument and Preserve would produce substantial dispersion and would result in negligible concentrations of air pollutants within this pristine Class I area. Therefore, Project Pele would negligibly affect air quality values within the Craters of the Moon National Monument and Preserve pristine Class I area.

Based on the above reasoning, PM_{10} emissions from the project also would negligibly impact the nearest PM_{10} nonattainment or maintenance area to the INL Site, which is the Fort Hall Indian Reservation PM_{10} nonattainment area in northeastern Power County and northwestern Bannock County (see **Figure 2.3-1**). The nearest border of this area to CITRC is about 33 miles in distance.

Site preparation and restoration activities at CITRC would not generate radiological air emissions. Operation of Project Pele potentially would generate radiological air emissions from (1) startup testing of the microreactor at the DOME at MFC, (2) microreactor operations at CITRC, (3) temporary microreactor storage, and (4) PIE at HFEF. INL would develop an Air Permitting and Applicability Determination for each applicable source of radiological air emissions to ensure compliance with 40 CFR 61, Subpart H. All radionuclide sources within the DOME and HFEF would vent to stacks that would operate with continuous emission monitoring systems and HEPA filters or a series of HEPA filters that have a control efficiency of at least 99.9 percent. Radiological air emissions from microreactor operations at CITRC would be minimal and would occur as uncontrolled effluent (without air filtration). Section 4.10.1, *Human Health – Normal Operations, All Project Phases – Operations*, presents estimates of annual radiological emissions that would occur from each phase of Project Pele.

4.5 Biological Resources

This section discusses the potential environmental consequences to biological resources that could occur during activities associated with Project Pele. This includes the potential for impacts to vegetation; wildlife; wetlands and aquatic habitats; and rare, threatened, endangered, or sensitive species. As stated in Section 4.0, *Introduction*, construction and operation of Project Pele are not expected to change existing conditions at MFC. As such, MFC is not discussed in this section. Per **Table 4.0-1**, the only phase with the potential to impact biological resources is Phase 4, Mobile Microreactor Operations at CITRC. No new impacts to biological resources would be anticipated during construction or operation of any of the other six proposed project phases, and those phases are not analyzed within this section.

A habitat-based analysis is used for most biological resources. This analysis quantifies the amount of different habitat types that would be removed or impacted by ground disturbing activities. This is done by "overlaying" a map of vegetation communities within the proposed project area onto the areas that would be impacted. For the purposes of this analysis, the ROI associated with Project Pele construction and demonstration includes Pads B, C, and D with a 200-foot (61-meter) buffer around the proposed security fences. The ecological review area, a 0.5-mile (805-meter) radius buffer that extends beyond Pads B, C, and D, was included in the analysis to account for an unforeseen hypothetical accident (see Section 4.11, *Human Health – Facility Accidents*). The quantity of each vegetation type removed is evaluated in the context of habitat importance in terms of species and function, sensitivity, and the availability of regionally similar resources. Significant impacts are considered to occur if activities (e.g., construction) were to take place within important habitat use areas during critical seasons (e.g., nesting, migration, hibernation). Likewise, if construction or operation of Project Pele were to cause population-level effects to any species from direct mortality or diminished survivorship, it would be considered significantly impactful. This analysis focuses on wildlife or vegetation types that are important to the function of the ecosystem or are protected under Federal or state law or statute.

Potential impacts on biological resources could include temporary and permanent disturbance, degradation, or loss of habitat from land-clearing activities or disturbance or displacement of wildlife due to an increase in noise and human activity associated with transport, construction, excavation, and demonstration. Impacts could also include fragmentation of remaining habitats resulting from project developments and increase in human-wildlife interactions (such as encounters and collisions between wildlife and motor vehicles). Multiple hazards (e.g., accidental spill or disaster) pose a risk for potential deleterious effects on vegetation and wildlife such as decline in species diversity, mortality, growth rate, vigor, and genetic mutations. Section 4.11, *Human Health – Facility Accidents*, discusses the potential off-normal, upset, or accident conditions that could arise during construction and operation of the proposed action, as well as how such scenarios would be managed. On-site management of accidents and spills minimizes potential impacts on biological resources caused from chemical spills. Overall, with implementation of avoidance and minimization measures impacts to biological resources are anticipated to be minimal.

Radiological exposure has different effects on biological resources where some species are more sensitive than others. Studies have demonstrated that plants, as a group, had effects of radiation that were almost an order of magnitude higher than in animals. In general, vegetation and wildlife exposure to radiation may lead to increased mutation rates, reduced growth rates, and pollen and seed viability as well as abnormal development (Mousseau & Møller, 2020).

4.5.1 Phase 4: Mobile Microreactor Operations at CITRC

4.5.1.1 Vegetation

Construction and demonstration of the proposed Project Pele would cause potential temporary and permanent impacts to sagebrush steppe habitats at CITRC. As stated in Section 4.0, *Introduction*, the actual selection and location of construction activities at Pads B, C, and D for site preparation at CITRC are not known at this time. Therefore, the analysis considered that construction activities for the concrete pad and fencing could occur anywhere within one of the three pads, including a 200-foot (61-meter) buffer surrounding each pad. Two pads could require minor grading of previously disturbed areas to house the load banks and diesel generators; no impacts to vegetation are anticipated. The analysis also assumed that construction access, staging, and parking would be restricted to existing developed areas within the pads and not result in impacts to vegetation.

The 200-foot buffer area of all three pads includes approximately 28 acres of vegetation (see **Table 4.5-1),** of which, approximately 1.6 acres could be permanently disturbed within the selected pad (Pad B, C, or D) for construction of the concrete pad and perimeter fencing, if these features are constructed entirely in an undisturbed location. To the maximum extent practical, developed or disturbed areas of the pads would be used to minimize impacts on vegetation.

As stated above, depending on placement of the proposed concrete pad and perimeter fencing, land clearing could remove existing habitats. **Table 4.5-1** lists the vegetation communities within the pad and buffer area, which includes sagebrush shrublands that potentially could be disturbed. Temporary impacts on vegetation from the impermanent transport of fuel, components, and the microreactor; staging of construction equipment; and worker parking during demonstration would be reduced by restricting construction access, staging, and parking to existing developed areas within the pads. These impacts would be temporary and localized and would not be anticipated to result in long-term or permanent impacts on surrounding vegetation communities. Initially, it would be very difficult to rehabilitate native vegetation similar in species composition, structure, and ecological function to that originally present, but over time, the area would be expected to recover and serve similar ecological functions. DOE implements a "no net loss of sagebrush habitat" policy on the INL Site under the CCA for the sage-grouse.

In compliance with the CCA, the project must complete pre- and post-construction surveys to establish the amounts of sagebrush restoration and other native revegetation efforts needed to rehabilitate disturbed areas as determined by DOE's ESER contractor. To mitigate the loss of sagebrush and comply with DOE policy, Project Pele would require monitoring sagebrush disturbance and planting amounts equal to that in non-project areas that are beneficial to sage-grouse. The amount of sagebrush within the disturbance footprint would be surveyed prior to any disturbance activities to ensure no loss of sagebrush habitat.

Table 4.5-1. Vegetation Communities Within the CITRC Pads and Ecological Review Area

Vegetation Community	***Project Component***			
	Pad B	***Pad C***	***Pad D***	***Ecological Review Area 1,319.32 (acres)***
	Vegetation within a 200-Foot Buffer	***Vegetation within a 200-Foot Buffer***	***Vegetation within a 200-Foot Buffer***	***0.5-Mile Radius***
Big Sagebrush – Green Rabbitbrush (Threetip Sagebrush) Shrubland	7.26	1.03	0	411.15
Green Rabbitbrush/Thickspike Wheatgrass Shrub Grassland and Needle and Thread Grassland	0	0	0	30.85
Green Rabbitbrush/Desert Alyssum (Cheatgrass) Ruderal Shrubland	0	6.66	3.46	408.57
Crested Wheatgrass Ruderal Grassland	0.01	4.54	4.81	372.48
Cheatgrass Ruderal Grassland	0	0	0	14.94
TOTAL ACRES OF VEGETATION	**7.27**	**12.23**	**8.27**	**1,237.99**
Previously Disturbed/ Facilities	4.2	20.75	8.14	32.49
Borrow Sources/ Disturbed	1.7	0	0	33.02
Exposed Rock/Cinder	0	0	0	5.78
Paved Road	0.23	0.44	0.19	10.02
TOTAL ACRES OF EXISTING DISTURBED AREAS	**6.13**	**21.19**	**8.33**	**81.31**

Source: (INL, 2019a)
Key: CITRC = Critical Infrastructure Test Range Complex; INL = Idaho National Laboratory
Note: Numbers presented are estimates; acreages will be quantified and amount of sagebrush will be updated prior to any disturbance activities to ensure no loss of sagebrush habitat.

Revegetation would occur in accordance with annual INL Site Revegetation Assessment program practices (INL, 2019c). Revegetation of the project site with native grasses would be evaluated and implemented to address soil stabilization and long-term weed control. Refer to the *Invasive Species* subsection below for additional information regarding revegetation.

Invasive Species

Under Project Pele, construction and land-clearing activities would potentially increase soil disturbance. Soil disturbance is a primary contributor to the spread of invasive plants and increases in weedy non-native invasive species. As a result, invasive species management and weed control would be necessary to facilitate reestablishment of native communities. Indirect impacts associated with personnel, motor vehicles, and equipment transport would provide potential opportunities for invasive plant species to spread into areas supporting native vegetation. Minimizing the spread of non-native species could reduce impacts to sensitive species and habitats.

Prior to project activities, the need for a Weed Management Plan will be evaluated and, if warranted, would be developed to establish proactive invasive species management goals. Invasive species management would continue to be implemented during Project Pele. INL Site staff would identify and implement BMPs to reduce the need for revegetation efforts during the NEPA process (e.g., minimizing off-road vehicle travel, limiting soil disturbance to previously disturbed areas, mowing vegetation instead of grubbing). An environmental checklist would also be used to determine when project activities could result in soil disturbance and identify when vegetation restoration is required (INL, 2019c).

4.5.1.2 Wildlife

Wildlife within the proposed project area could be permanently or temporarily disturbed or displaced due to loss of habitat from land-clearing activities and/or an increase in noise and human activity associated with construction and demonstration. Noise effects from construction would be short term (lasting only the duration of project construction) and would only affect wildlife in the immediate project areas. Species would likely flush from the area to similar habitat(s) available nearby. Those affected would generally be able to return to the temporarily disturbed areas after construction is completed. While some wildlife might avoid project sites long term, the affected areas would be small compared with other similar habitats available nearby.

Construction, demonstration, and transport activities could also result in potential collisions between wildlife and motor vehicles. In addition, on-site traffic at CITRC could increase by about 87 additional personnel during Phase 4 of Project Pele (Section 4.13.4, *Phase 4: Mobile Microreactor Operations at CITRC*). While this increase would represent a negligible impact on traffic, it could directly impact species (e.g., snakes) through increased risk of collision over time.

To minimize potential impacts, the need for operational and administrative controls would be evaluated and implemented to reduce adverse effects to wildlife species. Administrative controls would include posting speed limit signs and roping off sensitive areas. Increased vehicle activity within the proposed project area could increase the risk for wildlife strikes by vehicles. Mortality to wildlife caused by a collision could be minimized by reducing speeds to less than 15 miles per hour and increasing awareness of construction crews and staff to the presence of any animals that may frequent the area. If an animal is observed in the road, vehicles would stop and wait until the animal leaves the road and, if necessary, encourage the animal to move on by driving forward slowly.

Additionally, Project Pele could cause indirect impacts on wildlife from habitat fragmentation. Land clearing would cause disturbances in the landscape, resulting in new habitat edges and potentially disrupting wildlife ecosystem processes and habitats. The degree of the loss would depend on the behavior response of the individual species. The proposed fencing surrounding the mobile microreactor and increase in personnel traffic could impose dispersal barriers to most non-flying terrestrial animals. To mitigate the loss of sagebrush and comply with DOE policy in accordance with annual INL Site Revegetation Assessment program practices (INL, 2019c), the proposed project, would create additional sagebrush habitat as necessary to provide opportunities for wildlife movement. Furthermore, unaffected habitat in the region would be able to support wildlife movement; thus, impacts on habitat fragmentation would be limited.

4.5.1.3 Special Status Species

Federally Listed Species

No federally listed threatened or endangered species or designated critical habitats were identified under the USFWS IPaC review (USFWS, 2021b). Additionally, no federally listed threatened or endangered species have been historically documented at the INL Site under the ESER Program. As such, land-clearing activities at CITRC are not anticipated to result in temporary or permanent impacts on federally threatened and endangered species.

The Proposed Action could result in the direct loss of vegetation, subsequently causing direct and indirect impacts on MBTA and BCC species and their habitats. Under the Proposed Action, monitoring of breeding birds throughout the INL Site would continue. DOE-ID has a USFWS MBTA Special Purpose Permit for limited nest relocation and destruction and the associated take of migratory birds if deemed absolutely necessary for mission-critical activities. The permit would be applied in very limited and extreme situations where no other recourse is practicable (DOE-ID, 2021c). In accordance with the USFWS Mitigation Policy, DOE would be required to evaluate ways to avoid or minimize any such impacts during construction and operation of the proposed facilities. The addition of man-made features could entice wildlife such as nesting birds. For example, the proposed construction of temporary shielding at CITRC could attract swallows to newly available eaves and overhangs where swallows like to build mud nests. To prevent swallows and other birds from building nests in newly constructed facilities, INL personnel would take the following proactive steps:

- Install a physical barrier, such as bird netting under eaves and overhangs.
- Use sound deterrents such as swallow distress calls.
- Use visual deterrents such as flash tape, predator eye balloon, and/or reflective eye diverters.

Operational and administrative controls to avoid or reduce potential impacts to special status species would be implemented. These would include employing time-of-year restrictions during land-clearing activities. Suitable bird nesting habitat is present throughout the proposed project area. Construction and land-clearing activities, including vegetation removal, that occur from April 1 through October 1 would be controlled to preclude damage to active nests of passerines. Work during the migratory bird nesting season for passerines (April 1 through October 1) requires a migratory bird nesting survey 72 hours prior to soil or vegetation disturbance in an area. Nesting season for owls, hawks, and eagles may begin earlier than passerines, as early as October, and peak nesting season for corvids is February 1 to July 1. Nesting bird surveys, as indicated in the MBTA permit, would occur prior to any ground disturbance or vegetation removal. If surveys discover active nests, the project would implement measures, such as creating suitable buffer areas around active nests or halting work, to prevent nest failure or abandonment until young have fledged.

The annual BBS Route K/CITRC surrounds (is collocated with) the operational area boundary of CITRC (**Figure 3.5-1**, Biological Resources Within the Proposed Project Area at the INL Site). As a result, future annual routes may need to be modified accordingly to coincide outside of the project construction period. As such, INL Natural Resources Department would determine the need for any modifications to BBS routes. Thus, impacts on migratory birds (including BCC species) would be minimized, and implementation of the Proposed Action would not result in any significant impacts.

No bald or golden eagles (protected under the Bald and Golden Eagle Protection Act) are known to nest in or near the proposed project area. Therefore, impacts on bald or golden eagles are not expected.

State-Listed Species

Bats at the INL Site utilize a mosaic of high-quality, shrub-steppe habitats overlying near-surface basalt deposits with abundant (and protected) lava tube caves, fractured rock outcrops, talus-flanked buttes, and juniper uplands. These areas provide an abundance of high-quality foraging and roosting habitat for a variety of resident and transient bat species. Potential impacts to bat foraging habitats could occur from the removal of habitats during construction and land clearing associated with CITRC. The INL Bat Protection Plan would be implemented and there would be collaboration with the IDFG to minimize impacts to bats (Veolia, 2020). Furthermore, any conservation actions identified in the Idaho State Wildlife Action Plan would also be implemented.

No active pygmy rabbit burrows were identified within the pad locations during October 2020 surveys of the area, although potential suitable habitat for the species is present (Veolia, 2020). The Proposed Action could result in the direct loss of vegetation, causing associated indirect impacts to pygmy rabbit habitat around CITRC. Habitat has become increasingly fragmented due to crested wheatgrass encroachment and wildland fire.

There are no sage-grouse lek locations within CITRC (Veolia, 2020). The closest known leks are located approximately 1.93 miles south of Pad B, 1.67 miles south of Pad C, and 1.02 miles south of Pad D (see **Figure 3.5-1**, Biological Resources Within the Proposed Project Area at the INL Site). Nesting bird surveys, as indicated in the MBTA permit, would occur prior to any ground disturbance or vegetation removal to confirm the definitive absence of sage-grouse from the proposed project area. Although the sage-grouse does not warrant protection under the ESA, DOE and the USFWS continue to collaborate on sage-grouse protection at the INL Site under the CCA (DOE-ID & USFWS, 2014). While the proposed project area is not within the established sage-grouse conservation area, the loss of potential suitable habitat is subject to DOE's "no net loss of sagebrush habitat" policy on the INL Site, as discussed in previously in Section 4.5.1.1, *Vegetation*. In compliance with the CCA, the project must complete pre- and post-construction surveys to establish the amounts of sagebrush restoration and other native revegetation efforts needed to rehabilitate disturbed areas. To mitigate the loss of sagebrush and comply with the DOE policy, the Proposed Action requires monitoring sagebrush disturbance and planting amounts equal to that in areas beneficial to sage-grouse. Land clearing and the loss of up to 1.6 acres of sagebrush habitat could cause habitat degradation and fragmentation, but appropriate mitigation measures would be employed and sagebrush habitats would be restored elsewhere on-site under the CCA.

Additional, short-term impacts could result from construction noise, lasting only during the construction of the project (approximately 6 months). It is anticipated that special status mammals and birds would temporarily flee or flush from the area during times of high human activity. Given the proximity of available suitable habitat at the INL Site, temporary impacts would not be considered significant. Therefore, no significant impacts on state-listed species are expected under the Proposed Action.

Pads B, C, and D contain potential suitable habitat for the state-listed plants (**Table 3.5-2**, Special Status Species Known to Occur at the INL Site and Potential to Occur Within CITRC). Targeted surveys for these species have not been conducted, and the presence of these rare plant species cannot be determined at this time. Coordination with applicable INL Natural Resource staff would be required prior to any land-clearing activities. As part of the project's mitigation measures, surveys for rare plants would be required during optimal growing and blooming periods that correlate with the appropriate seasonal timing for potential species. If state-listed plants are found, mitigation measures would generally include avoidance of all known individuals and minimizing impacts to occupied habitat. Alternatively, if avoidance of a state-listed plant species is not possible, relocation or appropriate mitigation or restoration would be implemented.

Timing of Project Activities

The following details sensitive breeding, nesting, or generally more active times of wildlife known to occur within or near the proposed project area. Operational controls would be evaluated and implemented, if warranted, to minimize impacts on those species.

- **MBTA-protected species—waterfowl, corvids (ravens), owls, raptors (hawks, eagles), passerine birds and bats:** All year. Surface- and vegetation-disturbing activities should avoid nesting season for the various groups of birds and breeding bats, or be preceded by surveys to confirm the absence of nesting birds and breeding bats. Work during the migratory bird nesting season for passerines (April 1 through October 1) requires a migratory bird nesting survey 72 hours prior to vegetation disturbance. Nesting season for owls, hawks, and eagles may begin earlier than passerines, as early as October, peak nesting season for corvids is February 1 through July 1 and breeding season for bats is May 1 through October 31.
- **Sage-grouse:** March 15 through May 15 from 6 p.m. to 9 a.m. Eliminate human disturbance within 0.6 mile of active leks.
- **Pygmy rabbits:** All year. To the maximum extent practical, areas known to be occupied by pygmy rabbit would be avoided. Avoid (where practicable) or minimize activity within 300 feet of rabbit locations to prevent direct impacts.
- **Snakes:** May through September. Potential suitable habitat for snakes is present within the sagebrush communities. To avoid or reduce human-snake encounters, any hibernaculum locations should be avoided, especially when snakes are known to occur in high densities (May through early June and September through early October). If construction were to occur during these times, there could be an increased risk of snake mortality and an increase in safety concerns for workers. Construction workers would be encouraged to check dark places before operating machinery; step on, rather than over, rocks where a snake may be hiding; and take extra caution during cooler times of the day throughout the summer.

4.5.1.4 Aquatic Resources

Aquatic resources (i.e., wetlands, streams, or conveyances) are not present within Pads B, C, or D. Wetland features, 2.83 acres of freshwater ponds and 2.72 acres of riverine features, are present in the ecological review area approximately 470 feet east of Pad C and more than 1,300 feet from Pads B and D.

Potential indirect impacts from proposed construction could result in additional sediment loads being transported to surface waters in the project vicinity. Additional sediment loads would be managed through low-impact stormwater techniques such as local infiltration and sediment control devices (e.g., silt fencing) to prevent impacts to aquatic habitat. These measures could include the use of porous materials, directing runoff to permeable areas, and detention basins to release runoff over time. All necessary permits for stormwater discharges would be obtained prior to construction. Refer to Section 4.3, *Water Resources*, for a detailed discussion on impacts to groundwater, surface water, and stormwater resources.

Additional assessment would be required during the final design prior to any ground disturbance to assess the full scale of impacts and determine appropriate mitigation strategies. Minimally, this would include wetland delineations (USACE, 1987). Any sensitive features would be avoided or appropriate mitigation measures would be employed if impacts are unavoidable.

4.5.1.5 Wildfire

Land-clearing activities could cause disturbance to soil, which could indirectly promote the invasion of weeds that may alter the fire regime. An increase in weedy species can lead to high fuel loads (dense, dry vegetation) and generally lead to increased fire intensity and risk for a wildfire. As previously discussed in Section 4.5.1.1, *Vegetation*, invasive species management would continue to be implemented during Project Pele. Restoration and other native revegetation efforts would be evaluated and employed to rehabilitate disturbed areas. Additionally, wildland fire management would continue to be employed at the INL Site to reduce the risk of wildfire and prevent any additional losses of sagebrush habitats.

4.6 Cultural and Paleontological Resources

This section discusses the potential effects of Project Pele on cultural resources, with a focus on the elements of the project with potential for adverse effects, which is facility construction at CITRC (Phase 4) and either the RSWF or ORSA (Phase 6). As described in Section 4.0, *Introduction*, most phases of Project Pele would not require new construction or improvements, and the proposed activities would be consistent with the current (and historic) use of the existing historic facilities (see Section 3.6.2, *Cultural Resources*). Thus, their use would have no effect.

The ROI for cultural resources evaluation is the same as the APE defined in Section 3.6, *Cultural and Paleontological Resources*. This includes the land that would be disturbed by facility construction at CITRC along with a 200-foot buffer around the proposed security fences, land that would be disturbed by facility construction in the RSWF or ORSA, and select buildings and structures at MFC. As described below, no effect on cultural resources would occur from facility construction and land disturbance at CITRC (Phase 4) and the RSWF or ORSA (Phase 6) or from facility preparation, testing, use, transportation, and storage at MFC and CITRC (Phases 1, 2, 3, 5, and 7).

Potential effects to cultural resources were assessed by applying the criteria of adverse effect as defined in the implementing regulations for Section 106 of the NHPA (36 CFR 800.5[a]). An adverse effect would occur if any phase of the Proposed Action were to alter the characteristics of a property that is listed in, eligible for, or unevaluated for eligibility for the NRHP (including burial or sacred sites) that qualifies it for the NRHP. Such impacts include those that would diminish the integrity of the property's location, design, setting, workmanship, feeling, or association. Some examples of adverse effects to cultural resources include physical destruction or damage; introduction of visible, audible, or atmospheric elements out of character with the resource; or neglect resulting in deterioration. Adverse effects may include reasonably foreseeable effects caused by the action that may occur later in time, be farther removed in distance, or be cumulative.

Table 4.6-1 lists the potential environmental consequences on cultural and paleontological resources for the seven phases of Project Pele. Activities associated with Project Pele are anticipated to result in no effect (no impact) on cultural resources.

Table 4.6-1. Summary of Environmental Consequences to Cultural Resources

Project Phase	*Potential Impacts*	*Justification*
Phase 1: Fuel Mobile Microreactor (TREAT or HFEF)	No effect on ethnographic, significant cultural, and paleontological resources	This phase is consistent with current activities at TREAT and HFEF and would require no new construction.
Phase 2: Mobile Microreactor Startup Testing (MFC or CITRC)	No effect on ethnographic, significant cultural, and paleontological resources	This phase is consistent with current activities at MFC and CITRC. Startup testing at MFC would require no new construction. Impacts from any required construction at CITRC (if selected for startup testing) are covered under the subsections on site preparation within the Phase 4 analysis. Cultural resource awareness training would be required for personnel

Table 4.6-1. Summary of Environmental Consequences on Cultural Resources (Continued)

Project Phase	Potential Impacts	Justification
		working at CITRC, as specified by INL/LTD-20-60577.
Phase 3: Mobile Microreactor Disassembly and Transport (at CITRC or from MFC to CITRC)	No effect on ethnographic, significant cultural, and paleontological resources	The existing INL infrastructure can accommodate project-related transport. No new construction or infrastructure improvements are required. Cultural resource awareness training would be required for personnel working at CITRC, as specified by INL/LTD-20-60577.
Phase 4: Mobile Microreactor Operations at CITRC	No effect on ethnographic, significant cultural, and paleontological resources	No cultural resources are within the area proposed for construction, and there are no NRHP-eligible buildings or structures near the construction area. All ground-disturbing activities would be monitored by an INL Cultural Resource Management Office archaeologist, and Shoshone-Bannock Tribal representatives would be invited to participate in this monitoring. Cultural resource awareness training would be required for personnel working at CITRC, as specified by INL/LTD-20-60577.
Phase 5: Mobile Microreactor Disassembly at CITRC and Transport to Temporary Storage (RSWF or ORSA)	No effect on ethnographic, significant cultural, and paleontological resources	The existing INL Site infrastructure can accommodate project-related transport. No new construction or infrastructure improvements are required. Cultural resource awareness training would be required for personnel working at CITRC, as specified by INL/LTD-20-60577.
Phase 6: Mobile Microreactor Temporary Storage (RSWF or ORSA)	No effects on ethnographic, significant cultural, and paleontological resources are expected	No known cultural resources are within the area proposed for construction, and this phase is consistent with historic and current activities at RSWF and ORSA[1].
Phase 7: Mobile Microreactor and Spent Nuclear Fuel Post Irradiation Examination and/or Disposition	No effect on ethnographic, significant cultural, and paleontological resources	This phase is consistent with historic and current activities at the proposed facilities and would require no new construction.

Key: CITRC = Critical Infrastructure Test Range Complex; HFEF = Hot Fuel Examination Facility; INL = Idaho National Laboratory; MFC = Materials and Fuels Complex; NRHP = National Register of Historic Places; ORSA = Outdoor Radioactive Storage Area; RSWF = Radioactive Scrap and Waste Facility; TREAT = Transient Reactor Test Facility

Note:

[1] The RSWF area was not surveyed for archaeological resources and the potential effects to MFC historic properties within view of the ORSA area were not evaluated because an exact location for the temporary storage has not been selected yet. The necessary National Historic Preservation Act Section 106 survey and review will be performed later when an exact location has been selected.

4.6.1 Phase 4: Mobile Microreactor Operations at CITRC

No effects on ethnographic, cultural, or paleontological resources are anticipated from proposed construction activities at CITRC (Phase 4). Cultural resource investigations were conducted to identify, document, and assess the NRHP eligibility and overall cultural sensitivity of cultural resources within the APE (DOE-ID, 2021d). These activities resulted in the confirmation of four previously recorded cultural resources at CITRC. Three of the cultural resources were determined to not meet the threshold of significance to be recommended as eligible for listing in the NRHP. The fourth site is highly significant to the Shoshone-Bannock Tribe and is provided the same protections given to sites listed on the NRHP. All four resources are located outside the proposed security fence and would not be affected by construction activities. The existing four buildings and two trailers at CITRC are also recommended as not eligible for the NRHP. Construction and demonstration of a mobile microreactor at the INL Site would have no effect on significant archaeological and architectural resources.

The land where CITRC is located is culturally sensitive and highly significant to the Shoshone-Bannock Tribes. Therefore, all ground-disturbing activities at CITRC would be monitored by an INL Cultural Resource Management Office archaeologist to ensure that, should an inadvertent discovery occur, the remains would be secured until DOE and the Tribes are contacted and decisions made for their protection and preservation. Shoshone-Bannock Tribal representatives would also be invited to participate in the construction monitoring. Monitoring the ground-disturbing activities would ensure that the Proposed Action would have no impacts on any historic properties or culturally sensitive resources (DOE-ID, 2021d).

4.6.2 Phase 6: Mobile Microreactor Temporary Storage (RSWF or ORSA)

No effects on ethnographic, cultural, or paleontological resources are anticipated from proposed construction activities at either the RSWF or ORSA (Phase 6). No known cultural resources are located within the area proposed for construction and this phase is consistent with historic and current activities at RSWF or ORSA (INL, 2021a). However, the RSWF area was not surveyed for archaeological resources and the potential effects to MFC historic properties within view of the ORSA area were not evaluated because an exact location for the temporary storage has not been selected yet. The necessary NHPA Section 106 survey and review will be performed later when an exact location has been selected.

4.7 Infrastructure

4.7.1 All Project Phases

This subsection discusses the potential impacts associated with Project Pele on the utility infrastructure at the INL Site, specifically MFC and CITRC. Impacts from the consumption of electricity, fuel, and other resources would result if demand exceeds current capacity at a given location. Impacts to utility infrastructure would occur if the existing infrastructure is insufficient to support the Proposed Action during either the construction or operational phase. Each of the seven phases of Project Pele would involve some utilization of electricity, water, or fuel. These allocations are addressed in this subsection.

During construction activities associated with Project Pele, an incremental and temporary increase in energy demand at existing CITRC and MFC facilities may result due to the use of equipment and tools. Minimal utilization of the existing electrical infrastructure at the INL Site would be expected during construction; much of this energy need would be supplied by diesel generators and would not utilize the existing INL Site power grid. Materials such as propane, diesel fuel, and gasoline would be procured by outside vendors and brought to the site by contractors and would not have a direct effect on infrastructure systems at the INL Site. **Table 4.7-1** summarizes infrastructure requirements for Project Pele.

Table 4.7-1. Infrastructure Requirements for Project Pele Activities

Project Phase	Electricity (kWh)	Water (gallons)	Diesel (gallons)	Propane (pounds)	Gasoline (gallons)
Fuel Mobile Microreactor at MFC	10,000	1,500	NA	4,000	NA
Mobile Microreactor Initial Startup Testing	15,000	83,000	NA	NA	NA
Disassembly and Transport	NA	1,000	21,000	NA	3,500
Mobile Reactor Operations at CITRC	10,000	167,000	30,000	NA	2,000
Disassembly and Transport from CITRC to Temporary Storage	NA	1,000	21,000	NA	3,500
Temporary Storage at the INL Site	2,000	minimal	NA	NA	NA
Post–Irradiation Examination and Disposition	100,000	7,000	NA	30,000	NA
Total	**137,000**	**260,500**	**72,000**	**34,000**	**9,000**
INL Site Capacity	481,800,000 kWh/year	11.4 billion gal/year	NA [a]	NA [a]	NA [a]

Source: See Appendix B, *Environmental Resources*

Key: CITRC = Critical Infrastructure Test Range Complex; gal = gallons; INL = Idaho National Laboratory; kWh = kilowatt-hour; MFC = Materials and Fuels Complex; NA = not applicable

Note:

[a] Capacity is limited only by the ability to ship resources to the site.

Electricity usage associated with Project Pele over its duration totals 137,000 kilowatt-hours (kWh), or 64,333 kWh per year, if averaging use for the life span of the project over 1 representative year. This usage is well below the total INL Site capacity of 481,800,000 kWh per year. Peak loads associated with the Proposed Action would be no greater than 50 kW, which is well below the INL Site capacity of 55,000 kW. In addition, electricity usage would occur sequentially in conjunction with each project phase and would not overlap; therefore, the majority of electrical demand (100,000 kW) would not occur until the final 3 years of the project during Phase 7 (Post–Irradiation Examination and Disposition).

The total projected water usage for Project Pele over its duration of 260,500 gallons represents about 0.0023 percent of the INL Site's Federal Reserved Water Right of 11.4 billion gallons per year. The majority of water would be used for microreactor construction and operations (207,000 gallons) and the remainder for office use (53,500 gallons).

The current sanitary wastewater systems at CITRC and MFC are adequate to accommodate the additional load from the relatively small number of employees and cleaning and maintenance activities. Sanitary wastewater would be discharged to septic tanks with drainage fields or would be accommodated by existing on-site systems. As a result, sanitary discharge volumes to one of the three operating septic tanks and associated drainage fields at CITRC would not significantly increase nor would discharges to the existing sanitary sewer system at MFC.

Therefore, minimal impacts on site infrastructure would be expected.

4.8 Noise

The following evaluates the potential for noise and vibration levels to change as a result of Project Pele. For purposes of the analysis, the Proposed Action would result in adverse noise and vibration effects if it would cause any of the following:

- Conflict with any Federal, state, or local noise ordinances
- Long-term perceptible increase in ambient noise levels above regulatory thresholds at sensitive receptors during operations
- Excessive ground-borne vibration to persons or property

As described in Section 4.0, *Introduction*, the activities planned at MFC would use existing infrastructure, would be consistent with existing operations, and would not cause a significant increase to the baseline noise levels discussed in Section 3.8, *Noise*. Additionally, existing road infrastructure would not require improvements for transport.

4.8.1 Phase 4: Mobile Microreactor Operations at CITRC

Site Preparation and Mobile Microreactor Unloading

DoD anticipates a total duration of 6 months for construction activities at CITRC to include site preparations, shielding preparation, site electrical hookup, and modular office and sanitary facility construction. On-site construction noise would be temporary and mainly result from site preparations, grading, leveling, construction of the concrete pad and facilities, vehicle traffic, and other associated activities, including the use of heavy-duty construction equipment (e.g., trucks, graders, excavators, backhoes, compactors, cranes).

In general, average equivalent noise levels from typical construction sites range from 79 to 89 dBA at 50 feet (Bolt, Baranek and Newman, Inc., 1971). Construction noise levels are rarely steady but instead fluctuate depending on the type, amount, and duration of use of heavy equipment. There would be times when no large equipment would be operating, and noise would be at or near ambient levels. Construction noise differs by the type of activity, distance to noise-sensitive uses, existing site conditions (vegetation to buffer sound), and ambient noise levels. With multiple items of construction equipment operating concurrently, noise levels could be relatively high during daytime periods at locations within several hundred feet of active construction sites. Accounting for the concurrent use of the construction equipment, noise levels could be conservatively estimated to be about 83 dBA at 100 feet (DOT, 2012; DOT, 2018). Combined construction noise reduces levels to about 63 dBA at 1,000 feet (Lamancusa, 2009; DOT, 2018). Other construction noise would result from transportation-related activities, including worker vehicle trips and materials and waste trucks. To reduce potential impacts due to construction noise, construction would occur primarily during normal weekday business hours, and contractors would properly maintain construction equipment mufflers.

CITRC is about 5.9 miles from the INL Site boundary and 6.5 miles from the closest noise-sensitive receptor (i.e., home sites). Given the large distance, estimated construction noise would be indistinguishable to the closest noise-sensitive receptor. As a result, noise levels would be consistent with existing conditions described in Section 3.8, *Noise*, and would remain within applicable noise regulation standards.

Similar to human sensitive receptors, wildlife can experience noise and vibration impacts from human activities. Stress, avoidance of feeding, and loss of breeding success can result from elevated noise and vibration exposure to species. Section 4.5.1.2, *Wildlife*, discusses these noise effects on wildlife species in the immediate project area. In addition, because the INL Site is designated as a National Environmental

Research Park, construction noise could temporarily disturb research studies and wildlife species if located near CITRC. Impacts would be negligible as they would be short term and limited to construction activities.

As discussed in Section 3.8, *Noise*, the closest national and state parks are over 20 miles away from the construction area. The closest recreational area is Big Southern Butte, about 12 miles southwest of CITRC. Due to the long distance between the proposed construction and closest parks, construction noise is anticipated to be imperceptible at these locations.

Ground-borne vibration would be present during construction from site preparation, traffic, and other associated activities. Vibration would be temporary during construction and would generally be transient (e.g., single-impact equipment) and random (e.g., heavy construction equipment). Due to the distance to the nearest sensitive noise receptors, ground-borne vibration is expected to be below the threshold of human perception. As a result, impacts would not be expected.

Operations at CITRC

Noise impacts from operation of Project Pele at CITRC would mainly result from operation of the microreactor, intermittent use of a diesel-powered electric generator (500 kW in size), and worker commuter vehicles. INL personnel estimate the microreactor exhaust path would emit noise levels of about 110 decibels at 50 feet with no obstacles (Appendix B, *Environmental Resources*). INL personnel would place applicable equipment in noise-reducing enclosures with the goal of reducing noise levels to less than 80 decibels outside enclosures (Appendix B, *Environmental Resources*). Although operations at CITRC would be outdoors, due to the noise-reducing enclosures, radiation shielding, and radiation standoff distances, it is anticipated that the majority of the noise would be attenuated prior to staff accessing the power conversion unit, which would be the main source of noise. Personnel would not be near the system during operations except for occasional maintenance. Any personnel conducting maintenance on the system would wear required hearing protection.

The noise generated from operation of Project Pele would be consistent with other existing industrial activities and equipment at the INL Site, and the potential concurrent noise would be similar to existing levels at the INL Site. For example, noise from worker vehicle trips would be similar to existing vehicular noise and would not cause a change to the existing noise environment at the INL Site. As a result, operation of Project Pele and existing equipment would not impact off-site receptors. Given the distance from CITRC to the INL Site boundary (5.9 miles) and to the closest off-site noise-sensitive receptor (6.5 miles), operational noise and vibration would not be perceptible at the closest noise-sensitive receptor. As a result, Project Pele would have negligible impacts on the noise environment.

4.8.2 Phase 5: Mobile Microreactor Disassembly at CITRC and Transport to Temporary Storage (RSWF or ORSA)

Disassembly and transport activities at CITRC would involve equipment that would emit noise and vibration levels typical of industrial activities. Noise sources would include construction-type equipment for disassembly (e.g., forklift) and transport trucks (e.g., semi-trailer truck). Site restoration activities would involve removal of shielding and any remaining materials with typical construction equipment such as graders, excavators, dump trucks, tractor haulers, and pickup trucks.

Noise and vibration generated from disassembly and transport would be similar to construction activities associated with site preparation activities discussed in Section 4.8.1, *Phase 4: Mobile Microreactor Operations at CITRC*. Such activities would cause temporary increases in ambient noise levels in the immediate vicinity of CITRC, but given the large distance to the INL Site boundary (5.9 miles) and closest noise-sensitive receptor, estimated construction noise would be indistinguishable to the closest noise-sensitive receptor. As a result, negligible impacts would be expected since noise levels would be consistent with existing conditions described in Section 3.8, *Noise*, and would remain within applicable noise regulation standards.

4.8.3 Phase 6: Mobile Microreactor Temporary Storage (RSWF or ORSA)

Construction of the concrete pad and shed at either RSWF or ORSA for temporary storage of the mobile microreactor would result in temporary noise and vibration from construction activities. Construction noise levels would be similar to the site preparation noise levels described in Section 4.8.1, *Phase 4: Mobile Microreactor Operations at CITRC*. In general, average equivalent noise levels from typical construction sites range from 79 to 89 dBA at 50 feet (Bolt, Baranek and Newman, Inc., 1971). Accounting for the concurrent use of the construction equipment, noise levels could be conservatively estimated to be about 83 dBA at 100 feet (DOT, 2012; DOT, 2018). Combined construction noise reduces to about 63 dBA at 1,000 feet (Lamancusa, 2009; DOT, 2018). To reduce potential impacts from construction noise, construction would occur primarily during normal weekday business hours, and contractors would properly maintain construction equipment mufflers.

The proposed temporary storage locations at RSWF and ORSA are over 3.1 miles from the INL Site boundary. Given the large distance, estimated construction noise would have negligible impacts since it would be indistinguishable at and beyond the boundary of the INL Site.

4.9 Waste and Spent Nuclear Fuel Management

This section discusses the potential waste and SNF generation and management during each phase of Project Pele. Existing waste management practices and associated facilities are discussed in Sections 3.9.1, *Low-Level Radioactive Waste*, 3.9.2, *Mixed Low-Level Waste*, 3.9.3, *Transuranic Waste*, 3.9.4, *Spent Nuclear Fuel*, and 3.9.5, *Nonhazardous Solid Waste and Recyclable Materials*. Section 4.12, *Human Health – Transportation*, discusses the transportation of waste off-site from the INL Site to treatment and/or disposal facilities.

The overall impact of the Proposed Action on waste and SNF management would be negligible to minor. Wastes generated as a result of the Proposed Action would be managed within the current waste management systems and sent off-site for treatment and/or disposal as necessary. Treatment and disposal of all wastes as a result of the Proposed Action is well within the current throughput capacity of INL Site facilities, as discussed in Section 3.9, *Waste and Spent Nuclear Fuel Management*.

In the past, waste generation at CITRC has been intermittent and not representative of the projected waste generation of Project Pele. Therefore, previous MFC baseline waste generation data were incrementally scaled to provide an approximation for testing both at CITRC and the DOME. **Table 4.9-1** presents the scaled waste generation projections as a result of Project Pele.

Table 4.9-1. Projected Waste Generation for Project Pele

Phase	*Low-Level Radioactive Waste (LLW)*	*Mixed Low-Level Waste (MLLW)*	*Cold Waste*
Phase 1	6.5 m^3 – Miscellaneous	0.3 m^3 – Miscellaneous	2.3 m^3 – Miscellaneous
Phase 2	15,000 gallons – Shield Water 13.2 m^3 – Miscellaneous	0.8 m^3 - Miscellaneous	1.3 m^3 – Miscellaneous
Phase 3	50 units – Connections 250 ft – Piping 0.8 m^3 – Blowdown Waste	N/A	250 ft – Piping 250 ft – Wire Conduit 500 ft – Wiring

Table 4.9-1. Projected Waste Generation for Project Pele (Continued)

Phase	Low-Level Radioactive Waste (LLW)	Mixed Low-Level Waste (MLLW)	Cold Waste
Phase 4	**Site Preparation** N/A **Operations** 13.2 m^3 – Miscellaneous 35,000 gallons – Shield Water	**Site Preparation** N/A **Operations** 0.8 m^3 – Miscellaneous	**Site Preparation** 45.9 m^3 – Concrete Washout **Operations** 1.3 m^3 – Miscellaneous 2,294 m^3 – Reclaimed Concrete
Phase 5	2.5 m^3 – Blowdown Waste	N/A	N/A
Phase 6 [a]	N/A	N/A	1.5 m^3 – Concrete Washout 31 m^3 – Construction waste
Phase 7	24.3 m^3 – Miscellaneous 500 ft – Piping 1,000 ft – Wiring 2 Units – CONEX Containers 1 Unit – Reactor Vessel 20 yd^3 – Various Reactor CONEX Internals	1.3 m^3 – Miscellaneous	2.3 m^3 – Miscellaneous

Source: (INL, 2021f)
Key: CONEX = container express (shipping container); ft = feet; m^3 = cubic meters; N/A = not applicable; yd^3 = cubic yards
Note:
[a] All waste generated during Phase 6 would be during site preparation.

4.9.1 Phase 1: Fuel Mobile Microreactor (TREAT or HFEF)

Reactor fueling to be performed during Phase 1 would incrementally increase the LLW production at the facility selected for initial testing (TREAT or HFEF). Mobile microreactor fueling is estimated to result in an average yearly net generation of 6.5 cubic meters of LLW and 0.3 cubic meter of miscellaneous MLLW (personal protective equipment, Kimwipes™, etc.) (INL, 2021f).

Additionally, a bounding estimate of 2.3 cubic meters of cold waste (non-hazardous waste, universal waste, hazardous waste, TSCA waste, and industrial waste) would be generated during microreactor fueling (INL, 2021f).

4.9.2 Phase 2: Mobile Microreactor Startup Testing (MFC or CITRC)

During the Phase 2 testing, the microreactor would require water bladders to provide neutron shielding and prevent the activation of surrounding materials. The water would be treated prior to use in the shielding bladders to remove mineral impurities and limit activation products, to ensure radiation in the water remains below LLW limits or within off-site repository acceptance criteria (INL, 2021f).

A bounding estimate of 15,000 gallons of shield water would be used during testing. Once initial testing during Phase 2 has concluded the shield water would be purged for waste analysis and is expected to be disposed of as LLW. This shield water waste would be shipped off-site for treatment and/or disposal (INL, 2021f).

An annual average bounding estimate of 13.2 cubic meters of miscellaneous LLW and 0.8 cubic meter of miscellaneous MLLW (personal protective equipment, Kimwipes™, HEPA filters, etc.) would be generated during testing operations of Phase 2 (INL, 2021f). All LLW and MLLW would be shipped off-site for treatment and/or disposal. Treatment and disposal of these wastes are well within the current capacities of existing off-site facilities.

A bounding estimate of 1.3 cubic meters of cold waste would be generated during the startup testing phase (INL, 2021f).

4.9.3 Phase 3: Mobile Microreactor Disassembly and Transport (at CITRC or from MFC to CITRC)

Specific connections would be required to adapt the deployment of the microreactor to the DOME at MFC. During the testing at the DOME, a portion of the piping and connections would be contaminated with radioactive byproducts from the microreactor. Once the initial startup testing is complete, it is estimated that 50 connections and 250 feet of piping would be disassembled and disposed of as LLW. Other components to be disposed of as cold waste include an additional 250 feet of nonradioactive contaminated piping, 250 feet of wire conduit, and 500 feet of wiring (INL, 2021f).

Prior to shipment, the microreactor would be depressurized (also known as a blowdown) to equalize the pressure vessel to atmospheric pressures. Two blowdowns are expected to occur at the DOME. The noble gas released as a result of a blowdown would be filtered through HEPA filters prior to releasing it into the surrounding environment. Once the blowdown occurs, the HEPA filters may be disposed of as LLW, and the radioactive penetration systems may be bagged to prevent any releases during transit. In total, 20 HEPA filters could be used and bagged before transporting, which would consume approximately four 55-gallon drums. Therefore, approximately 0.8 cubic meter of LLW would be generated from the blowdowns during Phase 3 (INL, 2021f).

4.9.4 Phase 4: Mobile Microreactor Operations at CITRC

Site Preparation at CITRC

Site preparation at CITRC would involve construction of a 200-foot by 200-foot concrete pad for storage of CONEX containers and a security fence around the perimeter of the test site. Construction of the concrete pad would generate a bounding estimate of 45.9 cubic meters of concrete washout (leftover concrete washed off concrete trucks after construction). The concrete washout can be recycled after it is allowed to harden in a sealed container. The construction of the concrete pad and security fence would generate a minimal amount of miscellaneous nonhazardous solid waste and recyclable materials (INL, 2021f). As previously discussed in Section 3.9.5, *Nonhazardous Solid Waste and Recyclable Materials*, nonhazardous solid waste would be disposed of at the INL landfill, where capacity limitations would not be a concern. No radioactive or hazardous wastes are anticipated to be generated during site preparation.

Operations at CITRC

During operations of the microreactor at CITRC, an annual average of 13.2 cubic meters of miscellaneous LLW and 0.8 cubic meter of miscellaneous MLLW (personal protective equipment, Kimwipes^{TM}, HEPA filters, etc.) would be generated annually. The characteristics of the LLW and MLLW would be similar to the waste currently generated by existing activities at the INL Site and managed within the current waste management systems (INL, 2021f).

Similar to Phase 2 testing, mobile microreactor operations in Phase 4 would require water bladders. It is assumed that Phase 4 testing would use the same shield water bladders as Phase 2. An additional 35,000 gallons of shield water would be used and then purged and disposed of as LLW at the conclusion of testing operations at CITRC (INL, 2021f). All LLW and MLLW would be shipped off-site for treatment and/or disposal.

A bounding estimate of 1.3 cubic meters of cold waste would be generated annually during the operations at CITRC. After testing at CITRC is complete, the test pads will be reclaimed to their original state, resulting in the removal of some or all of the concrete. A bounding estimate of concrete to be disposed of during site reclamation efforts is 2,294 cubic meters. Some of the barriers will be repurposed or recycled (INL, 2021f).

4.9.5 Phase 5: Mobile Microreactor Disassembly at CITRC and Transport to Temporary Storage (RSWF or ORSA)

Six blowdowns are expected to occur before transporting the microreactor to temporary storage. In total, 60 HEPA filters could be used and bagged after use to prevent any releases during transit. The bagged penetrations would consume approximately twelve 55-gallon drums. Therefore, 2.5 cubic meters of LLW would be expected to be generated from the blowdown operations during Phase 5 (INL, 2021f).

4.9.6 Phase 6: Mobile Microreactor Temporary Storage (RSWF or ORSA)

A 50-foot by 50-foot concrete pad would be poured at the selected site of the temporary storage area. The construction of this concrete pad would generate a bounding estimate of 1.3 cubic meters of concrete washout (INL, 2021f). The concrete washout waste would be stored in a sealed container to harden, which would allow this waste to be recycled. Additionally, a bounding estimate of 31 cubic meters of other construction cold waste would be generated during site preparations for temporary storage. No radioactive or hazardous wastes are anticipated to be generated during site preparation and temporary storage.

4.9.7 Phase 7: Mobile Microreactor and Spent Nuclear Fuel Post Irradiation Examination and Disposition

During Phase 7, the microreactor core would be disassembled and analyzed to determine appropriate waste streams for the various components. During PIE, an average annual bounding estimate of 24.3 cubic meters of miscellaneous LLW and 1.5 cubic meters of miscellaneous MLLW would be generated (personal protective equipment, Kimwipes™, etc.) (INL, 2021f). **Table 4.9-2** lists miscellaneous microreactor components to be classified and disposed of as LLW at the conclusion of Project Pele.

Table 4.9-2. Microreactor Miscellaneous Low-Level Radioactive Waste Components

Component	*Quantity*
Piping	500 feet
Wiring	1,000 feet
CONEX Containers	2 units
Reactor Vessel	1 unit
Various Reactor CONEX Internals	15 cubic meters

Source: (INL, 2021f)
Key: CONEX = container express (shipping container)
Note: Projected waste generation identified in this table is also presented in **Table 4.9-1** (Phase 7).

An average annual bounding estimate of 2.3 cubic meters of miscellaneous cold waste (non-hazardous waste, universal waste, hazardous waste, TSCA waste, and industrial waste) would also be generated during PIE. A minimal amount of waste (no more than 3.4 cubic meters) may be classified as GTCC-like waste or transuranic waste during PIE activities and would be packaged in shielded containers for storage. TRU would be shipped to WIPP for disposal, and GTCC-like waste would be shipped to Waste Control Specialists for storage while waiting for a disposal pathway to be identified (INL, 2021f).

Less than 3.4 cubic meters of SNF would be generated during this phase. SNF and moderator blocks would be removed from the mobile microreactor and packaged in no more than three standard DOE SNF canisters for storage. SNF would be managed and stored at the INL Site but pending off-site shipment to a permanent repository. SNF would be managed in accordance with applicable laws and other requirements (INL, 2021f).

4.10 Human Health – Normal Operations

This section presents information on the potential impacts on humans associated with incident-free (normal) releases of radioactivity from the proposed Project Pele. Information on radiation doses that would be received by workers and the public as a result of demonstration activities for the mobile microreactor is presented. This section also discusses potential nonradiological impacts (from accidents and exposure to nonradiological chemicals) to workers from activities proposed in this EIS. Radiological human health risks are considered for involved workers, a non-involved worker, the off-site population, a member of the public exposed to the average radiological dose, and a member of the public identified as the MEI. Workers and members of the public are protected from exposure to radioactive material and hazardous chemicals by facility design and administrative procedures. DOE regulations and directives include 10 CFR 820, Procedural Rules for DOE Nuclear Facilities; DOE Order 458.1, *Radiation Protection of the Public and the Environment* (DOE, 2020b); 10 CFR 835, Occupational Radiation Protection; and 10 CFR 851, Worker Safety and Health Program.

DOE uses both radiation dose, expressed in rem (which stands for "roentgen equivalent man"), millirem, or person-rem and LCFs to represent the human health effects of exposure to radiation. In this EIS, a single risk factor is used for all isotopes to convert dose (in rem or person-rem) to an LCF regardless of the source of the dose.

A risk factor of 0.0006 LCF per person-rem or rem is used, consistent with DOE guidance (DOE, 2003). An LCF of less than 1 can be interpreted as the probability of an LCF. For an individual, this would be the probability of the MEI or average individual getting a fatal cancer. For a population, this can be interpreted as the probability of at least 1 LCF within the population.

DOE Order 458.1 (DOE, 2020b) imposes an annual individual dose limit of 10 millirem from

Involved worker: A worker directly or indirectly involved with demonstration of the mobile microreactor that as a result receives an occupational radiation exposure from direct radiation (i.e., neutron, x-ray, beta, or gamma) or from radionuclides released to the environment from normal operations.

Non-involved worker: A worker at the INL Site not involved in mobile microreactor demonstration activities who would not be subject to direct radiation exposure but could be incidentally exposed to radiological emissions from the mobile microreactor.

Off-site population: Comprises members of the general public who live within 50 miles (80 kilometers) of the mobile microreactor.

Maximally exposed individual (MEI): A hypothetical member of the public who—because of realistically assumed proximity, activities and living habits—would receive the highest radiation dose, taking into account all pathways, for a given event, process, or facility (DOE Order 458.1 (DOE, 2020b)). For purposes of this EIS, this individual is assumed to be at the INL Site boundary during normal operations.

Average individual: A member of the public who receives the average dose as determined by dividing the off-site population dose by the number of people in the population.

Person-rem: a unit of collective radiation dose applied to populations or groups of individuals; it is the sum of the doses received by all the individuals of a specified population.

Background natural radiation: Globally, humans are exposed constantly to radiation from the solar system and the Earth's rocks and soil. This natural radiation contributes to the natural background radiation that always surrounds us.

Background man-made radiation: Man-made sources include medical and dental x-rays, household smoke detectors, and materials released from nuclear and coal-fired power plants.

Radiation exposure: The average individual in the United States annually receives about 625 millirem of radiation dose from all background sources, of which about half is received from natural sources such as cosmic and terrestrial radiation and radon-220 and -222 in homes (National Council on Radiation Protection and Measurements, 1993).

Radiation effects: Radiation can cause a variety of adverse health effects in humans. Health impacts of radiation exposure, whether from external or internal sources, generally are identified as somatic (i.e., affecting the exposed individual) or genetic (i.e., affecting descendants of the exposed individual). Radiation is more likely to produce somatic than genetic effects. The somatic risks of most importance are induced cancers. Both the U.S. Environmental Protection Agency (EPA) and Centers for Disease Control and Prevention identify cancer as the primary long-term health affect associated with radiation exposure. Because fatal cancer is the most serious effect of environmental and occupational radiation exposures, estimates of cancer fatalities, rather than cancer incidence, are presented as a measure of impact in this document. These estimates are referred to as "latent cancer fatalities" (LCFs), because the cancer may take many years to develop.

airborne pathways (incorporating the requirements of 40 CFR 61 Subpart H), 100 millirem from all pathways, and 4 millirem from the drinking water pathway (incorporating the requirements of 40 CFR 141). Public doses from all pathways are maintained to levels ALARA. To protect workers from impacts from radiological exposure, 10 CFR 835 imposes an individual dose limit of 5,000 millirem in a year. DOE's goal is to maintain radiological exposures ALARA. Therefore, DOE has established an administrative control level of 2,000 millirem for worker doses (DOE, 2017b). Typically, DOE sites impose even more restrictive limits; INL has a 700 millirem per year administrative limit for worker doses.

Various organizations have issued radiation protection guides. The two organizations most directly responsible for the development of radiological requirements and exposure criteria associated with the operation of DOE facilities are DOE and the EPA:

- **DOE.** Radiological protection of the public and site workers from the operation of DOE facilities is primarily the responsibility of DOE. DOE establishes and enforces requirements for radiological protection at DOE sites in regulations and orders. Requirements for worker protection are included in 10 CFR 835, *Occupational Radiation Protection Program*. Radiological protection of the public and environment is addressed in DOE Order 458.1, *Radiation Protection of the Public and the Environment* (DOE, 2020b).
- **EPA.** The EPA has published a series of documents under the *title Radiation Protection Guidance to Federal Agencies*. This guidance is used as a benchmark by a number of Federal agencies, including DOE, for the purpose of ensuring that regulation of public and occupational workforce exposures is protective, reflects the best available scientific information, and is carried out in a consistent manner. In addition, the EPA has established a regulatory limit of 10 millirem per year for exposure of the public to emissions from DOE facilities (40 CFR 61, Subpart H) (EPA, 2021d).

Several organizations, in addition to DOE and EPA, continually evaluate the impacts of radiation and provide radiation protection guidance. The responsibilities of the main radiation safety organizations, particularly those that affect policies in the United States, are summarized below:

- **International Commission on Radiological Protection (ICRP).** The ICRP is responsible for providing guidance in matters of radiation safety.
- **National Council on Radiation Protection and Measurements.** In the United States, this council is the national organization that formulates and disseminates guidance and recommendations on radiation protection and measurements that represent the consensus of leading scientific thinking.
- **National Research Council/National Academy of Sciences.** The National Research Council integrates the broad science and technology community with the Academy's mission to further knowledge and advise the Federal Government. The National Research Council's Biological Effects of Ionizing Radiation (BEIR) Committee prepares reports to advise the Federal Government on the health consequences of radiation exposure.
- **U.S. Nuclear Regulatory Commission.** The NRC regulates nuclear power plants and the use of source materials, special nuclear materials, and byproduct materials by commercial and certain governmental entities.

Radiation can cause a variety of damaging health effects in humans, both somatic and genetic. Somatic effects (those that affect the exposed individual) are more probable. The most significant effect is induced cancer fatalities. These are called LCFs because the onset of cancer may take many years to develop after the radiation dose is received. In this EIS, LCFs are used as the measure of 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 (e.g., tobacco, excessive body weight, infectious organisms, alcohol consumption, 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 2021, about 1.9 million new cancer cases would be diagnosed and about 608,570 cancer deaths would occur. About 30 percent of U.S. cancer deaths are estimated to be caused by tobacco use. The average U.S. resident has about 4 chances in 10 of developing an invasive cancer over his or her lifetime (41 percent probability for males, 39 percent for females). Cancer is the second leading cause of death in the United States (American Cancer Society, 2021).

In 2002, the Interagency Steering Committee on Radiation Standards (ISCORS) recommended that Federal agencies use conversion factors of 0.0006 fatal cancers per rem for mortality and 0.0008 cancers per rem for morbidity (incidences of cancer) when making qualitative or semi-quantitative estimates of risk from radiation exposure to members of the general public. 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 cancers per rem) could be used for both workers and members of the public in 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* (NRC, 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.

Accordingly, a risk factor of 0.0006 LCFs per rem (person-rem) was used in this EIS to estimate risk impacts due to radiation doses from normal operations and accidents. The presentation of risks from radiation exposure associated with EIS 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 LCFs per person-rem, this collective dose is expected to cause 6 additional LCFs in this population (10,000 person-rem times 0.0006 LCFs per person-rem).

Calculations of the number of LCFs sometimes do not yield whole numbers and may 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 LCFs 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. In this EIS, LCFs calculated for a population are presented as both the rounded whole number, representing the most likely outcome for that population, and the calculated statistical estimate of risk, which is presented in parentheses.

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 10 rad. This results in the use of a "linear no-threshold" model. Other methods of extrapolation to the low-dose region could yield higher or lower numerical estimates of LCFs. There is scientific uncertainty about cancer risk in the low-dose region below the range of epidemiologic observation. Studies of human populations exposed to low doses are inadequate to demonstrate the actual level of risk. The latest recommendations of the National Research Council support use of a "linear no-threshold" risk model in which the risk of cancer proceeds in a linear fashion at lower doses without a threshold (i.e., any non-zero dose results in an increased risk of cancer) (NRC, 2006).

The dose assessments performed for this EIS were based on site-specific environmental data, site-specific meteorology, mobile microreactor-specific data, and assumptions related to various exposure parameters. Version 2.10 of the GENII Version 2 computer code (Napier, 2011) was used to calculate the projected doses to the public and non-involved workers from demonstration of the mobile microreactor at the INL Site. The GENII computer code was developed under quality assurance plans based on the American National Standards Institute Standard NQA-1, is one of the toolbox models that meets DOE Order 414.1D (DOE, 2020c-D), and is overseen by DOE's Office of Quality Assurance Policy and Assistance. All steps of code development were documented and tested, and hand calculations verified the code's implementation of major transport and exposure pathways for a subset of the radionuclide library. The code was reviewed by the EPA Science Advisory Board and a separate, EPA-sponsored, independent peer review panel. The quality assurance of GENII Version 2 has been reviewed by DOE (DOE, 2004a) and continues to be rigorously reviewed with each updated version released by Pacific Northwest National Laboratory, the developer of the code.

4.10.1 All Project Phases

Construction

The modifications to existing facilities at the INL Site would have no radiological impact on the general public or INL workers. Construction of the concrete pad at CITRC associated with Phase 4 operational testing, and the concrete pad and shed for temporary storage of the mobile microreactor associated with Phase 6 at either the RSWF or ORSA, would not result in radiological emissions and would have no radiological impact on the general public. Construction of the pads would not be radiologically controlled work, so worker exposure would be limited to exposure to background radiation.

Nonradiological accidents pose a risk to site workers. All on-site work would be performed in accordance with BMPs and in accordance with applicable OSHA requirements and DOE orders and regulations. In particular, worker safety practices would be governed by worker safety requirements in 10 CFR 851, Worker Safety and Health Program. DOE Order 450.2, *Integrated Safety Management* (DOE, 2017c), integrates safety into management and work practices at all levels ensuring protection of workers, the public, and the environment.

The estimated number of accidental worker injuries and fatalities are based on the number of workers that would be involved in modification activities, the duration of the activity, and national worker injury and fatality rates. On average, as many as 36 workers (including contractors, management, security, safety, and visitors) would be involved in the modification of facilities (that is, construction of the concrete pads). Construction of the pads would require only a couple of months. There would be no expected fatalities based on an average worker fatality rate in the construction industry of 9.7 fatalities per 100,000 full-time workers (Bureau of Labor Statistics, 2019a). There would be no expected injuries based on the national average for construction workers for accidents resulting in lost worker days of 2.8 accidents per 100 full-time workers (Bureau of Labor Statistics, 2019b).

Operations

Public Health

Under the Proposed Action, there are three phases of Project Pele that could result in radiological emissions: startup testing (Phase 2), operational testing (Phase 4), and PIE prior to disposition of the mobile microreactor (Phase 7). No radiological emissions are expected during the other phases involving fuel loading and final assembly, transport of the mobile microreactor on the INL Site between MFC, TREAT and CITRC, or temporary storage of the mobile microreactor.

Under the Proposed Action, the annual radiological air emissions from the mobile microreactor during operational tests at CITRC are expected to be no more than the quantities listed in **Table 4.10-1**.

Table 4.10-1. Radiological Emission During Normal Operations at CITRC

Nuclide	*Release (curies)* [a]	*Nuclide*	*Release (curies)* [a]
Antimony-127	6.0×10^{-11}	Niobium-95	2.1×10^{-10}
Antimony-129	7.5×10^{-08}	Neodymium-147	2.5×10^{-10}
Argon-41 [b]	132	Praseodymium-143	5.0×10^{-10}
Barium-140	4.3×10^{-10}	Rubidium-86	8.5×10^{-06}
Cerium-141	2.2×10^{-10}	Rhodium-105	1.3×10^{-09}
Cerium-143	4.9×10^{-09}	Ruthenium-103	1.1×10^{-10}
Cerium-144	1.0×10^{-11}	Ruthenium-105	1.1×10^{-08}
Cesium-134	1.7×10^{-10}	Ruthenium-106	1.1×10^{-12}
Cesium-136	4.8×10^{-11}	Silver-110m	1.2×10^{-14}
Cesium-137	5.5×10^{-11}	Strontium-89	6.0×10^{-06}
Hydrogen-3 (Tritium)	9.5×10^{-02}	Strontium-90	1.2×10^{-08}
Iodine-131	3.4×10^{-04}	Technetium-99m	2.5×10^{-08}
Iodine-132	4.2×10^{-03}	Tellurium-127m	7.5×10^{-07}
Iodine-133	2.3×10^{-03}	Tellurium-127	2.5×10^{-06}
Iodine-134	1.0×10^{-02}	Tellurium-129m	6.5×10^{-06}
Iodine-135	3.7×10^{-03}	Tellurium-129	9.0×10^{-04}
Krypton-85m	2.5×10^{-02}	Tellurium-131m	1.1×10^{-04}
Krypton-85	5.5×10^{-05}	Tellurium-132	2.5×10^{-04}
Krypton-87	5.0×10^{-02}	Xenon-133	1.2×10^{-02}
Kypton-88	7.5×10^{-02}	Xenon-135	2.4×10^{-02}
Krypton-89	2.8×10^{-02}	Ytrium-90	1.5×10^{-10}
Krypton-90	1.2×10^{-02}	Zirconium-95	1.2×10^{-10}
Lanthanum-140	5.5×10^{-09}	Zirconium-97	1.0×10^{-09}
Molybdenum-99	2.6×10^{-09}		

Source: (INL, 2021f)
Notes:
[a] Releases from the mobile microreactor would essentially be at ground level. The mobile microreactor has no stack or ventilation system to force air out of the radiological shielding erected around the microreactor module. The mobile microreactor would contain a gaseous waste processing system. The system is anticipated to consist of a holding tank and in-line filters. The holding tank would be used to slowly bleed the short-lived gaseous radionuclides after they have decayed. See Chapter 9, *Glossary*, for an explanation of scientific notation (e.g., 2.1×10^{-10}).
[b] Argon-41 is the product of air activation.

Releases during other phases of Project Pele would be much smaller than those listed in the table. The startup testing phase of Project Pele would take about 6 months. During this phase of the demonstration, insufficient radiological emissions would be generated to impact the public. At the beginning of tests, the mobile microreactor TRISO fuel would be fresh, having never been used in a reactor.[49] No isotopes would be generated from fission to be released. Most of the tests performed during startup testing do not require the mobile microreactor to be operating at full power (tests at up to 20 percent of full power are anticipated as a part of the startup testing), and many do not require the mobile microreactor to be critical. This low usage during testing and the short duration of testing would not generate a large quantity of radionuclides that would be available for release. As stated in Chapter 2, *Description of Alternatives*, the TRISO fuel used in the mobile microreactor is very robust and, under normal operating conditions, is capable of retaining almost all of the radionuclides generated during operation of the mobile microreactor. These factors result in a very small potential release from the mobile microreactor during startup testing, much smaller than that estimated for operation of the mobile microreactor during operational testing at CITRC.

The other potential sources of radiological emissions from Project Pele are from the PIE of mobile microreactor fuel and components performed at the HFEF and other existing facilities at MFC. Proposed activities use existing processes and facilities. The dose from these facilities is tracked based on inventory on a quarterly basis. Emissions from PIE would be consistent with current emissions and operations. These activities are not anticipated to cause a change in air emissions from these facilities, facility radiological emissions would continue to meet the requirements of 40 CFR 61 Subpart H and DOE Order 458.1, *Radiation Protection of the Public and the Environment* (DOE, 2020b) and would not result in additional public health impacts. Thus, the potential impacts would not add to the impacts from existing operations as documented in several reports, including the Annual Site Environmental Reports referenced in Section 3.10, *Human Health – Normal Operations*.

To estimate the radiological impacts of incident-free operation of the mobile microreactor during testing, the following assumptions and factors were considered:

- Meteorological data for the CITRC location for the years 2013 through 2020 were used to generate the input joint frequency distribution of wind speed, direction, and stability class data used by GENII in the dispersion of the source term.
- All receptors were assumed to be exposed to radioactive material deposited on the ground from facility emissions. Exposure pathways include direct exposure from air immersion and ground exposure, inhalation, and translocation through the food chain.
- The annual exposure time to the plume (for inhalation and immersion) and soil contamination was assumed to be 0.7 year for the MEI.
- The annual exposure time to the plume (for inhalation and immersion) and soil contamination was assumed to be 0.5 year for the population.
- The annual exposure time to the plume (for inhalation and immersion) was assumed to be 1 year for the MEI, average individual and general population.
- Non-involved worker exposure was limited to the plume and resuspension pathways; ingestion exposure pathways were not considered. The annual exposure time to the plume (for inhalation and immersion) was assumed to be 2,500 hours.
- All receptors were assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of adult humans.
- The analysis used a finite plume (i.e., Gaussian) model for air immersion doses. Both a continuous release and a puff release (entire annual source term released over a 1-hour period) were considered, the more conservative results are presented here. The 1-hour release was included

[49] The highly enriched uranium (HEU) source material for the high-assay low-enriched uranium fuel is from stockpiles at Y-12, and this HEU also has not been irradiated, having never been used as reactor fuel.

because the mobile microreactor is depressurized intermittently during testing. The primary coolant is filtered and ultimately released to the atmosphere. The bulk of the identified source term could be released during this operation.[50]

- The release has been modeled as a ground-level release with no plume rise.
- The calculated internal doses were assumed to be the 50-year committed effective dose equivalent from 1 year of emissions.
- Ingestion exposures from atmospheric transport include ingestion of farm products and inadvertent ingestion of soil. Farm products include leafy vegetables, other vegetables, cereal grains, fruit, cow's milk, beef, poultry, and eggs. The concentration in plants at the time of harvest was evaluated as the sum of contributions from deposition onto plant surfaces, as well as uptake through the roots. Pathways by which animal products may become contaminated include animal ingestion of contaminated plants, water, and soil. Site-specific agricultural data were not developed. This analysis used the generic agricultural production data and the human consumption rates provided in the GENII code for both the population and MEI calculations.

Unless otherwise stated above, the GENII default parameters for the average individual and the MEI were used.

Radiological impacts were estimated for the general public living within 50 miles of the mobile microreactor when located at CITRC. **Table 4.10-2** lists the annual impacts to the population projected[51] to be living within a 50-mile radius of CITRC in 2027, a population of approximately 257,444. The table also includes impacts to an average member of the public within 50 miles and an off-site MEI (a hypothetical individual located at the INL Site boundary south of CITRC).

Table 4.10-2. Annual Radiological Impacts to the Public During Normal Operations at CITRC

Category	*Maximally Exposed Individual*	*Population Within 50 Miles* [a]	*Average Individual within 50 Miles*
Dose	less than 0.01 millirem	less than 0.001 person-rem	less than 1×10^{-5} millirem [b]
Latent Cancer Fatality Risk [c]	0 (4×10^{-9})	0 (2×10^{-7})	0 (less than 1×10^{-10})
Regulatory Dose Limit [d]	10 millirem	Not applicable	10 millirem
Dose from Natural Background Radiation [e]	382 millirem	98,000 person-rem	382 millirem

Key: CFR = Code of Federal Regulations; CITRC = Critical Infrastructure Test Range Complex; DOE = U.S. Department of Energy; INL = Idaho National Laboratory; LCF = latent cancer fatality

Notes:

[a] The population dose for this table was based on a projected 2027 population estimate of 257,444 within 50 miles of the CITRC. Projected populations are based on the 2010 Census and the 2019 American Community Survey populations within 50 miles of the INL Site.

[b] The number 1×10^{-5} = 0.00001. See Chapter 9, *Glossary*, for an explanation of scientific notation (e.g., 1×10^{-5}).

[c] Based on a risk estimator of 0.0006 LCF per person-rem (DOE, 2003).

[d] 40 CFR 61, Subpart H, establishes an annual limit of 10 millirem via the air pathway to any member of the public from DOE operations.

[e] (DOE-ID, 2021c).

Table 4.10-2 shows the estimated population dose associated with mobile microreactor operation at CITRC to be less than 0.001 person-rem. Under the Proposed Action, the MEI would receive an estimated annual dose of less than 0.01 millirem, and the average annual dose to an individual in the population

[50] The argon-41 is a product of air activation and is not in the primary coolant. Argon-41 would be generated and released continuously.

[51] Projected populations are based on the 2010 Census and the 2019 American Community Survey populations within 50 miles of the INL Site.

would be less than 1 x 10^{-5} (i.e., 0.00001) millirem. EPA and DOE have established an annual limit of 10 millirem to the individual air pathway dose from all sources. Both the average individual and MEI doses from the mobile microreactor operation at CITRC are insignificant compared to this limit. Additionally, for comparison, the population and individual doses from exposure to natural background radiation levels for the INL Site area are provided. As listed in **Table 4.10-2**, the population and individual doses from mobile microreactor operation are an insignificant fraction, less than 0.003 percent for the MEI, of the annual dose from natural background radiation and roughly equivalent to 15 minutes of the background dose.[52]

No LCFs would be expected within the general population from the population dose; this population dose would increase the annual risk of a latent fatal cancer in the population by about 2 x 10^{-7} (i.e., 0.0000002). In other words, the likelihood that one fatal cancer would occur in the population as a result of the annual radiological releases associated with this alternative is less than 1 chance in 5 million per year. The corresponding increased risk of an individual developing a latent fatal cancer would be less than 1 × 10^{-10} (i.e., 0.0000000001), or less than about 1 chance in 10 billion per year. For the MEI, an increased annual risk of developing a latent fatal cancer would be about 4 × 10^{-9} (i.e., 0.000000004). In other words, the likelihood that the MEI would develop a fatal cancer would be about 1 chance in 200 million for each year of operations.

Worker Health

Involved worker exposures would primarily result from the demonstration of the mobile microreactor (including startup testing [Phase 2], transportation of the mobile microreactor between test locations [Phase 3] and to the temporary storage location [Phase 5], and operational testing [Phase 4]) and PIE in the HFEF (Phase 7). Additional worker exposure would result from the inspection of the mobile microreactor during temporary storage at either the RSWF or ORSA (Phase 6). During the fueling and final assembly of the mobile microreactor, workers would not be exposed to a radiation environment, as the microreactor materials would not have been activated and the fuel would be fresh.

To protect workers from impacts from radiological exposure, 10 CFR 835 imposes an individual dose limit of 5,000 millirem in a year. In addition, worker doses are monitored and controlled below the regulatory limit to ensure that individual doses are less than an administrative limit of 2,000 millirem per year, and maintained at ALARA levels (DOE, 2017b). INL personnel would monitor worker doses and take appropriate action to limit individual worker doses below this administrative level.

During Project Pele's 3 years at the INL Site, 18 of the workers involved in mobile microreactor demonstration activities (startup testing, transporting the mobile microreactor between test locations, and operational testing of the mobile microreactor) as identified in **Table 4.14-1** would be expected to receive a dose totaling 10 person-rem over the approximately 3 years of the demonstration portion of Project Pele (INL, 2021a). The doses to individual workers are expected to range from 0.5 rem to 1 rem over the lifetime of Project Pele (about 170 millirem to 330 millirem per year per worker). Workers would be exposed to a radiation environment in all phases of the demonstration from startup testing through transfer to the temporary storage location.

This exposure, the total of 10 person-rem for the duration of Project Pele, is not expected to result in any additional LCFs (0.006) among the workforce. The average increased risk of an individual worker developing a latent fatal cancer would be less than 0.0003, or about 1 chance in 3,000 from the exposure from the entire 3-year duration of Project Pele.

Any PIE performed on the mobile microreactor fuel or components during Phase 7 would be a continuation of the activities currently performed at HFEF and would not add to the worker dose at this

[52] Alternately, the dose to the MEI is about 300 times less than the dose received on a flight from New York to Los Angeles (2 to 5 millirem).

facility. Currently, workers at HFEF receive an average annual dose of about 140 millirem (based on 80 workers and a facility dose of 11 person-rem per year (DOE, 2020a). Individual workers involved in PIE of mobile microreactor fuel or components at HFEF would, on average, receive this dose.

The temporary storage location during Phase 6, RSWF or ORSA, would not be permanently manned. Twice a year, a crew of five workers would perform an inspection to verify safety cooling and shielding systems of the mobile microreactor are functional. Each inspection would last about 5 hours. Additionally, routine security inspections of the site would be performed. Due to the frequency and limited duration of the safety inspections (INL, 2021a), worker doses during the temporary storage of the mobile microreactor are expected to be minimal.

During Phase 2, the mobile microreactor would be located within MFC (in the DOME) or at CITRC. For the reasons discussed in the *Public Health* subsection above, the radiological emissions from the startup testing phase of Project Pele would be insufficient to impact any collocated worker (a nearby worker not directly involved in the mobile microreactor demonstration). At the CITRC test pads, the nearest collocated worker would not be at the CITRC test site but at the CITRC facility located about 2,500 feet to the south of Pad B.[53] Based on the radiological emissions identified previously (**Table 4.10-1**) the dose to a worker at this location was estimated. This collocated worker would receive a dose of less than 0.1 millirem per year. This exposure would result in an insignificant incremental risk of an LCF (less than 1×10^{-7}) (i.e., 0.0000001).

Safety and health requirements for DOE workers are governed by 10 CFR 851, which establishes requirements for a worker safety and health program to ensure that DOE workers have a safe work environment. Included are provisions to protect against hazardous chemicals. Project Pele workers could be exposed to hazardous chemicals during demonstration of the mobile microreactor, mainly during assembly, and during any potential PIE activities. For example, beryllium would be used in the core of the mobile microreactor, but the material would be a solid and would not be machined at the INL Site. Generally, the quantity of material would be small, and in many cases, it would be used in areas not inhabited by workers. Worker safety would not be impacted by the use of these hazardous chemicals.

Personnel would also be susceptible to industrial accidents that could result in injury or death. The estimated number of accidental worker injuries and fatalities are based on the number of staff involved in operational activities and national worker injury and fatality rates. On average, up to 54 staff would be involved in mobile microreactor activities. This includes INL workers, contractors, management, security personnel, safety staff, and visitors. During each year of the project, no fatalities would be expected based on an average worker fatality rate in the utilities industry of 2.0 fatalities per 100,000 worker years (Bureau of Labor Statistics, 2019a). As stated in Section 3.10, *Human Health – Normal Operations,* the "days away, restricted, or on-the-job transfer" (DART) rate for the INL Site has averaged 0.62 injuries per 200,000 work hours from 2016 to 2020 (DOE, 2021c-B). This injury rate results in less than one staff injury during each year of the project.

4.11 Human Health – Facility Accidents

This section addresses human health impacts from exposures to hazardous or radioactive materials released as a result of accidents involving the mobile microreactor through all project phases as described in Section 2.3, *Proposed Action Alternative*, and as shown in **Figure 2.3-2**, Project Pele Flowchart. Intentional destructive acts are covered by the accidents discussed in this section. The mobile

[53] This facility (the structure between Pads A and D in Figure 2.3-9) may not be occupied at all times; to estimate the non-involved worker dose permanent occupancy was assumed. Other INL Site facilities that would be permanently occupied are much further (several miles) from the test location. Personnel at these locations would see significantly smaller doses from test operations at the CITRC test pads. Locating the mobile microreactor at Pad B results in a larger non-involved worker dose at this location than if the mobile microreactor were to be located at Pads C or D.

microreactor is designed to survive a wide variety of off-normal, upset, or accident conditions. The mobile microreactor design incorporates significant functions for safety based on passive safety systems.

4.11.1 Key Mobile Microreactor Safety Functions

The mobile microreactor is designed to protect human health by relying primarily on the passive safety of the design, which prevents the release of fission products to the environment with limited to no requirements for intervention of active safety systems. The key mobile microreactor safety functions are satisfied and met by reliably designed systems, thus securing safe operation through thoughtful design. These key safety functions can be summarized as:

- Reactivity control;
- Adequate cooling;
- Protection of engineered fission-product boundaries; and
- Shielding.

These safety functions are relevant for safe mobile microreactor operations, as well as transport.

Reactivity Control

Reactivity is a measure of the change in the number of neutrons that are available to cause fission. Reactivity control in a nuclear mobile microreactor functions much like the accelerator and brake on an automobile. Inserting positive reactivity to the mobile microreactor system increases the mobile microreactor power level, much like pressing the accelerator increases the vehicle speed. Inserting negative reactivity in the mobile microreactor decreases the power level or potentially terminates the fission chain reaction altogether, much like pressing the brake slows and eventually stops the vehicle. Reactivity control in the mobile microreactor during normal and most abnormal operations is provided by control drums, which rotate to add or remove reactivity in order to control mobile microreactor power or shut the mobile microreactor down. The control drums are positioned by both normal control and shutdown systems, which function separately and independently to provide appropriate control drum responses. In the event that a plant upset or accident condition results in the need for shutting the mobile microreactor down, the mobile microreactor can be shut down either through the normal control system rotating the control drums to a position that terminates the nuclear reaction or through an instantaneous shutdown activation, which results in an immediate insertion of negative reactivity of sufficient magnitude to shut the mobile microreactor down and keep it shut down even as it cools down to ambient temperatures. The design of the insertion mechanisms is such that the system has sufficient potential energy (e.g., gravity or spring) to ensure that the negative reactivity insertion will occur if the signal holding the control drums in place is lost or in the event of loss of power. The mobile microreactor protection system is designed to initiate a mobile microreactor shutdown upon receiving specific signals from sensors within the mobile microreactor. The system is extremely reliable, with independence and diversity included in the design (INL, 2021a).

A key design feature of the mobile microreactor that contributes to reactivity control is the design of the fuel and core system such that the core experiences a negative reactivity feedback as a result of increased temperatures. This negative temperature feedback ensures that the power in the mobile microreactor cannot "run away" and that deliberate actions are necessary to increase the power level. The negative feedback is principally provided by broadening of the neutron energy absorption spectrum in the fuel as fuel temperatures increase. The broadening increases the fraction of neutrons that are absorbed in the fuel without causing fission, thus reducing the fraction of neutrons available for fission to produce power. The temperature reactivity feedback effectively suppresses power at elevated temperatures, which keeps the fuel within design limits. Keeping the fuel temperature within design limits maintains the capability of TRISO fuel to retain fission products (INL, 2021a).

Adequate Cooling

The mobile microreactor provides adequate fission product and decay heat removal through several design features. The first and most important design feature is the fuel. TRISO fuel is a fuel form that has been specifically developed to ensure retention of radioactive fission products during normal operating and accident conditions. Each TRISO particle is made up of a uranium oxycarbide (a mixture of uranium dioxide and uranium carbide) fuel kernel encapsulated by three layers of carbon- and ceramic-based (silicon carbide) material. Significant testing and demonstration experience for TRISO fuel indicates that it has been tested and verified to temperatures almost double those that would be experienced by the mobile microreactor during normal operation and above that expected to be seen during accident conditions without significant degradation and release of fission products, even under accident conditions. Details of the TRISO fuel qualification can be found in EPRI-AR-1 (Electric Power Research Institute, 2019). Mobile microreactor system designs are of sufficiently low power that peak temperatures in the range of 1,000 to 1,200°C are expected for normal operations. The significant margins between the planned operating temperatures and the fuel qualification temperatures provide a large safety benefit with regard to the capacity of the system to handle upset conditions without adverse impacts (INL, 2021a).

During operation, the mobile microreactor is normally cooled via pressurized inert gas that flows through the core to an intermediate heat exchanger, where the heat is transferred to the open air power cycle. In the event that the normal heat rejection pathway fails, the system is designed for a passive mode to ensure that low-level fission and decay heat can be rejected by allowing the heat from the mobile microreactor vessel to transfer outward, where a passive decay heat capacity rejects the heat to exterior air, which is ultimately exhausted out of a stack. One benefit of the passive heat removal system is that it functions without the use of active components (e.g., pumps, blowers) and relies upon inherent temperature gradients to transfer heat out through the mobile microreactor vessel and create air flow in the natural circulation loop. The design of the heat rejection system provides high resiliency and increased heat rejection capacity at a higher temperature, thereby inhibiting further fuel temperature increase (INL, 2021a).

Protection of Engineered Fission-Product Boundaries

Protection of fission product boundaries is provided through adequate cooling to limit temperatures and by the design of the pressure boundaries. Pressure boundaries are designed to ensure temperatures and pressures are below design limits even in the most severe accidents caused by internal or external hazards. If some fuel fails due to manufacturing defects or localized damage, the structure of the primary mobile microreactor vessel serves to provide a pressure-rated fission product boundary for retention of circulating activity within the primary system (INL, 2021a).

Shielding

The mobile microreactor design includes shielding that is structurally robust. The shielding ensures that workers and the public are protected from exposure to radiation resulting from mobile microreactor operations and transport or upset conditions and events. For stationary power operations, neutron and gamma shielding materials will be employed to reduce neutron activation of materials and doses during operation. For transportation, the shielding system consists primarily of high-density shield materials integrated within or affixed to the outside of the shipping package (INL, 2021a).

4.11.2 Hazardous Material Release Impacts

Hazardous material exposures at the INL Site are controlled through programs intended to protect workers from normal industrial hazards. These programs are controlled by the safety and health regulations for DOE contractor workers governed by 10 CFR 851, Worker Safety and Health Program, which establishes requirements for worker safety and health programs to ensure that DOE contractor workers have a safe work environment. Provisions are included to protect against occupational injuries and illnesses, accidents, and hazardous chemicals.

Hazardous material impacts are evaluated in terms of comparison to appropriate industrial hygiene standards for normal occupational exposure (see Section 4.10, *Human Health – Normal Operations*) and Protective Action Criteria (PAC) values (DOE, 2018c) for potential accident or upset conditions. The PAC values are estimates of airborne concentration thresholds above which one can reasonably anticipate observing adverse effects. Hazardous material releases as a result of accidents are evaluated for uranium and silver constituents of the mobile microreactor fuel. The hazardous material impacts of potential facility accidents associated with the mobile microreactor are less than the PAC values.

4.11.3 Radioactive Material Release Impacts

The potential impacts from radiological material releases are evaluated for design-basis (possible accidents considered in the design process) and beyond-design-basis (accidents so unlikely that they are not considered in the design process) mobile microreactor accidents. Human health risks from facility accidents are considered for individual receptors and population groups. These receptors and population groups include involved and non-involved workers, the off-site population, and an MEI (i.e., maximally exposed individual) member of the public within the off-site population as defined in Section 4.10, *Human Health – Normal Operations*.

Consequences of "bounding accidents," which are the highest consequence events resulting from operational and natural phenomena-related accidents, are calculated for accidents at MFC/TREAT, CITRC, and transport between the facilities. Accident frequencies are grouped into the categories of "anticipated" at a frequency greater than 10^{-2} (i.e., 0.01) per year, "unlikely" at a frequency 10^{-2} to 10^{-4} (i.e., 0.01 to 0.0001) per year, "extremely unlikely" at a frequency 10^{-4} to 10^{-6} (i.e., 0.0001 to 0.000001) per year, and "beyond extremely unlikely" at a frequency less than 10^{-6} (i.e., 0.000001) per year. Most bounding accidents have a probability greater than 10^{-6} (i.e., 0.000001) per year and are classified as "design-basis" accidents and safety systems would restrict releases to the atmosphere. Other accidents, in which the safety systems fail, are designated as beyond-design-basis events because of their extremely low probability (less than 10^{-6} per year) (i.e., 0.000001 per year). The potential accident sequences associated with beyond-design-basis mobile microreactor accidents are highly speculative. Beyond-design-basis accidents would most likely be initiated by a major earthquake severe enough to cause major damage to structures throughout the region.

A thorough evaluation of the potential upset conditions and associated accidents are evaluated in the facility safety basis documents. For this EIS, accidents that could occur during the phases of the mobile microreactor demonstration described in Section 2.3, *Proposed Action Alternative*, were evaluated. Fresh[54] fuel handling accidents associated with fueling of the mobile microreactor are not specifically addressed in this section. The consequences of accidents that might occur during fueling activities are covered by the accident scenarios addressed in this section. Startup testing would involve minimal fission products as the fuel would still be considered fresh. The PIE of the mobile microreactor fuel and components is within the bounds of the activities currently being performed at the HFEF and other facilities at MFC. As such, the safety analysis reports of the PIE facilities cover this category of accident. Specific accidents such as spent fuel handling accidents associated with defueling and disposition of the mobile microreactor are not addressed in this section, but the consequences of accidents that might occur during defueling and disposition activities are covered by the accident scenarios addressed in this section. The impacts of accidents that might occur during temporary storage, defueling, or disposition of the mobile microreactor would be reduced because the radionuclides would decay while the mobile microreactor is in temporary storage. Furthermore, operations such as removing fuel from the mobile microreactor would likely be conducted in facilities that would provide confinement of any radionuclides that might be released.

[54] The term "fresh" refers to handling fuel that has not been used for operating the microreactor.

4.11.3.1 Accident Source Terms

Three source terms are considered in the accident analysis: a source term that includes fission products from an inadvertent nuclear criticality, a source term based on an end of operational testing inventory, and a source term based on an end-of-life (EOL) inventory that has been decayed for seven days.[55, 56]

The source term for the criticality fission products is based on Table 6-8 of DOE-HDBK-3010-94 (DOE, 2013b) for a criticality in a uranium solution that fissions or splits 1.0×10^{19} (10 quintillion) uranium atoms. In the data call report (INL, 2021a), attenuation factors are applied to the fission product data from DOE-HDBK-3010-94 to give a source term for a criticality involving the mobile microreactor. The attenuated fission product source term, which is from the "Short Term Release Quantity" column in Table F-2 of the data call report (INL, 2021a), is shown in **Table 4.11-1**. The characteristics of the TRISO fuel are such that the uranium in the HALEU fuel would not be released in a criticality. Consequently, the radionuclide inventory in HALEU fuel is not included in the criticality source term.

Table 4.11-1. Curies of Important Nuclides Released During an Inadvertent Nuclear Criticality Involving Uranium Solution

Nuclide	*Activity [a] (Ci)*	*Activity [b] (Bq)*
Krypton-83m	1.6×10^{2}	5.9×10^{12}
Krypton-85m	1.5×10^{2}	5.6×10^{12}
Krypton-85	1.6×10^{-3}	5.9×10^{7}
Krypton-87	9.9×10^{2}	3.7×10^{13}
Krypton-88	6.5×10^{2}	2.4×10^{13}
Krypton-89	4.2×10^{4}	1.6×10^{15}
Xenon-131m	8.2×10^{-2}	3.0×10^{9}
Xenon-133m	1.8×10^{0}	6.7×10^{10}
Xenon-133	2.7×10^{1}	1.0×10^{12}
Xenon-135m	2.2×10^{3}	8.1×10^{13}
Xenon-135	3.6×10^{2}	1.3×10^{13}
Xenon-137	4.9×10^{4}	1.8×10^{15}
Xenon-138	1.3×10^{4}	4.8×10^{14}
Iodine-131	4.4×10^{-1}	1.6×10^{10}
Iodine-132	5.5×10^{1}	2.0×10^{12}
Iodine-133	8.0×10^{0}	3.0×10^{11}
Iodine-134	2.3×10^{2}	8.3×10^{12}
Iodine-135	2.4×10^{1}	8.7×10^{11}

Key: Bq = Becquerel; Ci = Curie

Notes:

[a] From the "Short Term Release Quantity" column in Table F-2, INL/EXT-21-62873. Activity refers to the decay rate of a radionuclide. One Curie (Ci) is defined as 3.7×10^{10} disintegrations per second. See Chapter 9, *Glossary*, for an explanation of scientific notation (e.g., 1.6×10^{2}).

[b] Bq is Ci times 3.7×10^{10}.

[55] Source term refers to the radionuclides considered in the analysis of an accident.

[56] An inadvertent nuclear criticality is an uncontrolled nuclear fission chain reaction.

The mitigated source term for the mobile microreactor at EOL or end of operational testing is taken from INL/EXT-21-62873 (INL, 2021a) (INL, 2020f). The mitigated source term for the 10 megawatts thermal mobile microreactor at EOL is developed by scaling the material at risk for a 600 megawatts thermal next generation nuclear plant HTGR and includes factors for fuel defect fractions, in-service fuel failure fractions, heavy metal contamination, attenuation factors for the helium pressure boundary,[57] and attenuation factors for the reactor building. An unmitigated source term was calculated by removing mitigation credit of barriers such as the reactor building and is taken from Table F-7 of INL/EXT-21-62873 (INL, 2021a) for the mobile microreactor is shown in **Table 4.11-2**. The EOL radionuclide inventory with seven days of decay is shown in Table F-3 of INL/EXT-21-62873 (INL, 2021a). The radionuclides of concern were decayed for 7 days to incorporate the assumption that the microreactor needs to cool for 7 days before it can be transported. Attenuation factors are applied to the EOL radionuclide inventory with seven days of decay to give a decayed EOL source term. The decayed EOL source term, which is shown in **Table 4.11-3**, is from Table F-4 of INL/EXT-21-62873 (INL, 2021a).

Table 4.11-2. Unmitigated Mobile Microreactor Radionuclide Source Term at End-of-Life (EOL)

Nuclide	Activity [a] (Ci)	Activity [b] (Bq)
Xenon-133	4.1×10^{1}	1.5×10^{12}
Krypton-85	2.8×10^{-1}	1.0×10^{10}
Krypton-88	4.4×10^{0}	1.6×10^{11}
Iodine-131	1.1×10^{1}	4.0×10^{11}
Iodine-133	8.0×10^{0}	2.9×10^{11}
Tellurium-132	1.2×10^{1}	4.6×10^{11}
Cesium-137	1.6×10^{1}	5.9×10^{11}
Cesium-134	3.6×10^{0}	1.3×10^{11}
Strontium-90	2.5×10^{0}	9.3×10^{10}
Silver-110	2.3×10^{0}	8.5×10^{10}
Silver-111	1.0×10^{2}	3.8×10^{12}
Antimony-125	1.7×10^{-1}	6.1×10^{9}
Ruthenium-103	4.5×10^{0}	1.7×10^{11}
Cerium-144	2.0×10^{0}	7.2×10^{10}
Lanthanum-140	5.9×10^{-1}	2.2×10^{10}
Plutonium-239	1.7×10^{-4}	6.4×10^{6}

Key: Bq = Becquerel; Ci = Curie; EOL = end-of-life

Notes:

[a] From the unmitigated “Short- + Long-Term ST (Ci)” column in Table F-7, INL/EXT-21-62873. Activity refers to the decay rate of a radionuclide. One Curie (Ci) is defined as 3.7×10^{10} disintegrations per second. See Chapter 9, *Glossary*, for an explanation of scientific notation (e.g., 4.1×10^{1}).

[b] Bq is Ci times 3.7×10^{10}.

[57] The pressure boundary is the structure of the microreactor that contains the gaseous coolant.

Table 4.11-3. End-of-Life (EOL) Radionuclide Source Term Decayed for Seven Days

Nuclide	Activity (Ci)	Activity (Bq)
Xenon-133	3.0×10^{0}	1.1×10^{11}
Xenon-131	1.2×10^{-4}	4.5×10^{6}
Krypton-85	4.4×10^{-2}	1.6×10^{9}
Krypton-88	5.4×10^{-19}	2.0×10^{-8}
Iodine-131	9.2×10^{-1}	3.4×10^{10}
Iodine-132	5.2×10^{-1}	1.9×10^{10}
Iodine-133	3.7×10^{-3}	1.4×10^{8}
Tellurium-132	4.1×10^{-1}	1.5×10^{10}
Tellurium-125	1.3×10^{-3}	4.8×10^{7}
Cesium-137	5.7×10^{-1}	2.1×10^{10}
Cesium-134	2.1×10^{-1}	7.9×10^{9}
Yttrium-90	1.6×10^{-1}	6.0×10^{9}
Strontium-90	1.8×10^{-1}	6.7×10^{9}
Barium-137	1.7×10^{-1}	6.3×10^{9}
Silver-110	1.0×10^{0}	3.8×10^{10}
Silver-111	3.7×10^{1}	1.4×10^{12}
Antimoney-125	4.7×10^{-3}	1.7×10^{8}
Ruthenium-103	6.8×10^{-1}	2.5×10^{10}
Rhodium-103	6.1×10^{-1}	2.3×10^{10}
Cerium-144	8.4×10^{-2}	3.1×10^{9}
Lanthinum-140	1.8×10^{-3}	6.6×10^{7}
Promethium-144	2.2×10^{-2}	8.3×10^{8}
Plutonium-239	1.7×10^{-6}	6.4×10^{4}

Key: Bq = Becquerel; Ci = Curie; EOL = end-of-life

Notes:

[a] From the unmitigated "Short- + Long-Term ST (Ci)" column in Table F-4, INL/EXT-21-62873. Activity refers to the decay rate of a radionuclide. One Curie (Ci) is defined as 3.7×10^{10} disintegrations per second. See Chapter 9, *Glossary*, for an explanation of scientific notation (e.g., 3.0×10^{0}).

[b] Bq is Ci times 3.7×10^{10}.

4.11.3.2 Modeling of Accident Scenarios

The WinMACCS computer program (NRC, 1990; NRC, 1998; DOE, 2004b) is used to calculate radiological impacts from accidents involving the mobile microreactor. Consequences are determined for a non-involved worker, the MEI, and the off-site population. SecPop (NRC, 2019) provides estimates of population, land use, and economic values related to a specific site and creates a site file that is needed by WinMACCS to perform a site-specific off-site consequence analysis of the health, economic, and environmental impacts of a hypothetical, atmospheric release of radioactive material from a nuclear facility. Receptor doses are calculated for the mean meteorological conditions.

A duration of 10 minutes is assumed for all mobile microreactor accident releases. The 10-minute duration is appropriate because the Gaussian plume diffusion model used in the analysis for all scenarios was developed for INL Site sagebrush terrain, with effluent releases from a few minutes to 15 minutes in duration (INL, 2020f). Furthermore, assuming a release duration of 10 minutes is consistent with the accident phenomenology expected for all scenarios, with the possible exception of fire. Depending on the circumstances, the time between fire ignition and extinction may be considerably longer, particularly for the larger beyond-design-basis fires. Even in a fire of long duration, substantial fractions of the total radiological source term may be released in short periods as the fire consumes areas having high radionuclide concentrations.

The term "latent cancer fatality" or LCF is used to represent the potential human health impacts of exposure to radiation. LCFs are estimated by multiplying the radiation dose by a factor (risk estimator) representing the rate at which radiation exposure could result in latent mortality. Estimates of potential LCFs for this EIS are based on using a risk estimator of 0.0006 LCF per rem or person-rem (DOE, 2003). Additional information about radiation and its effects on humans is provided in Section 4.10, *Human Health – Normal Operations*.

For doses equal to or greater than 20 rem resulting from an acute exposure, the risk estimator is doubled (National Council on Radiation Protection and Measurements, 1993). Potential accident scenarios have been identified for the mobile microreactor at MFC/TREAT, and CITRC, and transport between the facilities. The analysis includes accidents that have a low frequency of occurrence, but large consequences, and a spectrum of other accidents that have higher frequencies of occurrence and smaller consequences. Impacts are generated for all of the locations where mobile microreactor activities would occur for each of the three receptors (50-mile population, MEI, and a non-involved worker).

Results of the mobile microreactor probabilistic risk analysis and other safety analyses indicate that all operational accidents would be controlled and not result in fuel melting. This includes the typical accidents associated with light water reactors (LWRs), including loss of off-site power, transient overpower events, experiment malfunctions, and seismic events. The passive heat removal systems are sufficiently robust that all of the conventional LWR accidents are either prevented or mitigated, and no radioactive releases would be expected. No fuel would melt and the releases from the gaseous cooling systems have very small radiological consequences.

As the mobile microreactor design evolves past the conceptual design phase, additional event initiators and subsequent accident sequences may be developed, but the accident scenarios analyzed are expected to cover the consequences from any event that may be considered. The accident scenarios provide a reasonable but bounding estimate of the potential impacts from very low probability, high-consequence accidents and accidents with larger probabilities and lesser consequences. The detailed analysis considered a wide spectrum of potential accident scenarios, including fire, spills, criticality, fuel-handling errors, confinement breaches, instrumentation failure, earthquake, and aircraft crash.

The mobile microreactor accident consequences are based on conservative assumptions that do not consider decay of short-lived isotopes, mitigation to limit releases, or emergency actions such as evacuation or sheltering-in-place. Furthermore, sufficient safety controls are expected to be in place so that the probability of accidental releases would be "beyond extremely unlikely." Thus, the potential impacts are likely overstated. Other publically available accident assessments are based on more realistic, less conservative, assumptions. The NRC-evaluated risks for LWRs are based on more realistic assumptions for as-built LWRs and consider preventative and mitigation features of the LWRs, including evacuation of persons within the typical 10-mile radius emergency planning zones surrounding the LWRs. Severe accident modeling for LWRs also considers radioisotope decay for releases that occur hours or days after the LWR shuts down.

Consequences to the maximally exposed member of the public, the off-site population residing within 50 miles of the facility, and a non-involved worker located 330 feet from the facility are calculated. The potential near-term impacts from the initial plume passage are reported as the "Near-Term-Dose," while the long-term impacts of exposure to the radionuclides after the plume passage are added to the "Near-Term-Dose" and reported as the "Near+Long-Term Dose." The long-term (or chronic) dose includes the combined effects of exposure to radionuclides remaining after the plume passage. Exposure pathways include ingesting contaminated foods; direct radiation exposure from residual material on the ground

(ground shine); inhalation of disturbed, residual ground-level particulates (resuspension); and ingestion of contaminated water. The food pathway could be the largest source of longer-term dose from accidents releasing fission products, unless mitigated by restricting access to the food supply after an accident. Restricting access to the food supply would be expected in response to an accidental radioactive material release. No major consequences for the noninvolved worker are expected from mobile microreactor accidents, because noninvolved workers should be able to evacuate immediately or be unaffected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of radioactive materials.

Consequences for workers directly involved in the processes under consideration are not quantified but are considered qualitatively. The uncertainties involved in quantifying accident consequences for an involved worker are quite large because of the high sensitivity of results to assumptions (e.g., plume dispersion within a short distance). Considering that the involved worker would probably be much closer to an accident than a noninvolved worker leads to a qualitative conclusion that accident impacts would generally be greater to an involved worker than to a noninvolved worker. Earthquakes could also have substantial consequences, ranging from workers being killed by debris from collapsing structures to high radiation doses from the uptake of radionuclides.

4.11.3.3 Accident Description and Consequences

A hazards analysis was performed to identify accident scenarios associated with the mobile microreactor. The analysis considered hazards, their frequency, and potential consequences. Based on the analysis, accidents that shared similarities were grouped into the following three accident categories: criticalities, transportation, and operations. Accidents with the largest consequence in each category are called bounding accidents as the accident consequences are representative of the reactor systems, structures, and components ability to respond to an accident of that category. The categories include accidents that are generally unlikely or extremely unlikely. High-frequency accidents that are anticipated would have consequences that are covered by the consequences of unlikely or extremely unlikely accidents. Furthermore, the mobile microreactor would be designed to prevent or mitigate anticipated accidents. Because of the small source term associated with the mobile microreactor, the design may not need to be as robust as for reactors with a larger source term. Consequently, to have an equally acceptable risk profile, beyond design basis accidents could have a frequency of 1 in 10,000 to 1 in a million years as opposed to 1 in a million years or less as would be expected for a reactor with a larger source term. The bounding accident for each category is discussed in the following subsections.

Inadvertent Criticality Accident

The inadvertent criticality is assumed to occur even though inadvertent criticality safety controls are implemented to prevent accidents and all confinement barriers are designed to remain intact. An inadvertent criticality could occur during any phase of the project. An inadvertent criticality is assumed to occur because of human errors, fuel handling errors, plant design or construction errors, or a transportation accident (e.g., flooding or core reconfiguration). The frequency of the inadvertent criticality is extremely unlikely with an annual probability as described in Section 4.11.3, *Radioactive Material Release Impacts*. Because of the TRISO fuel design, no uranium would be released from the HALEU fuel as a result of the inadvertent criticality. To cover the consequences of an inadvertent criticality, an event is assumed to occur with 1×10^{19} (10 quintillion) fissions occurring in a uranium solution. The source term for the inadvertent criticality is obtained from the "Short Term Release Quantity" column in Table F-2 of INL/EXT-21-62873 (INL, 2021a) and is shown in **Table 4.11-1**. The inadvertent criticality is assumed to occur during transportation on the haul road near MFC when the mobile microreactor would be nearest to the near-site boundary on US-20 to maximize the consequences to the public while still giving the maximum dose to the noninvolved worker. Even though controls would require adequate shielding, personnel are assumed to be in close proximity to the mobile microreactor structure without adequate shielding for an inadvertent criticality to give a worst-case scenario. An inadvertent criticality could expose personnel to high levels of radiation and could lead to fuel temperatures higher than those for which the TRISO fuel is designed. TRISO fuel could crack and/or degrade, resulting in a release of fission products into the environment. The consequences of an inadvertent criticality accident are shown in **Table 4.11-4** with a dose significantly below regulations and minimal impact to workers and the public.

Table 4.11-4. Radiological Impacts from an Inadvertent Criticality Accident

Accident	Source Term	Impacts on Noninvolved Worker (100 meters)		Impacts on an MEI [a]		Near-Term Impacts on Population within 50 Miles		Near+Long-Term Impacts on Population within 50 Miles	
		Dose (rem)	Probability of an LCF	Dose (rem)	Probability of an LCF	Dose (person-rem) [b]	LCFs [c]	Early + Chronic Dose (person-rem) [b]	LCFs [c]
Inadvertent Criticality (on haul road near MFC)	**Table 4.11-1**	0.21	1.3×10^{-4}	0.031	1.9×10^{-5}	0.020	0 (1.2×10^{-5})	0.047	0 (2.8×10^{-5})

Key: CITRC = Critical Infrastructure Test Range Complex; LCF = latent cancer fatality; MEI = maximally exposed individual; MFC = Materials and Fuels Complex; rem = roentgen equivalent man; TREAT = Transient Reactor Test Facility

Notes:

[a] An MEI was assumed to be on U.S. Highway 20, 2,000 feet (610 meters) from the transport path.

[b] Near-term impacts on the 50-mile population include the potential radiological exposures due to the initial plume passage without mitigation measures such as sheltering-in-place or evacuation. Near+Long-Term impacts include doses from chronic radiological exposures to radionuclides remaining after the plume passage. Exposure pathways include resuspension and inhalation of remaining particulates, direct radiation exposure from residual material on the ground, and ingestion of contaminated food or water. The food pathway could be the largest source of longer-term dose from accidents releasing fission products unless mitigated by the interdiction of the nearby food chain. For purposes of the EIS, no interdiction or mitigation is assumed but such measures would occur in accordance with DOE Order 151.1D, Comprehensive Emergency Management System (DOE, 2016e). The total dose reported includes both the near-term and long-term impacts without mitigation. Person-rem is the exposure of a population to radiation and is the average dose per individual (in rem) multiplied by the number of people exposed. Rem is a unit of effective absorbed dose of ionizing radiation in human tissue.

[c] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses when the reported result is 1 or less. The LCF value presented represents the risk of an LCF for the MEI and the number of LCFs that would be expected in the off-site population within 50 miles of the facility. See Chapter 9, *Glossary*, for an explanation of scientific notation (e.g., 1.3×10^{-4}).

On-Site Transportation Accident

An on-site transportation accident could occur during phases when the microreactor is moved from MFC or TREAT to CITRC or from CITRC to MFC. A vehicle impacting the mobile microreactor could occur during any phase of the project. The size of the mobile microreactor would make the probability of an aircraft impact beyond extremely unlikely. The on-site transportation accident is assumed to be initiated by human error or an equipment malfunction and would bound an event where a vehicle impacts the mobile microreactor. The frequency of the event is unlikely with an annual probability as described in Section 4.11.3, *Radioactive Material Release Impacts*. The accident is assumed to occur during transportation on the haul road near MFC when the mobile microreactor would be nearest to the near site boundary on US-20 to maximize the consequences to the public while still giving the maximum dose to the noninvolved worker. A subsequent fuel-fed fire could provide energy to further damage structures and equipment, aerosolize material, and drive materials into the environment. Even though the mobile microreactor may be exposed to a fire with possible plume rise, the release is assumed to occur at ground level. To cover the consequences of a vehicle accident, an event is assumed to occur with EOL fuel decayed for seven days. The source term for the transportation accident is obtained from the unmitigated "Short- + Long-Term ST (Ci)" column in Table F-4 of INL/EXT-21-62873 (INL, 2021a) and is shown in **Table 4.11-3**. The radionuclides of concern were decayed for 7 days to incorporate the assumption that the microreactor needs to cool for 7 days before it can be transported. The consequences of a transportation accident are shown in **Table 4.11-5** with a dose significantly below regulations and minimal impact to workers and the public.

Table 4.11-5. Radiological Impacts from an On-Site Transportation Accident

Accident	Source Term	Impacts on Noninvolved Worker (100 meters)		Impacts on an MEI [a]		Near-Term Impacts on Population within 50 Miles		Near+Long-Term Impacts on Population within 50 Miles	
		Dose (rem)	Probability of an LCF	Dose (rem)	Probability of an LCF	Dose (person-rem) [b]	LCFs [c]	Early + Chronic Dose (person-rem) [b]	LCFs [c]
Transportation Accident (on haul road near MFC)	**Table 4.11-3**	0.071	4.3×10^{-5}	3.6×10^{-3}	2.2×10^{-6}	0.015	0 (8.9×10^{-6})	0.39	0 (2.4×10^{-4})

Key: CITRC = Critical Infrastructure Test Range Complex; LCF = latent cancer fatality; MEI = maximally exposed individual; MFC = Materials and Fuels Complex; rem = roentgen equivalent man; TREAT = Transient Reactor Test Facility

Notes:

[a] An MEI was assumed to be on U.S. Highway 20, 2,000 feet (610 meters) from the transport path.

[b] Near-term impacts on the 50-mile population include the potential radiological exposures due to the initial plume passage without mitigation measures such as sheltering-in-place or evacuation. Near+Long-Term impacts include doses from chronic radiological exposures to radionuclides remaining after the plume passage. Exposure pathways include resuspension and inhalation of remaining particulates, direct radiation exposure from residual material on the ground, and ingestion of contaminated food or water. The food pathway could be the largest source of longer-term dose from accidents releasing fission products unless mitigated by the interdiction of the nearby food chain. For purposes of the EIS, no interdiction or mitigation is assumed but such measures would occur in accordance with DOE Order 151.1D, *Comprehensive Emergency Management System* (DOE, 2016e). The total dose reported includes both the near-term and long-term impacts without mitigation. Person-rem is the exposure of a population to radiation and is the average dose per individual (in rem) multiplied by the number of people exposed. Rem is a unit of effective absorbed dose of ionizing radiation in human tissue.

[c] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses when the reported result is 1 or less. The LCF value presented represents the risk of an LCF for the MEI and the number of LCFs that would be expected in the off-site population within 50 miles of the facility. See Chapter 9, *Glossary*, for an explanation of scientific notation (e.g., 4.3×10^{-5}).

Operation Accident

Mobile microreactor operations include startup testing at the DOME or CITRC and functional testing at CITRC. The mobile microreactor operation accident is assumed to occur even though safety controls are implemented to prevent accidents and all confinement barriers are designed to remain intact. Accidents during startup testing would involve up to 400 kg of fresh fuel. Accidents involving fresh fuel would have consequences less than accidents involving fuel after the mobile microreactor has been run to generate power and fission products have built up in the fuel. Startup testing would generally involve low reactor powers and short durations. As a result, fission product accumulation in the fuel during startup testing would be minimal. Fission product accumulation in the fuel would be far greater as a result of full power operations for extended durations during functional testing. During mobile microreactor operations, accidents could occur that would release fission products from the TRISO fuel particles that are packed in graphite compact cylinders. Any contamination within the primary system could be released as a result of leaks from the pressure boundary.

In this accident scenario, large or multiple breaches of the mobile microreactor pressure boundary are assumed to occur in conjunction with failure of the control rods/drums. Failure of the control rods/drums could result in a fuel temperature increase. If fuel temperatures were to rise, TRISO fuel damage may result and fission products could be released from the particles into the cooling medium of the mobile microreactor. If the pressure boundary of the primary coolant were breached, a release of fission products would occur. The Project Pele mobile microreactor design includes separate CONEX containers for the mobile microreactor and the control modules. The CONEX container would provide some confinement of the fission products but confinement by the CONEX container is not included in the analysis to provide worst-case conditions.

Instrumentation and control failure could limit mobile microreactor control. If such an event were coupled with a large reactivity excursion from all control drum/rod withdrawal, the reactor power could increase, raising temperatures to the point of TRISO fuel failure and causing mobile microreactor core damage. This could represent an exposure and environmental risk if the pressure boundary were also breached.

As part of the TRISO fuel design, most of the fission products are expected to be contained within the fuel particles, but flooding or chemical attack of the mobile microreactor core could compromise the TRISO fuel layers, resulting in a release of fission products and radiation exposure. Release of the fission products could either be caused by rapid temperature changes that cause particles to crack and fissure, or layer degradation due to chemical reactions or high temperatures. In some cases, extra moderation (e.g., from the flooding water) could increase the reactivity and increase the mobile microreactor power, raising temperatures to the point of TRISO fuel failure and causing mobile microreactor core damage. Failure of the TRISO fuel and mobile microreactor core damage would cause a fission product release if the pressure boundary were also breached.

The probability and magnitude of seismic activity is strongly site dependent. Idaho and the Snake River Valley have a long history of seismic activity. Though the mobile microreactor structure would be built to applicable seismic standards, the water, concrete, or earthen shielding surrounding the mobile microreactor might collapse in a seismic event. In such a case, personnel in the area could be exposed to high levels of radiation coming from the operating mobile microreactor. Furthermore, the collapse of shielding may cause damage to the passive heat removal system, and flooding of the mobile microreactor as previously described.

To cover the consequences of an accident that occurs during operation of the mobile microreactor, an accident is assumed to occur after the mobile microreactor has run for an extended time during functional testing. The accident is assumed to occur at CITRC and to be initiated by operator error or equipment failure or severe natural phenomena hazards (e.g., extreme straight-line wind, tornado, flood, seismic event, volcanic activity). For this analysis, a severe earthquake is assumed to occur. The frequency of the event is extremely unlikely with an annual probability as described in Section 4.11.3, *Radioactive Material Release Impacts*. Radionuclides would be released because of fuel failure. An earthquake that results in this much damage would require accelerations substantially higher than the design-basis requirements for the mobile microreactor and major failures of buildings and equipment would be expected. The source term for the operational accident is obtained from the unmitigated "Short- + Long-Term ST (Ci)" column in Table F-7 of INL/EXT-21-62873 (INL, 2021a) and is shown in **Table 4.11-2**. The consequences of a mobile microreactor operation accident are shown in **Table 4.11-6** with a dose significantly below regulations and minimal impact to workers and the public.

Table 4.11-6. Radiological Impacts from a Mobile Microreactor Operation Accident

Accident	***Source Term***	***Impacts on Noninvolved Worker (100 meters)***		***Impacts on an MEI*** [a]		***Near-Term Impacts on Population within 50 Miles***		***Near+Long-Term Impacts on Population within 50 Miles***	
		Dose (rem)	***Probability of an LCF***	***Dose (rem)***	***Probability of an LCF***	***Dose (person-rem)*** [b]	***LCFs*** [c]	***Early + Chronic Dose (person-rem)*** [b]	***LCFs*** [c]
Operational Accident (at CITRC)	**Table 4.11-2**	0.52	3.1×10^{-4}	3.5×10^{-4}	2.1×10^{-7}	0.079	0 (4.7×10^{-5})	12	0 (7.1×10^{-3})

Key: CITRC = Critical Infrastructure Test Range Complex; INL = Idaho National Laboratory; LCF = latent cancer fatality; MEI = maximally exposed individual; MFC = Materials and Fuels Complex; rem = roentgen equivalent man; TREAT = Transient Reactor Test Facility

Notes:

[a] An MEI was assumed to be on U.S. Highway 20, 5.6 miles (9 kilometers) from CITRC.

[b] Near-term impacts on the 50-mile population include the potential radiological exposures due to the initial plume passage without mitigation measures such as sheltering-in-place or evacuation. Near+Long-Term impacts include doses from chronic radiological exposures to radionuclides remaining after the plume passage. Exposure pathways include resuspension and inhalation of remaining particulates, direct radiation exposure from residual material on the ground, and ingestion of contaminated food or water. The food pathway could be the largest source of longer-term dose from accidents releasing fission products unless mitigated by the interdiction of the nearby food chain. For purposes of the EIS, no interdiction or mitigation is assumed but such measures would occur in accordance with DOE Order 151.1D, *Comprehensive Emergency Management System* (DOE, 2016e). The total dose reported includes both the near-term and long-term impacts without mitigation. Person-rem is the exposure of a population to radiation and is the average dose per individual (in rem) multiplied by the number of people exposed. Rem is a unit of effective absorbed dose of ionizing radiation in human tissue.

[c] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses when the reported result is 1 or less. The LCF value presented represents the risk of an LCF for the MEI and the number of LCFs that would be expected in the off-site population within 50 miles of the facility. See Chapter 9, *Glossary*, for an explanation of scientific notation (e.g., 4.3×10^{-5}).

4.11.4 Conclusions

Because of the protective characteristics of the TRISO fuel particles, only a very, very small fraction of the radioactive materials would be released from the fuel under operating or accident conditions and temperatures. As a result, radiological impacts to the public from any accident would be a small fraction of an individual's natural background radiation dose rate of about 0.38 rem per year. The results of the analysis show that the consequences of accidents involving the mobile microreactor would not adversely impact any of the receptors. Radiation doses to the maximally exposed member of the public, the off-site population residing within 50 miles of the facility, and a noninvolved worker located 330 feet from the accident are well below any regulatory limits. The probability of LCFs is very small for the maximally exposed member of the public, the off-site population residing within 50 miles of the accident, and a noninvolved worker located 330 feet from the accident. The largest impacts to receptors would be associated with different accidents. The largest impacts to the off-site population and noninvolved worker are associated with an operational accident at CITRC. The largest MEI dose is associated with an inadvertent criticality accident during transport of the mobile microreactor between locations on the INL Site.

4.12 Human Health – Transportation

This section presents human health considerations associated with transport elements of the proposed Project Pele. Both radiological and nonradiological transportation impacts would result from shipment of radioactive materials and waste. Radiological impacts are those associated with the effects from low levels of radiation emitted during incident-free transportation and from the accidental release of radioactive materials. Nonradiological impacts are independent of the nature of the cargo being transported, and are expressed as traffic accident fatalities resulting only from the physical forces that accidents could impart to humans.

4.12.1 Methodology and Assumptions

Transportation packages containing radioactive materials emit low levels of radiation; the amount of radiation depends on the characteristics of the transported materials. DOT regulations require that transportation packages containing radioactive materials have sufficient radiation shielding to limit the radiation dose rate to 10 millirem per hour at a distance of 6.6 feet from the transporter.

For incident-free transportation, the potential human health impacts of the radiation field surrounding the transportation packages are estimated for transportation workers and the general population along the route (termed off-traffic or off-link). Human health impacts are also estimated for people sharing the route (termed in-traffic or on-link), at rest areas, and at other stops along the route. This EIS used the RADTRAN 6.02 (Radioactive Material Transportation Risk Assessment) computer code (Weiner et al., 2013; Weiner et al., 2014) to estimate the impacts on transportation workers and the population along the route, as well as the impacts on an MEI (e.g., a person stuck in traffic, a gas station attendant, an inspector). Because it is impossible to predict the specific location of an off-site transportation accident, generic atmospheric conditions were selected for the risk and consequence assessments.

Transportation accidents involving radioactive materials present both nonradiological and radiological risks to workers and the public. Nonradiological impacts of transportation accidents include traffic accident fatalities. Radioactive material would be released during transportation accidents only when the transport package carrying the material is subjected to forces that exceed its design standard. Only a severe fire or a powerful collision, both events of extremely low probability, could damage a transportation package used to transport fissile materials or highly radioactive material to the extent that there could be a significant release of radioactive material to the environment.

The radiological impact of a specific accident is expressed in terms of probabilistic risk (i.e., dose risk). Dose risk is defined as the accident probability (i.e., accident frequency) multiplied by the accident consequences (i.e., dose). The overall radiological risk is obtained by summing the individual radiological risks from all reasonably conceivable accidents. The analysis of accident risks takes into account a spectrum of accident severities ranging from high-probability accidents of low severity (e.g., a fender bender) to hypothetical high-severity accidents having low probabilities of occurrence.

In determining transportation risks, per-shipment risk factors were calculated for incident-free and accident conditions using the RADTRAN 6.02 code (Weiner et al., 2013; Weiner et al., 2014) in conjunction with the Web Transportation Routing Analysis Geographic Information System (WebTRAGIS) code (Peterson, 2018), which was used to identify transportation routes in accordance with DOT regulations and other parameters. The WebTRAGIS program currently provides population density estimates along the routes based on the 2012 U.S. census data for determining population radiological risk factors. For incident-free operations, the affected population includes individuals living within 0.5 mile on either side of the road. For accident conditions, the affected population includes individuals living within 50 miles of the accident, and the MEI was assumed to be a receptor located 330 feet directly downwind from the accident. The estimated population for which incident-free and accident doses are calculated was increased to account for population growth through the year 2025.

4.12.2 Transportation-Related Activities

The transportation risk assessment is limited to estimating the human health risks related to off-site transportation. The risks related to off-site transportation include incident-free risks related to being in the vicinity of a shipment during transport or at stops, and accident risks. The impacts of increased local traffic volume or infrastructure are not evaluated in this analysis. These impacts would be insignificant, since there would only be a small number of shipments of radioactive materials over the duration of the project. Any road closures for the movement of the mobile microreactor would be of short distance and duration and would be performed during the period when there is very limited traffic on the highway connecting MFC and CITRC at the INL Site.

The off-site transportation-related activities include (see Chapter 2, *Description of Alternatives*):

- Transport of the mobile microreactor and its support systems/components within four CONEX shipping containers from BWXT in Lynchburg, Virginia, to the INL Site;
- Transport of the HALEU fuel, as TRISO compacts containing TRISO fuel particles/pebbles, from BWXT to the INL Site;
- Transport of LLW and MLLW (both contact-handled and remote-handled) from the INL Site to off-site Federal or commercial treatment or disposal facilities (for purposes of analysis in this EIS, the disposal site were assumed to be the NNSS near Las Vegas, Nevada; Energy*Solutions* near Clive, Utah; and Waste Control Specialists, LLC, near Andrews, Texas); and
- Transport of the construction material needed for the project demonstration at CITRC (nonradiological impacts only).

The majority of shipments would be LLW and MLLW.

For off-site transport, highway routes were determined using the routing program WebTRAGIS (Peterson, 2018). The routes were selected to be reasonable and consistent with routing regulations and the general practice, but they are only representative routes because the actual routes would be chosen in the future. At the time of shipment, the route would be selected on the bases of current road conditions, weather conditions, and traffic congestion.

The selected routes for transport of the LLW and MLLW to off-site disposal facilities are those from the INL Site to the NNSS, EnergySolutions, and Waste Control Specialists. Local roads would be used near each of the facilities, but the majority of the routes would consist of interstate highways (e.g., I-15, I-84, I-80, and I-25).

4.12.3 Transportation Routes

To assess incident-free and transportation accident impacts, route-specific characteristics were determined for each of the transport activities. Route characteristics that are important to the radiological risk assessment include the total shipment distance and population distribution along the route. The specific route selected determines both the total potentially exposed population and the expected frequency of transportation-related accidents.

Route characteristics for routes analyzed in this EIS are summarized in **Table 4.12-1**. Rural, suburban, and urban areas are characterized according to the following breakdown (Peterson, 2018):

- Rural population densities range from 0 to 54 persons per square kilometer (0 to 140 persons per square mile).
- Suburban population densities range from 55 to 1,284 persons per square kilometer (140 to 3,326 persons per square mile).
- Urban population densities include all population densities greater than 1,284 persons per square kilometer (3,326 persons per square mile).

The affected population for route characterization and incident-free dose calculation includes all persons living within 0.5 mile on either side of the transportation route. Population densities along the BWXT–INL route have been projected to 2025 using state-level data from the 2020 census (USCB, 2021c) and assuming state population growth rates from 2010 to 2020 continue to 2025.

Table 4.12-1. Off-Site Transport Truck Route Characteristics

Origin	*Destination*	*Nominal Distance (kilometers)*	*Distance Traveled in Zones (kilometers)*			*Population Density in Zone (number per square kilometer)*			*Number of Affected Persons*
			Rural	*Suburban*	*Urban*	*Rural*	*Suburban*	*Urban*	
BWXT	INL	3,475	2,792	616	67	10	451	2,369	**741,062**
INL [a]	NNSS	1,330	1,178	129	22	15	951	3,608	**354,070**
INL [a]	Energy*Solutions*	511	381	108	22	27	992	3,608	**317,354**
INL [a]	WCS	2,365	2,007	303	55	20	772	3,521	**748,407**

Key: BWXT = BWX Technologies, Inc. ; INL = Idaho National Laboratory; NNSS = Nevada National Security Site; WCS = Waste Control Specialists

Note:

[a] These routes are the same as those analyzed in the *Versatile Test Reactor Environmental Impact Statement* (DOE, 2020a) Appendix E, Table E-1.

4.12.4 Radioactive Material Shipments

Transportation of the radioactive materials would occur in certified packages on exclusive-use vehicles. Analysis of off-site radioactive material shipments is currently limited to transports associated with the reactor fuel for the mobile microreactor. As indicated in Chapter 2, *Description of Alternatives*, the mobile microreactor is expected to be powered by HALEU TRISO fuel and would need a maximum of 400 kg of HALEU.

The EIS analysis of off-site transportation involves the shipment of TRISO fuel (in the form of compacts containing TRISO fuel particles/pebbles) from BWXT to the INL Site. All shipments between the HEU source (e.g., NNSA Y-12 Complex in Oak Ridge, Tennessee) and the BWXT HEU downblending facility in

Erwin, Tennessee, and the transports of materials between Erwin, Tennessee, and the BWXT fuel fabrication facility in Lynchburg, Virginia, have been addressed in the *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* (DOE, 1996b).

One option for transporting the mobile microreactor fuel from BWXT in Virginia to the INL Site is in the DAHER Group, Transport Logistics International, Inc. (DAHER TLI) Versa Pac (VP) (NRC, 2020) container, which is certified by the NRC for transport of unirradiated TRISO fuel. Other containers (e.g., the NAC International-Legal Weight Truck [LWT], Westinghouse Electric Company, LLC Traveller, or Areva Federal Services, LLC MOX Fresh Fuel Package [MFFP]) could be used for transporting the mobile microreactor fuel if these alternative containers were certified by NRC for the transport of unirradiated TRISO fuel.[58] The VP considered for this transport is the VP-110 package, which is a 110-gallon drum-like packaging approved for transport of TRISO fissile materials. **Figure 4.12-1** shows the schematic of the major components within a VP (Kent et al., 2016).

The VP-110 package outer nominal dimensions (diameter x height) and the payload (internal cavity) dimensions are 30 x 42 inches and 21 x 29 inches, respectively. For the transport of HALEU fuel, which is about 20 percent enriched in uranium-235 (U-235), the package has a limit of 410 grams of U-235, or about 2 kg of HALEU mass. For conservatism, it was assumed that the 400 kg of HALEU fuel would be transported in 10 shipments from BWXT in Virginia to the INL Site (INL, 2021a). The health impacts associated with shipment of nuclear material (reactor fuel) were calculated with all TRISO fuel packages being transported in commercial trucks (INL, 2021a).

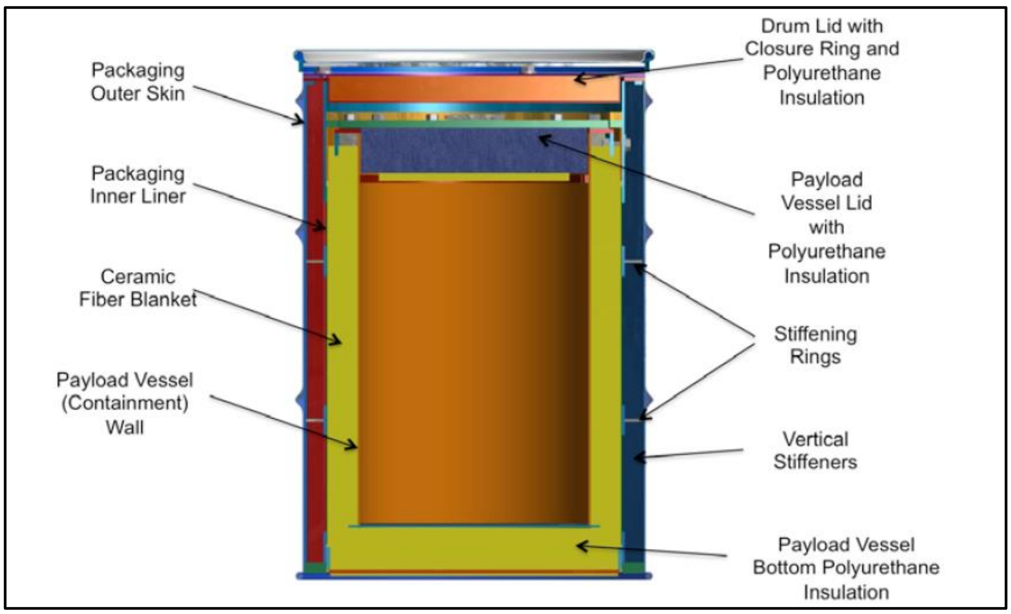


Figure 4.12-1. Versa Pac Major Components

The uranium weight fractions and the corresponding uranium activity of the HALEU fuel in a VP-110 package is listed in **Table 4.12-2**. This composition is based on the assumption of using depleted uranium with a U-235 enrichment of 0.25 percent for downblending of the weapon grade HEU with an enrichment of 93.1 percent. The HALEU fuel is assumed to have a U-235 enrichment of 19.75 percent.

[58] Irrespective of the type of packaging being used for the future transport of the TRISO fuel, the risk of the transport of the unirradiated TRISO fuel would be very small, as indicated in Section 4.12.7, *Transportation Risk Results*.

Table 4.12-2. Content of Versa Pac-110 with High-Assay Low-Enriched Uranium (HALEU)

Radioisotope	Weight Fraction	Activity [a] per VP-110 (Ci)
Uranium-234	0.0021	2.74×10^{-2}
Uranium-235	0.1975	8.86×10^{-4}
Uranium-236	0.0011	1.41×10^{-4}
Uranium-238	0.7994	5.58×10^{-4}

Key: HALEU = high-assay low-enriched uranium; VP = Versa Pac container
Note:
[a] Activity refers to the decay rate of a radionuclide. One Curie (Ci) is defined as 3.7×10^{10} disintegrations per second. See Chapter 9, *Glossary*, for an explanation of scientific notation (e.g., 3.7×10^{10}).

The various low-level wastes that would be generated from the mobile microreactor operation at the INL Site, and its support facilities, including the PIE operations, are estimated in the INL report TEV-4257, *Project Pele Waste and Material Data for Environmental Impact Statement (EIS)* (INL, 2021f). The INL report provides the estimated volumes of different wastes from each facility operation, along with the expected radionuclide inventories for each type of waste from each facility. This compilation of waste data would lead to more than 10 different waste-radionuclide combinations. This information is similar to those provided for the waste quantities and characteristics in the VTR EIS (DOE, 2020a). Since the data bases and assumptions are similar to those used in the VTR EIS, the information as summarized in the VTR EIS Appendix E, Section E.5.2 was used for the characterization of the generated low-level waste in this EIS.

The various wastes from the mobile microreactor and its support facility operations are assumed to be packaged for transportation to an off-site disposal facility by considering the following factors:

- Contact-handled LLW and MLLW are packaged in B-12 boxes (20 percent), B-25 boxes (20 percent), and 16-foot ISO-compliant containers (60 percent), for transport to a disposal facility.
- Remote-handled LLW and MLLW are packaged in 55-gallon drums and placed in a Type B shielded casks for transport to a disposal facility; the CNS 10-160B cask (COC-71-9204 2020) was used a representative transport package.

Based on the estimated information on the potential generation of various LLW wastes in the INL TEV-4257 report (INL, 2021f), it was determined that the project would generate an equivalent of a total of 19 shipments of contact-handled LLW/MLLW (16 shipments) and remote-handled wastes (3 shipments) over the 3 years of operation and 3 years of PIE activities.

4.12.5 Incident-Free Transportation Risks

During incident-free transportation of radioactive materials, a radiological dose results from exposure to the external radiation field that surrounds the shipping containers. The population dose is a function of the number of people exposed, their proximity to the containers, their length of time of exposure, and the intensity of the radiation field surrounding the containers.

Radiological impacts were determined for crew members (truck drivers) and the general population during incident-free transportation. The general population is composed of the persons residing within 0.5 mile on either side 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. Exposures to inspectors are evaluated and presented separately in this section.

Collective doses for the crew and general population were calculated by using the RADTRAN 6.02 computer code (Weiner et al., 2013; Weiner et al., 2014). The radioactive material shipments were assigned an external dose rate based on their radiological characteristics. Off-site transportation of the radioactive material has a defined regulatory limit of 10 millirem per hour at 6.6 feet from the outer lateral surfaces of the vehicle (10 CFR 71.47 and 49 CFR 173.441). The external dose rate of a package is driven by the radiological characteristics of its content. Given the composition of HALEU, the packages containing TRISO fuel are assigned a dose rate of 2 millirem per hour at 3.3 feet. The external dose rate for the various contact-handled LLW/MLLW is also 2 millirem per hour at 3.3 feet, and the dose rate for the remote handled waste is 10 millirem per hour at 3.3 feet from the truck.

To calculate the collective dose, a unit risk factor for a single shipment (a per-shipment risk factor) between a given origin and destination was developed to estimate the impact of transporting one shipment of radioactive material over the shipment distances in various population density zones. The unit dose is a function of the distance and exposure time for both the driver and the exposed public. To include the potential of traffic congestion, the analysis assumed that for 10 percent of the time, travel through suburban and urban zones would encounter rush hour conditions, leading to a lower average speed and higher traffic density.

For truck shipments, three hypothetical scenarios were evaluated to determine the dose to the MEI in the general population. These scenarios are as follows (DOE, 2002c):

- A person caught in traffic and located 4 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
- A service station worker at a distance of 52 feet from the shipping container for 50 minutes

The hypothetical MEI doses were accumulated over a single year for all transportation shipments, but for the scenario involving an individual caught in traffic next to a shipping container, the radiological exposures were calculated for only one event, because it was considered unlikely that the same individual would be caught in traffic next to all containers for all shipments.

The radiological risks from transporting the radioactive materials 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, 2003).

4.12.6 Transportation Accident Risks

In general, two types of analyses are performed in order to provide DOE and the public with a reasonable assessment of radioactive material transportation accident impacts. First, an accident risk assessment was performed that takes into account the probabilities and consequences of a spectrum of potential accident severities using a methodology developed by NRC (NRC, 1977; NRC, 1987; NRC, 2000). For the spectrum of accidents considered in the analysis, accident consequences in terms of collective "dose risk" to the population within 50 miles were determined using the RADTRAN 6.02 computer program (Weiner et al., 2013; Weiner et al., 2014). Secondly, to represent the maximum reasonably foreseeable impacts on individuals and populations should an accident occur, maximum radiological consequences were calculated in an urban or suburban population zone for an accidental release with a likelihood of occurrence greater than 1 in 10 million per year using the RISKIND (Risks and Consequences of Radioactive Material Transport) Version 2.0 computer program (Yuan et al., 1995).

The accident consequence assessment also considers the potential impacts of severe transportation accidents. In terms of risk, the severity of an accident must be viewed in terms of potential radiological consequences, which are directly proportional to the fraction of the radioactive material within a transport package that is released to the environment during the accident. Although accident severity regions span the entire range of mechanical and thermal accident loads, they are grouped into accident categories that can be characterized by a single set of release fractions and are, therefore, considered together in the accident consequence assessment (NRC, 1977; NRC, 1987; NRC, 2000). The accident category severity fraction is the sum of all conditional probabilities in that accident category. For the TRISO fuel transport, the severity categories in the *Radioactive Material Transportation Study* (NRC, 1977) were used.

For off-site transportation of radioactive materials and wastes, route-specific accident rates and accident fatality risks were determined. The values selected were the total state-level accident and fatality rates provided in ANL/ESD/TM-150 (Saricks & Tompkins, 1999). The state-level rates were then adjusted based on the distance traveled in each state to derive a route-specific accident and fatality rate per truck-kilometer. Because of the potential underreported data that were used in in Saricks and Tompkins report (UMTRI, 2003), state-level truck accident and fatality rates in the Saricks and Tompkins report were increased by factors of 1.64 and 1.57, respectively, to account for the underreporting (Saricks & Tompkins, 1999; UMTRI, 2003).

Radiological consequences were calculated by assigning radionuclide release fractions on the basis of the type and form of radioactive material, the type of shipping container, and the accident severity category. For this analysis, release fractions for the TRISO fuel were selected based on its ruggedness and its structure that can maintain its content at high temperature. The release fractions are for the high impact (high crush force) and high-temperature fire accident conditions.

4.12.7 Transportation Risk Results

Table 4.12-3 presents the per-shipment risk factors (unit risk factor for a single shipment) that have been calculated for the collective populations of exposed persons and for the crew for the anticipated routes and shipment configurations. The per-shipment risk factors for the transport of the various low-level wastes are those that were calculated in the VTR EIS (DOE, 2020a). Radiological risks are presented in terms of doses and LCFs per shipment for each unique route, material, and container combination. The radiological risks would result from potential exposure of people to external radiation emanating from the packaged waste. The exposed population includes the off-link public (people living along the route), on-link public (pedestrian and car occupants along the route), and public at rest and fuel stops. LCF risk factors were calculated by multiplying the accident dose risks by a health risk conversion factor of 0.0006 LCF per rem or person-rem of exposure (DOE, 2003).

For transportation accidents, the risk factors are given for both radiological impacts, in terms of potential LCFs in the exposed population, and nonradiological impacts, in terms of nonoccupational number of traffic fatalities. LCFs represent the number of additional latent fatal cancers among the exposed population. Under accident conditions, the population would be exposed to radiation from released radioactivity (if the package were damaged) and would receive a direct dose (even if the package is unbreached). For accidents that had no release, the analysis conservatively assumed that it would take about 12 hours to remove the package or commercial vehicle from the accident area (DOE, 2002c).

Table 4.12-3. Risk Factors per Shipment of Radioactive Material

Material or Wastes	Origin	Transport Destination	Incident-Free				Accident	
			Crew Dose (person-rem)	Crew Risk (LCF) [a]	Population Dose (person-rem) [b]	Population Risk (LCF) [a]	Radiological Risk (LCF) [a]	Non-radiological Risk (Traffic Fatalities)
TRISO Fuel	BWXT	INL	0.024	1×10^{-5}	0.13	8×10^{-5}	6×10^{-10}	0.0002
LLW (B-25)-MMR Operation [c]	INL	NNSS	0.026	2×10^{-5}	0.023	1×10^{-5}	3×10^{-10}	0.000055
LLW (B-12)-MMR Operation	INL	NNSS	0.023	1×10^{-5}	0.023	1×10^{-5}	2×10^{-10}	0.000055
LLW (16′-Iso)-MMR Operation	INL	NNSS	0.044	3×10^{-5}	0.019	1×10^{-5}	6×10^{-10}	0.000055
LLW (B-25)-MMR Operation	INL	Energy*Solutions*	0.011	6×10^{-6}	0.011	6×10^{-6}	4×10^{-10}	0.000059
LLW (B-12)-MMR Operation	INL	Energy*Solutions*	0.009	5×10^{-6}	0.011	6×10^{-6}	2×10^{-10}	0.000059
LLW (16′-Iso)-MMR Operation	INL	Energy*Solutions*	0.017	1×10^{-5}	0.009	5×10^{-6}	7×10^{-10}	0.000059
LLW (B-25)-MMR Operation	INL	WCS	0.047	3×10^{-5}	0.043	3×10^{-5}	9×10^{-10}	0.00011
LLW (B-12)-MMR Operation	INL	WCS	0.041	2×10^{-5}	0.043	3×10^{-5}	6×10^{-10}	0.00011
LLW (16′-Iso)-MMR Operation	INL	WCS	0.079	5×10^{-5}	0.036	2×10^{-5}	2×10^{-9}	0.00011
RH-LLW-MMR Operation [c, d]	INL	NNSS	0.03	2×10^{-5}	0.037	2×10^{-5}	4×10^{-11}	0.000055
RH-LLW-MMR Operation	INL	Energy*Solutions*	0.012	7×10^{-6}	0.017	1×10^{-5}	4×10^{-11}	0.000059
RH-LLW-MMR Operation	INL	WCS	0.053	3×10^{-5}	0.068	4×10^{-5}	9×10^{-11}	0.00011

Key: BWXT = BWX Technologies; INL = Idaho National Laboratory; LCF = latent cancer fatality; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; MMR = mobile microreactor; NNSS = Nevada National Security Site; RH = remote-handled; TRISO = tristructural isotropic; WCS = Waste Control Specialists

Notes:

[a] Risk is expressed in terms of LCFs. Radiological risk is calculated for one-way travel while nonradiological risk is calculated for two-way travel. Accident dose risk can be calculated by dividing the risk values by 0.0006 (DOE, 2003). LCF risks are rounded to one non-zero digit. See Chapter 9, *Glossary*, for an explanation of scientific notation (e.g., 1×10^{-5}).

[b] Person-rem is the exposure of a population to radiation and is the average dose per individual (in rem) multiplied by the number of people exposed. Rem is a unit of effective absorbed dose of ionizing radiation in human tissue.

[c] The LLW also includes MLLW. All entries with the MMR operation wastes include those generated from the operation of the mobile microreactor, its support facilities, and the post-irradiation examination activities. These wastes are transported in a combination of Type A B-25 and B-12 steel boxes with 5 boxes per shipment and in 16-foot ISO-compliant containers with 1 container per shipment.

[d] The RH-LLW also includes RH-MLLW. These wastes are transported in a shielded Type B cask. CNS 10-160B used as an example.

Table 4.12-4 shows the risks of transporting radioactive materials for all shipments. The risks are calculated by multiplying the previously given per-shipment factors by the number of shipments over the duration of the program.

As indicated in **Table 4.12-3** and **Table 4.12-4**, all shipment risk factors are less than one. This means that no LCFs or traffic fatalities are expected to occur during these transports.

The maximum estimated doses to workers and the public MEIs are presented in **Table 4.12-5**, considering all shipment types. Doses are presented on a per-event basis (rem per event, per exposure, or per shipment), because it is generally unlikely that the same person would be exposed to multiple events. A member of the public living along the route would likely receive multiple exposures from passing shipments during the period analyzed. The cumulative dose to this resident is calculated by assuming all the shipments pass his or her home. The cumulative dose is calculated assuming that the resident is present for every shipment and is unshielded at a distance of about 98 feet from the route. Therefore, the cumulative dose depends on the number of shipments passing a particular point and is independent of the actual route being considered.

If one assumes the maximum resident dose provided in **Table 4.12-5** applies to all radioactive transport types, then the maximum dose to this resident (if all the materials were shipped via this route [a total of 29 shipments]) would be about 0.009 millirem, with a risk of developing an LCF of about 5×10^{-9} (0.000000005).

Table 4.12-4. Risks of Transporting Radioactive Material

Route	Number of Shipments	One-way Kilometers Traveled	Incident-Free				Accident	
			Crew		Population		Radiological Risk	Non-radiological Risk
			Dose (person-rem) [a]	LCFs [a]	Dose (person-rem) [b]	LCFs		
TRISO Fuel to INL Site	10	34,750	0.24	1×10^{-4}	1.3	8×10^{-4}	6×10^{-9}	0.002
Low-level (contact-handled and remote-handled) waste transport								
INL Site to Energy*Solutions*	19	9,710	0.23	1×10^{-4}	0.21	1×10^{-4}	7×10^{-9}	0.001
INL Site to NNSS	19	25,270	0.58	3×10^{-4}	0.47	3×10^{-4}	7×10^{-9}	0.001
INL Site to WCS	19	44,935	1.03	6×10^{-4}	0.86	5×10^{-4}	2×10^{-8}	0.002
Subtotal [c]	**19**	**44,935**	**1.03**	$\mathbf{6 \times 10^{-4}}$	**0.86**	$\mathbf{5 \times 10^{-4}}$	$\mathbf{2 \times 10^{-8}}$	**0.002**
Total	**29**	**79,685**	**1.27**	$\mathbf{8 \times 10^{-4}}$	**2.16**	$\mathbf{1 \times 10^{-3}}$	$\mathbf{3 \times 10^{-8}}$	**0.004**

Key: INL = Idaho National Laboratory; LCF = latent cancer fatality; NNSS = Nevada National Security Site; TRISO = tristructural isotropic; WCS = Waste Control Specialists

Notes:

[a] See Chapter 9, *Glossary*, for an explanation of scientific notation (e.g., 1×10^{-5}).

[b] Person-rem is the exposure of a population to radiation and is the average dose per individual (in rem) multiplied by the number of people exposed. Rem is a unit of effective absorbed dose of ionizing radiation in human tissue.

[c] Reflects the maximum risk values amongst the three possible off-site disposal sites.

Table 4.12-5. Estimated Dose to Maximally Exposed Individual Under Incident-Free Transportation Conditions

Receptor	Dose to Maximally Exposed Individual
Workers	
Crew member (truck driver)	2 rem per year [a]
Inspector	0.028 rem per event per hour of inspection
Public	
Resident (along the truck route)	0.0000003 rem per event
Person in traffic congestion	0.012 rem per event per half an hour stop
Person at a rest stop/gas station	0.0002 rem per event per hour of stop
Gas station attendant	0.00026 rem per event

Key: DOE = U.S. Department of Energy; DOT = U.S. Department of Transportation; rem = roentgen equivalent man

Note:

[a] In addition to complying with DOT requirements, a DOE employee would also need to comply with 10 CFR 835, which limits worker radiation doses to 5 rem per year. DOE's goal is to maintain radiological exposure as low as reasonably achievable. DOE has, therefore, established the administrative control level of 2 rem per year (DOE, 2017b). Based on the number of commercial shipments and the total crew dose to two drivers in **Table 4.12-4**, a commercial driver dose would not exceed this administrative control limit. Therefore, the administrative control limit is reflected in this table for the maximally exposed truck crew member.

4.12.8 Impact of Construction and Operational Material and Hazardous Waste Transport

This section evaluates the impacts of transporting nonradioactive materials (such as the mobile microreactor components, construction equipment and supplies, and hazardous wastes).

The risks from transporting the hazardous wastes and nonradioactive materials are estimated in terms of the number of traffic fatalities. For construction materials, it was assumed that materials would be transported 75 miles one way, all in the state of Idaho. For the four mobile microreactor CONEX containers, the transport is assumed to originate from BWXT in Lynchburg, Virginia (2,160 miles to the INL Site). Hazardous wastes are assumed to be transported about 1,240 miles. The truck accident and fatality rates that were assumed for construction materials were based on the state-level accident and fatality data, with appropriate corrections for the underreporting information (Saricks & Tompkins, 1999; UMTRI, 2003). This assumption leads to truck accident and fatality rates of 6.45 accidents per 10 million truck-kilometers traveled and 3.91 fatalities per 100 million truck-kilometers traveled for INL. The route-specific truck accident and fatality rates calculated for transport of four CONEX containers were 7.55 accidents per 10 million truck-kilometers traveled and 2.75 fatalities per 100 million truck-kilometers traveled; these are the same accident and fatality rates as those used for the transport of TRISO fuel to the INL Site. The truck accident and fatality rates assumed for transport of hazardous material transports were 5.77 accidents per 10 million truck-kilometers traveled and 2.34 fatalities per 100 million truck-kilometers traveled (Saricks & Tompkins, 1999; UMTRI, 2003), which is reflective of the national mean.

Table 4.12-6 shows the estimated potential number of accidents and fatalities for nonradioactive materials transports.

Table 4.12-6. Estimated Impacts of Construction Material and Hazardous Waste Transport

Materials	*Number of Shipments*	*Total Distance Traveled (kilometers)*	*Number of Accidents*	*Number of Fatalities*
Mobile Microreactor CONEX	1 [a]	13,900	1×10^{-2} [b]	4×10^{-4}
Construction	175 [c]	42,350	3×10^{-2}	2×10^{-3}
Hazardous and Nonradioactive Wastes [d]	2	4,000	2×10^{-3}	9×10^{-5}
Total	178	60,250	4×10^{-2}	2×10^{-3}

Key: CONEX = container express (shipping container); INL = Idaho National Laboratory
Notes:
[a] This transport consists of a one-time convoy of four truck trailers to ship the four mobile microreactor CONEX containers.
[b] See Chapter 9, *Glossary*, for an explanation of scientific notation (e.g., 1×10^{-2}).
[c] These transports are within the state of Idaho, at a one-way distance of about 75 miles. The numbers of accidents and fatalities are based on the round trip distance, as a set of truck trailers performing these transports.
[d] The nonradioactive wastes (i.e., cold wastes) are conservatively assumed to have been disposed of at a distance similar to that of a hazardous waste.

4.12.9 On-Site Transports

On-site shipment of radioactive materials and wastes would occur at the INL Site. These shipments would not have any substantial effect on members of the public because roads between the site processing areas are closed to the public or have comparatively short distances to which the public has access. The on-site waste shipments from construction and operations evaluated in this EIS would be a small fraction of the overall site waste shipments. The transport of the mobile microreactor to CITRC would either occur on an on-site road, or occur on a small segment of US-20 with the road closed. These activities would occur in a controlled environment with a proper vehicle speed, given the heavy load content, and no accidents are expected.

For on-site transport at the INL Site, DOE Order 460.1D (DOE, 2016f) allows for the preparation of a Transportation Safety Document to demonstrate equivalent safety for deviations from hazardous materials transportation requirements. The INL Transportation Safety Document (INL, 2017b) describes the INL packaging and transportation program and explains the methodology for complying with the rules, laws, and regulations governing on-site and off-site transportation functions at the INL Site.

Non-routine shipments are shipments that do not fully comply with DOT hazardous material regulations and require the preparation of a Transport Plan. Cases that require the preparation of Transport Plans include variations to packaging requirements (such as the use of a packaging not authorized by DOT for shipping the material), packaging limits (such as radiation or contamination limits), and any other DOT requirements that cannot be met. The INL Transportation Safety Document (INL, 2017b) requires that Transport Plans identify, as applicable, the specific DOT requirement(s) not met, hazard category, safety analysis, technical safety requirements, administrative controls, hazard controls, engineered barriers, and site-mitigating conditions that ensure a level of safety equivalent to that afforded by DOT requirements for routine shipments.

4.12.10 Conclusions

Based on the results presented, the following conclusions have been reached (see **Table 4.12-4** through **Table 4.12-6**):

- The transportation of radioactive material (fuel) and waste likely would result in no additional fatalities as a result of radiation, either from incident-free operation or postulated transportation accidents.
- The nonradiological accident risks (the potential for fatalities as a direct result of traffic accidents) are greater than the radiological accident risks.
- It is estimated that no potential traffic fatalities would be expected over the duration of the activities. For comparison, in 2017, there were over 37,133 traffic fatalities in the United States due to all vehicular crashes (DOT, 2019). The incremental increase in risk to the general population from shipments associated with Project Pele would, therefore, be very small and would not substantially contribute to cumulative impacts.

4.13 Traffic

This section discusses the potential effects to traffic networks that could occur from Project Pele. Impacts to traffic would occur if the Proposed Action increases the LOS on local roadways within the INL Site or public roadways within the ROI, causes a disruption to traffic patterns, or creates road closures. As indicated in Section 4.0, *Introduction*, each phase of Project Pele has the potential to affect traffic. Overall impacts on traffic from the Proposed Action are anticipated to be negligible to minor.

4.13.1 Phase 1: Fuel Mobile Microreactor (TREAT or HFEF)

The core fueling and final assembly phase of Project Pele would be expected to last 4 weeks from arrival of the components to completed assembly of the mobile microreactor. The frequency of the initial shipments would be four times a week for 2 weeks. The trucks would be tractor-trailers. Shipments of material and waste outside the initial shipment of microreactor components and fuel are not expected during the core fueling and final assembly of the microreactor.

During this phase, an average of 96 additional personnel combined between the microreactor assembly and fueling tasks (or 96 vehicle trips) would occur on-site over the 4-week period to the existing 250 to 300 daily vehicle trips in and out of MFC, and to the 6,836 workforce at the larger INL Site. Commuter trips generated by these personnel would result in a temporary negligible impact to existing off-site traffic volume; no changes to the existing road network LOS are anticipated.

4.13.2 Phase 2: Mobile Microreactor Startup Testing (MFC or CITRC)

Following Phase 1, the startup and initial testing phase are anticipated to take 6 months to complete. During that time, an average of 45 additional personnel would be on-site on a daily basis. Similar to Phase 1, commuter trips generated by these personnel would result in a negligible impact to existing off-site traffic volume, and no changes to the existing road network LOS are anticipated.

4.13.3 Phase 3: Mobile Microreactor Disassembly and Transport (at CITRC or from MFC to CITRC)

Following Phase 2, the microreactor modules would be disassembled and would be loaded onto four semi-trailers for transport to CITRC. This would be a one-time shipment. The multipurpose haul road or US-20 would be used to transport the microreactor modules from the DOME to CITRC. If US-20 is used, the highway would be shut down for a 2-hour window during non-peak times (midnight to 4:00 a. m.) to enable safe and unhindered transport of the microreactor between the two locations. The one-time shut-down of US-20 during transport would result in a short-term, adverse impact on traffic. Overall, the impact would be negligible over the life of the project.

This phase is anticipated to take around 5 weeks to complete. During that time, an average of 105 additional personnel would be on-site on a daily basis. Commuter trips generated by these personnel would result in a negligible impact to existing off-site traffic volume and no changes to the existing road network LOS are anticipated.

4.13.4 Phase 4: Mobile Microreactor Operations at CITRC

Construction

Shipments of material such as concrete for shielding and construction materials would occur during site preparations. An average frequency of three shipments during the construction and site preparation stages are expected. During that time, an average of 36 additional personnel would be on-site on a daily basis. Vehicle trips generated by site preparation activities would result in a negligible impact to existing off-site traffic volume and no changes to the existing road network LOS.

Operations

After the preparation stage, additional shipments are not expected. Shipments of waste are not expected during microreactor operations at CITRC, as the microreactor is self-contained.

This phase is anticipated to take around 2.5 years to complete. During that time, an average of 51 additional personnel would be on-site on a daily basis for microreactor assembly and operations. Commuter trips generated by these personnel would result in a negligible impact to existing off-site traffic volume and no changes to the existing road network LOS.

4.13.5 Phase 5: Mobile Microreactor Disassembly at CITRC and Transport to Temporary Storage (RSWF or ORSA)

Disassembly and Transport

This phase is anticipated to take around 5 weeks to complete. The microreactor modules would be disassembled and would be loaded onto four semi-trailers for transport to the temporary storage site. During microreactor disassembly (including site restoration) and transport, an average of 105 additional personnel would be on-site on a daily basis. Vehicle trips generated by site preparation activities would result in a negligible impact to existing off-site traffic volume and no changes to the existing road network LOS.

Site Restoration

This phase is anticipated to take around 5 weeks to complete. During that time, an average of 54 additional personnel would be on-site on a daily basis; this count is included in the 105 total for this phase identified above. Commuter trips generated by these personnel would result in a negligible impact to existing off-site traffic volume and no changes to the existing road network LOS.

4.13.6 Phase 6: Mobile Microreactor Temporary Storage (RSWF or ORSA)

There is no defined duration for this phase, which would require biannual inspections. During that time, an average of 11 additional personnel would be on-site twice per year during the inspections. Commuter trips generated by these personnel would result in a negligible impact to existing off-site traffic volume and no changes to the existing road network LOS.

4.13.7 Phase 7: Mobile Microreactor and Spent Nuclear Fuel Post-Irradiation Examination and Disposition

This phase is anticipated to take around 3 years to complete. During that time, an average of 30 additional personnel would be on-site on a daily basis. Commuter trips generated by these personnel would result in a negligible impact to existing off-site traffic volume and no changes to the existing road network LOS.

4.14 Socioeconomics

This section discusses the potential effects to socioeconomic conditions that could occur from Project Pele. Socioeconomic impacts result from the direct employment of construction and operations workers and the impacts on regional economic characteristics, population, housing, and community resources within the ROI. An important consideration in assessing potential impacts of the proposed facilities is the number of workers, families, and children who might move into the ROI (in-migrate), either temporarily or permanently, during construction and operation of the proposed facilities. Impacts on population are typically described in terms of total number of in-migrants (and their families) arriving in the region in the peak year of construction and first year of operation. The resulting population influx would have the potential to substantially affect the housing market in the ROI, with potential increases in demand for both rental and owner-occupied housing units. It could also increase demand for educational services and for other public services such as police and fire protection and health services. Finally, the increases in jobs and income from construction and operation of the proposed facilities would have both direct and indirect impacts on the local and regional economy. To the extent these increases would help reduce existing unemployment levels and boost the economy, they are considered to be beneficial.

The socioeconomic impact analysis focuses on all phases of the proposed Project Pele conducted at the INL Site. Staffing estimates for Project Pele (average estimates by phase) are derived from Appendix B, *Environmental Resources* (Table B-1, Project Staff by Phase) and are consistent with the on-site staffing estimates used in Chapter 2, *Description of Alternatives,* and the human health impact assessment and traffic assessment (see Sections 4.10, *Human Health – Normal Operations,* and 4.13, *Traffic*). These estimates are shown in **Table 4.14-1**. The total workforce staff would encompass both existing staff reassigned to this project and new hires, and include workers in the following categories: INL workers, contractors, oversight, safety, and security, which are considered full-time employees (FTEs); these totals are slightly lower than those presented in Sections 4.10 and 4.13 since they do not include the Visitor category (not FTEs). Note that the socioeconomic analysis focuses only on the portion of the projected workforce that would be considered new hires, including local hires that already live in the area and particularly new hires that would in-migrate into the ROI. Overall, the increase in jobs and income from construction and operations would have a small and short-term beneficial impact on the local and regional economy. The population influx associated with an in-migrating workforce and their families is considered relatively small and would have no major adverse impacts on the region in terms of population, employment, income levels, housing, or community services.

Table 4.14-1. Projected Staffing by Phase

<table>
<tr><th colspan="2">Phase and Duration</th><th>Total Workers</th><th>New Hires
(INL or subcontracted full-time staff)</th></tr>
<tr><td colspan="2">Core Fueling Mobile Microreactor (Phase 1)
Duration: 4 weeks</td><td>45</td><td>15 (year 1)</td></tr>
<tr><td colspan="2">Mobile Microreactor Startup Testing (MFC or CITRC) (Phase 2)
Duration: 6 months</td><td>39</td><td rowspan="3">30 (year 2)</td></tr>
<tr><td rowspan="2">Disassembly and Transport (at CITRC or from MFC to CITRC) (Phase 3)
Duration: 5 weeks</td><td>Disassembly</td><td>48</td></tr>
<tr><td>Transport</td><td>51</td></tr>
<tr><td rowspan="2">Mobile Microreactor Operations – CITRC (Phase 4)
Duration: 2.5 years
4a. Site Preparation/CITRC modification
4b. Operation</td><td>CITRC Modification</td><td>33</td><td>33-48</td></tr>
<tr><td>Mobile Microreactor Unloading and Operations</td><td>42</td><td>30 (prep for testing)
40 (peak) during testing/operations phase</td></tr>
<tr><td rowspan="2">Disassembly and Transport (Phase 5)
Duration: 5 weeks</td><td>Disassembly</td><td>48</td><td rowspan="2">30</td></tr>
<tr><td>Transport</td><td>51</td></tr>
<tr><td colspan="2">Mobile Microreactor Temporary Storage at the INL Site (Phase 6)
Duration: Not defined</td><td>10</td><td>12 (place in storage)</td></tr>
<tr><td rowspan="2">PIE and Disposition (Phase 7)
Duration: 3 years (activities include defueling, extract samples for PIE, ship waste off-site, perform PIE)</td><td>PIE</td><td>12</td><td rowspan="2">20</td></tr>
<tr><td>Disposition</td><td>15</td></tr>
</table>

Key: CITRC = Critical Infrastructure Test Range Complex; INL = Idaho National Laboratory; MFC = Materials and Fuels Complex; PIE = post-irradiation examination

4.14.1 All Project Phases

Construction

Construction activities associated with Project Pele would be limited to Phase 4 and Phase 6 and would include construction of the concrete pad at CITRC for the CONEX containers and construction of a concrete pad and shed at either RSWF or ORSA for temporary storage of the mobile microreactor. No facility modification or construction would be required for the other phases of Project Pele. There would be an average of 33 workers required for CITRC modification, with an expected peak of 48 workers; the same number of workers would be required for the 50-foot by 50-foot storage pad (Phase 6) as for CITRC modifications, but the duration would be shorter. All construction workers are assumed to be new hires from local construction companies. There would be no population influx associated with in-migrating construction workers, and therefore negligible adverse impact on the ROI with respect to population, housing, and community services. Any increase in employment would be expected to result in small and beneficial impacts on the local economy from the increase in jobs, income, and local/state taxes.

Operation

Based on the workforce estimates for all other project phases, it is assumed that peak staffing requirements for Project Pele would be associated with the microreactor operation at CITRC during Phase 4, with an estimate of up to 50 INL and subcontracted FTEs for each year of testing during the 2.5-year period of operation; 40 of these are expected to be new hires. Of the new hires, it is assumed that 70 percent (28) would be hired from the local area and 30 percent (12) would in-migrate into the ROI, some of whom may bring their families. In the event all 12 workers in-migrated with their families, the population influx would be very small, representing less than 0.01 percent of the population in the ROI, based on an average household size in Idaho of 2.68 persons. Note that visitors and contractors would be considered transient workers and would use temporary housing during the project. Visitors would be on a short-time stay and most likely be housed in local hotels; contractors would be less transient and housed in more temporary housing such as local rental apartments. There would be negligible impacts on the region in terms of population, housing, and community services. The small increase in jobs and income would be considered a potential beneficial impact on the area from the increase in jobs, income, and local/state taxes.

The potential increase in jobs and income from the mobile microreactor operation would create beneficial impacts on the economy of the area for the duration of the project, which is expected to last over 3 years. As indicated in Section 3.14, *Socioeconomics*, the INL Site is a major economic contributor to the southeastern Idaho economy. An increase in INL employment associated with Project Pele, however small, would further result in slight benefits to the local, regional, and state economy. For purposes of comparison, the 40 projected operations workforce personnel (FTEs) that would be new hires would represent about 0.6 percent of the 6,836 directly employed INL workers in 2020. In addition to the increases in employment and income, the expected increases in employee spending would create an additional positive induced effect on the economy and generate additional state and local revenues. Added revenues from sales, excise individual, and corporate income taxes would further increase state tax revenues.

In summary, the mobile microreactor operation would have negligible adverse and small beneficial impacts on socioeconomic resources from increases in overall economic output and tax revenues throughout the region. The added economic benefits to the region, added tax revenues, and other benefits stemming from the presence of the mobile microreactor are anticipated to be beneficial contributors to the quality of life in the communities surrounding the facility and across Idaho.

4.15 Environmental Justice

This section discusses impacts on environmental justice populations within a 50-mile radius of the CITRC at the INL Site, as that ROI is consistent with the ROI for radiological emissions.

As noted in Section 3.15, *Environmental Justice*, Executive Order 12898 established the need to identify and address disproportionately high and adverse human health or environmental effects of Federal activities on environmental justice populations. CEQ defines disproportionately high and adverse human health or environmental effects (CEQ, 1997). This analysis is consistent with that guidance and follows the approach conducted for the VTR EIS (DOE, 2020a).

In accordance with DOE orders, environmental sampling is performed at several locations on the INL Site, at the INL Site boundary, and at various distances from the INL Site, including at locations at Blackfoot and on the Fort Hall Indian Reservation to monitor for possible impacts on the Shoshone-Bannock Tribes. At the time of this EIS, the status of environmental sampling remains the same as described in the VTR EIS (DOE, 2020a).

No disproportionately high and adverse impacts on minority or low-income populations are expected. Increased health risks to minority or low-income individuals or populations exposed to radiation would be negligible.

4.15.1 All Project Phases

As discussed in Section 4.14, *Socioeconomics*, Project Pele would result in small, long-term beneficial impacts in the region. These beneficial impacts would be experienced by the population across the region, including Native American populations, as well as other minority and low-income populations.

As discussed in Section 4.10, *Human Health – Normal Operations*, almost all of the radiological emissions under Project Pele would occur during project phases associated with CITRC. Annual average individual doses were calculated for populations within the ROI at distances of 10, 20, and 50 miles of CITRC under the phases of the Proposed Action that occur at this location (there are no populations within 5 miles of CITRC). The highest average individual dose calculated for the MEI (i.e., someone located at the INL Site boundary south of CITRC), regardless of minority or low-income population was 7.0×10^{-3} millirem (i.e., 0.007 millirem). This number is so small that it represents no appreciable change in dose exposure over natural background levels at the INL Site (i.e., 382 millirem) and is well below regulatory limits (i.e., DOE annual public dose limit of 100 millirem or EPA air pathway dose limit of 10 millirem) (DOE-ID, 2021c). Therefore, all other average individual doses at each radial distance are smaller than this amount, and similarly do not represent any appreciable change in dose exposure over baseline levels. Any differences in average individual doses between population groups would be between levels that in and of themselves lack any significance. The greatest difference between any minority or low-income population group and non-minority or non-low-income population group was 6.3×10^{-5} millirem (i.e., 000063 millirem) for Other Minority populations within 10 miles of CITRC, which does not represent an appreciable change in the risk to the exposed individual of developing a latent fatal cancer. Project phases associated with other locations at the INL Site would result in minimal to no new radiological emissions, nor would they pose other health risks to the public, including on minority and low-income populations.

Regarding impacts to communities who rely on subsistence consumption, including concerns raised during the scoping period for this EIS by the Shoshone-Bannock Tribes, ongoing monitoring from the entirety of INL operations in both 2018 and 2019 did not indicate any health risks from radiation exposure directly or through subsistence consumption (DOE-ID, 2019e; DOE-ID, 2021c). Specifically, the total annual dose (via air and ingestion) estimated to be received by the MEI during 2019 was 0.06 millirem (DOE-ID, 2021c), which is far below the public dose limit of 100 millirem established by DOE. Even with the additional dose from the Proposed Action described above, overall levels of exposure would remain very small and well below DOE and regulatory limits. Furthermore, as described in Sections 4.3, *Water Resources*, 4.4, *Air Quality*, and 4.5, *Biological Resources*, there would be negligible off-site impacts to water resources, air quality, and biological resources that may affect off-site populations (to include Native Americans), as well as subsistence resources. Land disturbance at the INL Site would be negligible in terms of the overall extent of INL lands. Therefore, impacts to communities who rely on subsistence consumption (including Native American populations) would be negligible, and there would be no change to an individual's ability to continue to hunt and gather for various purposes throughout their traditional range.

Considering the above analysis and the very low levels of risk exposure by each minority or low-income population compared to non-minority or non-low-income populations, as well as the very low overall levels of exposure, operations of Project Pele would not result in disproportionately high and adverse impacts on minority or low-income populations near the INL Site, including Native American populations. Environmental sampling would continue to occur at the INL Site to ensure operations, including from Project Pele, do not impact off-site populations.

Impacts on the Shoshone-Bannock Tribes on the Fort Hall Reservation, and their use of sacred and traditional-use areas, natural landscapes, water, and ecological resources on the INL Site that are of special significance to them, are further considered in this EIS in Section 4.6, *Cultural and Paleontological Resources*.

4.16 No Action Alternative

As described in Chapter 2, *Description of Alternatives,* Section 2.4, under the No Action Alternative, SCO would not proceed with the proposed Project Pele at the INL Site. Activities at the INL Site would continue under present-day operations, and Project Pele would not be implemented. Therefore, impacts from the No Action Alternative are not discussed further in this EIS. Conditions at the INL Site would remain as described in Chapter 3, *Affected Environment*, for each of the 15 resource areas.

4.17 Mitigation Measures

This section summarizes measures required to protect and mitigate a potential estimated environmental consequence. No potential adverse impacts other than those identified for biological resources were identified that would require additional mitigation measures beyond those required by regulations or existing agreements or achieved through design features or BMPs. If mitigation measures to reduce impacts (above and beyond those required by regulations) were to be identified during implementation, they will be developed, documented, and executed.

Coordination with applicable INL Natural Resource staff would be required prior to any land-clearing activities. Measures as described in Section 4.5, *Biological Resources*, would be implemented and would include but not be limited to targeted surveys for special status species (e.g., MBTA, BCC, state-listed species) (**Table 3.5-2**, Special Status Species Known to Occur at the INL Site and Potential to Occur Within CITRC) would be performed during optimal periods that correlate with the appropriate seasonal timing to determine whether these species occur in the project construction footprint areas within Pads B, C, and D. If any special status species was found, mitigation measures would generally include avoidance and minimizing impacts to occupied habitat. Alternatively, if avoidance of special status species is not possible, relocation or appropriate mitigation or restoration would be implemented. Additionally, to comply with CCA, sagebrush habitat would be quantified prior to land-clearing activities and appropriate mitigation would be implemented. Invasive species management would also be carried out.

Chapter 5
Cumulative Impacts

This page left blank intentionally.

5 CUMULATIVE IMPACTS

NEPA established the CEQ to oversee Federal environmental impact regulations. CEQ defines cumulative impacts as "the impact on the environment which results from the incremental impact when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. Cumulative impacts can also result from spatial (geographic) or temporal (time) crowding of environmental perturbations (i.e., concurrent human activities and the resulting impacts on the environment are additive if there is insufficient time for the environment to recover) (Spaling, 1994). The ROI is the geographic area over which past, present, and reasonably foreseeable future actions (activities) could contribute to cumulative impacts, and is dependent on the type of resource analyzed.

This chapter's analysis of cumulative impacts does not include a detailed evaluation of activities at facilities preparing nonradiological mobile microreactor components, at facilities producing prototype microreactor fuel, or at waste management facilities. As described in Chapter 4, *Environmental Consequences*, Section 4.0, *Introduction*, the impacts of fabrication of nonradiological mobile microreactor components would be similar to other common industrial manufacturing processes, and would be minor. Therefore, the impacts of fabrication of nonradiological mobile microreactor components would not substantially contribute to cumulative impacts.

As described in Section 4.0, *Introduction,* preparation of mobile microreactor fuel would be performed in existing off-site facilities, in accordance with applicable regulations, licenses, and environmental reviews. The existing licenses and environmental reviews consider the environmental impacts of the operation of these facilities. Preparation of fuel for use in the mobile microreactor would be within the operating envelopes for these facilities. Therefore, preparation of the fuel for the mobile microreactor would not contribute to an increase in the analyzed cumulative impacts at these facilities.

As described in Chapter 4, *Environmental Consequences,* Section 4.9, *Waste and Spent Nuclear Fuel Management*, the management of the small quantities of wastes at off-site facilities would not exceed the facilities' capacities. The impacts of these activities were already considered in the licensing or permitting processes for these facilities and would not contribute to an increase in the analyzed cumulative impacts. Furthermore, there are a number of options available for the disposal of LLW and MLLW. Two DOE sites, the Hanford Site and the NNSS, allow for disposal of off-site–generated LLW and MLLW, as long as the waste meets each sites' waste acceptance criteria. In addition, there are two commercial facilities that can accept government-owned LLW: Energy*Solutions* LLW Disposal Facility near Clive, Utah; and Waste Control Specialists near Andrews, Texas. Therefore, there are a number of available waste disposal options to address the small volumes of LLW and MLLW that would be generated by the proposed activities.

The cumulative impacts methodology and assumptions are briefly described in Section 5.1. Reasonably foreseeable actions[59] are listed in Section 5.2. Cumulative impacts for activities at the INL Site are evaluated in Section 5.3.

5.1 Methodology

In general, the following approach was used to estimate cumulative impacts for this EIS:

- The affected environment and baseline conditions were identified, including the effects of past actions (see Chapter 3, *Affected Environment*).

[59] In this EIS, reasonably foreseeable actions are generally understood to be those that have been identified in a NEPA document or are from another environmental impact analysis that is available and for which the effects can be meaningfully evaluated. These include actions unrelated to DOE.

- Past, present, and reasonably foreseeable future actions were identified (see Section 5.2).
- The impacts of Project Pele activities were identified (see Chapter 4, *Environmental Consequences*).
- Cumulative impacts were evaluated by examining the combined effects of Project Pele activities with the effects of other past, present, and reasonably foreseeable future actions in the ROI (see Section 5.3, *Cumulative Impacts*).

5.2 Reasonably Foreseeable Actions

In addition to actions related to the activities evaluated in this EIS, other actions may contribute to cumulative impacts at the INL Site. These actions include on-site and off-site projects conducted by Federal, state, and local governments, the private sector, or individuals that are within the ROIs[60] of the actions examined in this EIS.

Information about present and future actions was obtained from the recently published VTR EIS (DOE, 2020a). The VTR EIS obtained the information from a review of NEPA documents and site-specific plans to determine if ongoing or reasonably foreseeable future projects could contribute to cumulative environmental impacts at the INL Site. Reasonably foreseeable future actions, as defined in 43 CFR 46, are “federal and non-federal activities not yet undertaken, but sufficiently likely to occur, that a responsible official of ordinary prudence would take such activities into account in reaching a decision.” Reasonably foreseeable future actions do not include those actions that are highly speculative or indefinite. Ongoing and reasonably foreseeable actions at the INL Site are:

- Plutonium-238 Production for Radioisotope Power Systems
- Disposal of Greater-Than-Class C (GTCC) LLW and GTCC-Like Waste
- Versatile Test Reactor
- Treatment and Management of Sodium-Bonded Spent Nuclear Fuel
- Sample Preparation Laboratory
- The Resumption of Transient Testing of Nuclear Fuels and Materials
- Use of DOE-Owned High-Assay Low-Enriched Uranium (HALEU)
- Multipurpose Haul Road
- Expanding Capabilities at the Power Grid Test Bed
- Expanding Capabilities at the National Security Test Range and Radiological Response Training Range
- Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel (SNF) Handling
- Recapitalization of Naval Nuclear Propulsion Program Examination Capabilities
- DOE Idaho Spent Fuel Facility/Independent SNF Storage Installation
- Idaho High-Level Radioactive Waste (HLW) and Facilities Disposition
- New Remote-Handled LLW Disposal Facility
- Utah Associated Municipal Power Systems Small Modular Reactors
- Oklo Power LLC, AURORA Micro-reactor
- Microreactor Applications Research, Validation and Evaluation (MARVEL) Project

Additional detail for these actions is provided in the VTR EIS (DOE, 2020a).

[60] The ROI for each resource area is described in Chapter 3, Section 3.0, *Introduction*, of this EIS.

5.3 Cumulative Impacts

Table 5.3-1 presents information for cumulative impacts indicator parameters for the INL Site.

Table 5.3-1. Information for Cumulative Impacts at the INL Site

Resource Area	*Impact Indicator*	*Contribution from Project Pele [a]*	*Contribution from Other Actions [b]*	*Comparison Criteria [c]*
Land Use	Land Disturbed (acres)	1.7	48,700	INL Site = 569,600
Geology and Soils	Rock and Soil Use (yd^3)	3,200	1,230,000	NA
Air Quality	Annual Air Emissions and Off-site Air Pollutant Concentrations	very small air emissions and off-site air pollutant concentrations	small air emissions and off-site air pollutant concentrations	PSD Permitting Thresholds and Ambient Air Quality Standards
Infrastructure	Electricity Use (MWh/yr)	64.3 [d]	471,000	Electricity Available = 481,800
	Water Use (gal/yr)	155,633 [d]	872,000,000	Federal Reserved Water Right = 11,400,000,000
Waste Generation	LLW (m^3/ yr)	247 m^3 [e]	9,500	NA
	MLLW (m^3/yr)	3.2 m^3 [e]	4,600	NA
	TRU or GTCC-like Waste (m^3/yr)	< 3.4 m^3 [e]	1,500	WIPP Capacity = 175,564 m^3
Human Health – Normal Operations	Collective Worker Dose (person-rem/yr)	3	230	NA
	Population Dose (person-rem/yr)	<0.001	0.11	Natural Background Radiation = 98,000
	MEI Dose (mrem/yr)	<0.01	1.9	DOE dose limit = 100
Socioeconomics	Construction Employment	48	4,170	ROI Labor Force = 157,398
	Operations Employment	40	8,020	
Transportation	Collective Crew Dose (person-rem)	1.3	430,000	NA
	Population Dose (person-rem)	2.2	441,000	NA
Ozone Depletion	Usage of Ozone Depleting Substances (MT $CFC_{11}e$)	Negligible	Not available	Global ozone depleting substance emissions = 320,000 [f]

Key: $CFC_{11}e$ = chlorofluorocarbon-11 equivalents; CO_2e = carbon dioxide equivalent; CONEX = container express (shipping container); DOE = U.S. Department of Energy; gal = gallons; GHG = greenhouse gas; GTCC = greater-than-Class C; LLW = low-level radioactive waste; m^3 = cubic meters; MEI = maximally exposed individual; MLLW = mixed low-level radioactive waste; mrem = millirem; MT = metric tons; MWh = megawatt-hours; NA = not applicable; rem = roentgen equivalent man (a measure of radiation); ROI = region of influence; TRU = transuranic; WIPP = Waste Isolation Pilot Plant; yd^3 = cubic yards; yr = year

Notes:

[a] Source: Chapter 4, *Environmental Consequences*, of this EIS.

[b] Source: Contribution from past, present, and reasonably foreseeable actions listed in Section 5.2, *Reasonably Foreseeable Actions*, and described in more detail in Chapter 5 of the *Versatile Test Reactor Environmental Impact Statement* (DOE, 2020a).

[c] Source: Site or facility capacity or other relevant comparison criteria from Chapter 3, *Affected Environment*, of this EIS.

[d] Usage averaged over span of Project Pele for one representative year of usage at peak of project activities.

[e] Source: Chapter 4, Section 4.9, *Waste and Spent Nuclear Fuel Management*. Total waste generated for the entire Proposed Action. Generated LLW would also include 750 feet of piping, 50 connections, 1,000 feet of wiring, two CONEX containers, and the microreactor vessel.

[f] Data from 2014 (Ritchie & Roser, 2018).

As shown in **Table 5.3-1**, the incremental impacts from Project Pele activities for land use, geology and soils, air quality, infrastructure, waste management, human health (normal operations), socioeconomics, transportation, and ozone depletion, would be very small, and would not substantially contribute to cumulative impacts. Therefore, cumulative impacts for these resource areas are not analyzed further. Because the impacts are not well represented by numerical indicator parameters, cumulative impacts on water resources, biological resources, cultural and paleontological resources, noise, traffic, environmental justice, and climate change are briefly discussed in the sections that follow.

5.3.1 Water Resources

Groundwater use during construction of the reasonably foreseeable actions listed in Section 5.2, *Reasonably Foreseeable Actions*, generally would be for short durations, would involve relatively small quantities of water, and would occur at different times and locations. Therefore, groundwater use during construction would not substantially add to cumulative impacts on groundwater at the INL Site.

Past and present INL Site operations use groundwater as the water supply source. The Federal Reserved Water Right for the INL Site allows a maximum water consumption of 11.4 billion gallons per year from the SRPA and a maximum diversion rate of 35,904 gallons per minute. The cumulative annual groundwater withdrawals expected from operation of the past, present, and reasonably foreseeable future actions at the INL Site represent about 872 million gallons per year, or about 7.6 percent of the Federal Reserved Water Right for the INL Site. These withdrawals would contribute to the declining SRPA water table elevation and could eventually impact water availability to other INL Site facilities or to downstream users. The 260,500 gallons of water required over the approximately 6-year duration of Project Pele would represent a negligible contribution to cumulative impacts on groundwater.

As discussed in Chapter 4, *Environmental Consequences*, Section 4.3.1.1, *Surface Water*, no industrial or process wastewater would be discharged, and sanitary wastewater would be discharged to existing sanitary wastewater treatment facilities and septic systems. Because the other past, present, and reasonably foreseeable future actions presented in Section 5.2, *Reasonably Foreseeable Actions*, would be implemented at locations across the INL Site and would discharge wastewater to different treatment systems in compliance with permit limitations, there would be little or no cumulative impacts of these discharges with the small discharges from Project Pele activities.

5.3.2 Biological Resources

As described in Section 4.5, *Biological Resources*, Project Pele could cause impacts on biological resources on up to about 40.3 acres, which represents less than 1 percent of the 48,700 acres disturbed by other actions, and an even smaller percentage of the total 569,600 acres of land area at the INL Site. Therefore, impacts associated with Project Pele activities would not substantially contribute to cumulative impacts on biological resources. Cumulative impacts on biological resources would be further minimized because land disturbance, habitat degradation and fragmentation, equipment noise, motor vehicle trips, and other activities for Project Pele and other present, and reasonably foreseeable future actions would occur at different locations and times, and appropriate operational and administrative controls (as described in Section 4.5, *Biological Resources*) would be implemented. As described in Section 4.10, *Human Health – Normal Operations*, radiological emissions from Project Pele would not substantially contribute to cumulative impacts on human health, and therefore, as discussed in Section 4.5, *Biological Resources*, would not substantially contribute to cumulative impacts on biological resources.

5.3.3 Cultural and Paleontological Resources

Damage to the nature, integrity, and spatial context of cultural and paleontological resources can have a cumulative impact if the initial act is compounded by other similar losses or impacts. Project Pele is expected to have no effects to NRHP-listed, -eligible, or -unevaluated sites and buildings, and paleontological resources. Therefore, Project Pele would not contribute to cumulative impacts to eligible cultural and paleontological resources.

5.3.4 Noise

Although construction noise could be moderately loud, the temporary and intermittent nature of the construction activities would not result in long-term cumulative impacts. The noise generated from operation of Project Pele and the other projects listed in Section 5.2, *Reasonably Foreseeable Actions*, would be consistent with other existing industrial activities and equipment at the INL Site and the potential concurrent noise would be similar to existing levels at the INL Site. Therefore, operations would not result in substantial cumulative noise impacts. In addition, most existing and planned projects at the INL Site listed in Section 5.2, would occur at different locations and at different times and would not contribute to cumulative noise effects in combination with Project Pele.

As discussed in Section 3.8, *Noise*, the closest sensitive receptor to Project Pele is a small development of homes in Atomic City that is about 6.5 miles from CITRC. Given the large distance, cumulative noise from construction or operation of projects at the INL Site would be indistinguishable from typical background at the closest off-site noise-sensitive receptor. See Section 4.8.1, *Phase 4: Mobile Microreactor Operations at CITRC*, for additional information about potential noise and vibration levels at the closest off-site receptor.

5.3.5 Traffic

As described in Chapter 4, *Environmental Consequences*, Section 4.13, *Traffic*, the impacts on traffic from the Proposed Action are anticipated to be negligible to minor. As such, they would not substantially contribute to cumulative traffic impacts and are not discussed further.

5.3.6 Environmental Justice

The analysis in Chapter 4, *Environmental Consequences*, Section 4.15, *Environmental Justice*, indicates no high and adverse human health or environmental impacts on any population within the ROI because of Project Pele. Impacts on minority and low-income populations would be comparable to those on the population as a whole and would be negligible. Because the impacts from the Proposed Action at the INL Site would be small and there would be no disproportionate high and adverse impacts on minority and low-income populations, Project Pele would not substantially contribute to cumulative environmental justice impacts at the INL Site or throughout the ROI.

5.3.7 Global Commons – Climate Change

GHGs are gases that trap heat in the atmosphere by absorbing infrared radiation. The accumulation of GHGs in the atmosphere regulates the Earth's temperature. GHG emissions occur from natural processes and human activities. The most common GHGs emitted from natural processes and human activities include carbon dioxide, methane, and nitrous oxide. The main source of GHGs from human activities is the combustion of fossil fuels, such as natural gas, crude oil (including gasoline, diesel fuel, and heating oil), and coal (USGCRP, 2018).

Atmospheric levels of GHGs and their resulting effects on climate change are due to innumerable sources of GHGs across the globe. The direct environmental effect of GHG emissions is a general increase in global temperatures, which indirectly causes numerous environmental and social effects. Therefore, the ROI for potential GHG impacts is global. These cumulative global impacts would be manifested as impacts on resources and ecosystems in the United States, including Idaho.

Predictions of long-term environmental impacts due to increased atmospheric GHGs include sea-level rise, changing weather patterns (e.g., increases in severity of storms and droughts), changes in local and regional ecosystems (e.g., potential loss of species), and a substantial reduction in winter snowpack (IPCC, 2014; USGCRP, 2018). The Northwest region that encompasses Idaho is at risk from an increase in flooding, drought, and heat waves; compromises to water supplies and hydropower; and an increase in wild fires. The region risks damage to aquatic and terrestrial ecosystems, an increase in the incidence of infectious diseases and other human health problems, and stresses to agricultural productivity (USGCRP, 2018).

Project Pele would emit 1,300 metric tons of CO_2e (carbon dioxide equivalents) over a period of about 6 years and would imperceptibly add to U.S. and global GHG emissions, which were estimated to be 6.6 billion metric tons of CO_2e and 36.4 billion metric tons of CO_2e, respectively in 2019 (EPA, 2021f; Global Carbon Project, 2020). Therefore, GHGs emitted from Project Pele would equate to a negligible percentage of U.S. and global GHG emissions and would not substantially contribute to future climate change. Should Project Pele come to maturity and fielding, a more widespread adoption of nuclear power for electricity generation would deliver an equitable, clean energy future to build resilience against the impacts of climate change.

5.4 Conclusion

As demonstrated in **Table 5.3-1** and described in Section 5.3, *Cumulative Impacts*, the incremental impacts for all resource areas from Project Pele activities would be very small, and would not substantially contribute to cumulative impacts.

Chapter 6
Resource Commitments

This page left blank intentionally.

6 RESOURCE COMMITMENTS

This section describes: any unavoidable adverse environmental impacts that could result from implementation of Project Pele; the irreversible and irretrievable commitments of resources; and the relationship between short-term uses of the environment and long-term productivity. Unavoidable adverse environmental impacts are impacts that would occur after implementation of any mitigation measures. Resources that would be irreversibly and irretrievably committed are those that cannot be recovered or recycled and those that are consumed or reduced to unrecoverable forms. The relationship between short-term uses of the environment and long-term productivity addresses issues associated with the condition and maintenance of existing environmental resources used to support the proposed action and the function of these resources after their use.

6.1 Unavoidable Adverse Environmental Impacts

Implementing the Proposed Action discussed in this EIS would result in unavoidable adverse environmental impacts. As described in Chapter 4, *Environmental Consequences*, and summarized in Chapter 2, *Description of Alternatives,* Section 2.7, *Summary of Environmental Consequences* (see **Table 2.7-1**), most of these impacts are expected to be minor overall and would arise from incremental impacts attributed to the construction and operations of Project Pele at the INL Site.

6.1.1 Construction

As described in Chapter 4, *Environmental Consequences*, construction of Project Pele at the INL Site would result in land disturbance, air emissions and noise, damage to the soil profile, stormwater runoff and soil erosion, damage to wildlife habitat, consumption of utilities and material resources including labor, generation of waste, and increased vehicle traffic that would be unavoidable, even with the application of BMPs. Construction activities are expected to have minor impacts overall and would be temporary in nature.

6.1.2 Operations

As described in Chapter 2, Section 2.3, *Proposed Alternative*, Project Pele would occur within MFC and CITRC facilities of the INL Site. As described in Chapter 4, *Environmental Consequences*, operation of Project Pele at the INL Site would result in committing land to that use for the operations period, generation of air emissions and noise, generation of stormwater, radiation exposure to workers and the public, consumption of utilities and material resources including labor, generation of waste, and increased vehicle traffic that would be unavoidable, even with the application of BMPs.

Operation of Project Pele would result in unavoidable radiation and chemical exposure to workers and the general public. Workers would be exposed to radiation during three phases of Project Pele: startup testing (Phase 2), operational testing (Phase 4), and PIE prior to disposition of the mobile microreactor (Phase 7). Worker dose is controlled by DOE orders, standards, and guidance. In addition, ALARA principles would be used for all tasks. The public would be exposed to minor radioactive emissions during facility operations and small amounts of direct radiation during radioactive material and waste transportation. Public doses would be a small percentage of the annual background dose (equivalent to less than 15 minutes exposure to a natural background radiation) and much smaller than the dose received on a flight from New York to Los Angeles. Independent of the characteristics of the transported materials, there would be unavoidable risks of accident fatalities among members of the public resulting from the physical forces imposed by traffic accidents. The risks from facility operation to the general population, maximally exposed off-site individual, and workers are discussed in Chapter 4, *Environmental Consequences*, Section 4.10, *Human Health – Normal Operations*. The risks from transportation of radioactive materials and wastes to the general population, maximally exposed off-site individual, and transportation crew are discussed in Section 4.12, *Human Health – Transportation*.

Also unavoidable would be the generation of radioactive, hazardous, mixed, and solid waste associated with normal facility operations. Any waste generated during operations would be collected, packaged, and eventually removed for recycling or disposal in accordance with applicable EPA and/or state regulations. Recycling of solid waste is preferable because it would avoid the impacts of disposal. Sanitary wastewater would also be generated and disposed of through on-site wastewater treatment systems.

Operation of Project Pele would generate approximately 3.4 cubic meters of heavy metal in the form of SNF that would remain radioactive for tens of thousands of years. The Project Pele SNF would require long-term management, along with the other commercial and DOE SNF and high-level radioactive waste. Although a national repository for SNF and high-level radioactive waste is not yet licensed, DOE remains committed to meeting its obligations to safely dispose of these materials. Until a repository or off-site interim storage facility becomes available, DOE would safely store the Project Pele SNF in dry cask storage at the generation site. Dry cask storage would have no gaseous or liquid discharges and therefore, there would be very low potential for environmental impact.

6.1.3 Unavoidable Adverse Impacts of the No Action Alternative

Under the No Action Alternative, operation of existing reactors and associated facilities would also result in similar unavoidable adverse impacts.

6.2 Irreversible and Irretrievable Commitment of Resources

Implementation of the Proposed Action, would entail the commitment of land, energy (e.g., electricity, fossil fuels) and water, labor, and materials and resources (e.g., steel, concrete, crushed stone, soil). In general, the commitments of energy, many materials, and labor, would be irreversible and, once committed, these resources would be unavailable for other purposes. Appendix B of this EIS provides details about the resources committed during construction and operation of the Proposed Action.

6.2.1 Land

Operation of Project Pele would require the commitment of land to the prescribed use over the operating period considered in this EIS. Thus, land would be committed during the operational period, but not necessarily irreversible over the long term. Over the long term, the land that would be occupied by either existing or proposed facilities could ultimately be returned or converted to another use. In addition, the disposal of waste would entail the irreversible commitment of land.

6.2.2 Energy and Water

Energy expended to support construction and operation of Project Pele would be in the form of electricity to operate equipment and fossil fuels to operate equipment (including heating equipment) and vehicles. Consumption of electricity (from certain sources) and fossil fuels would be an irretrievable commitment of nonrenewable resources. Some of the water consumed for construction and operation would constitute an irreversible commitment and would not be available for other uses. Some discharged water would return to the natural hydrologic cycle and would not be irreversibly and irretrievably committed.

6.2.3 Materials and Resources

The irreversible and irretrievable commitment of materials, equipment, and other resources comprises those used in the construction and modification of facilities, and those used during operations. This includes materials that cannot be recovered or recycled, materials that are contaminated and cannot be effectively decontaminated, and materials consumed or reduced to unrecoverable forms of waste. Principal construction materials would include concrete (a product of cement, sand, and gravel), crushed stone, and steel, although other materials such as wood, gases, and other metals would also be used. For practical purposes, materials including concrete incorporated into the framework of existing or new facilities would be unrecoverable and irretrievably lost. Some materials such as uncontaminated steel and other metals may be recycled when the facility is eventually decontaminated, decommissioned, and demolished. Materials such as uranium used in the reactor fuel during operations would be disposed of as SNF and therefore would be irreversibly and irretrievably committed. Employee labor during construction and operations would also be irreversibly and irretrievably committed.

6.3 Relationship Between Short-Term Uses of the Environment and Long-Term Productivity

Air emissions associated with Project Pele would introduce small amounts of radiological and nonradiological constituents to the air. As described in Chapter 4, *Environmental Consequences*, these emissions would result in additional environmental loading and exposure to human receptors, but would not impact compliance with air quality or radiation exposure standards. Because of the very small quantities of constituents released and the short half-life of many of the constituents, there would be no substantial residual environmental effects on long-term productivity.

At the INL Site, losses of wildlife and sagebrush habitat during construction are possible. Land clearing and construction activities would disperse wildlife and temporarily eliminate habitat. These short-term disturbances of wildlife and habitat could cause long-term reductions in the biological productivity of an area. Although some wildlife and habitat destruction would be inevitable during construction, these losses would be minimized by timing land disturbance to avoid nesting and mating seasons, by compensation of certain lost habitats (e.g., sagebrush and/or wetlands), and by restoration of temporarily disturbed habitat where possible. Groundwater at the INL Site would be used to meet sanitary water needs over the construction and operations periods. After use and treatment, this water would be released into septic tanks and drainage fields. The withdrawal, use, treatment, and discharge of water is not likely to affect the long-term productivity of this resource.

The disposal of waste would require energy and labor, and space at disposal facilities. The land occupied for waste disposal would require a long-term commitment and a reduction of the long-term productivity of the land.

After the operational life of Project Pele, DOE could place the microreactor in temporary storage, DOE could then dispose of all materials through appropriate waste streams, as discussed in Section 2.3, *Proposed Action Alternative*.

Under the No Action Alternative, environmental resources have already been, and continue to be, committed to operation of existing reactors and supporting facilities. Similar to the Proposed Action, upon completion of their useful life, land and facilities used under the No Action Alternative could be returned to other uses, including long-term productive uses.

This page left blank intentionally.

Chapter 7

Laws, Regulations, and Other Requirements

This page left blank intentionally.

7 LAWS, REGULATIONS, AND OTHER REQUIREMENTS

This chapter presents the environmental, safety, and health laws, regulations, orders, and permits that could apply to activities associated with the Proposed Action. These requirements and standards originate from a number of sources. Federal and state statutes define broad environmental and safety programs and provide authorization to agencies to carry out the mandated programs. More-specific requirements are established through regulations, at both the Federal and state levels. Regulations often include requirements for permits and consultations, which provide an in-depth, facility-specific review of the activities proposed.

Section 7.1, *Applicable Federal and State Laws and Regulations*, summarizes the Federal and state environmental, safety, and health requirements. Section 7.2, *Applicable Permits*, summarizes the existing facility permits and potential new permits or approvals for construction and operation of the proposed project. Section 7.3, *Consultations*, discusses required and potential consultations with Federal and state agencies and federally recognized Tribal governments.

7.1 Applicable Federal and State Laws and Regulations

The proposed activities at the INL Site would be regulated by numerous Federal and state legal requirements addressing environmental compliance. For some activities at the INL Site, the DOE has sole authority to take action, such as under the Atomic Energy Act of 1954. Project Pele would be authorized by DoD, Office of the Secretary of Defense, acting through the SCO. The DoD provides NEPA policy information at the following website: https://www.denix.osd.mil/nepa/, including DoD Directive 4715.6, which serves as the existing DoD policy for complying with NEPA.

The DOT regulates commercial transportation of hazardous and radioactive materials. The EPA would regulate many aspects of the proposed activities. In many cases, EPA has delegated all or part of its environmental protection authorities to the States but retains oversight authority. In this delegated role, the IDEQ regulates most air emissions; discharges to surface water and groundwater; drinking water quality; and hazardous and nonhazardous waste treatment, storage, and disposal.

The major Federal laws, regulations, and Executive Orders (Presidential directives that apply only to Federal agencies); state laws and regulations; and other requirements that could apply to Project Pele are identified in **Table 7.1-1**.

Table 7.1-1. Applicable Laws, Regulations, Orders, and Other Requirements

Law, Regulation, Order, or Other Requirement	*Description*
General Environmental	
National Environmental Policy Act of 1969, as amended (NEPA), 42 United States Code (U.S.C.) Section 4321 et seq.	Establishes a national policy for environmental protection and directs all Federal agencies to use a systematic, interdisciplinary approach to incorporating environmental values into decision-making (Idaho does not have state-level NEPA regulations).
Council on Environmental Quality (CEQ), *Regulations for Implementing NEPA,* 40 Code of Federal Regulations (CFR) Parts 1500–1508	Defines actions that Federal agencies must take to comply with NEPA, such as the development of environmental impact statements.
Department of Defense (DoD) Directive 4715.1E, *Environment, Safety, and Occupational Health (ESOH)* (03/19/2005)	Establishes policies on ESOH to sustain and improve the DoD mission. ESOH management systems are to be used in mission planning and execution across all military operations and activities.

Table 7.1-1. Applicable Laws, Regulations, Orders, and Other Requirements (Continued)

Law, Regulation, Order, or Other Requirement	***Description***
DoD Instruction 4715.6, *Environmental Compliance in the United States* (08/31/2018)	Designates DoD Components as lead agents to provide management of key DoD environmental issues and authorizes the publication of issuances to support the DoD environmental compliance program.
DoD Instruction 4715.9, *Environmental Planning and Analysis* (05/03/1996)	Implements policy and assigns responsibilities for integration of environmental considerations into DoD activity and operational planning.
Executive Order 11514, *Protection and Enhancement of Environmental Quality* (03/05/70), as amended by Executive Order 11991 (05/24/77)	Requires Federal agencies to direct their policies, plans, and programs so as to meet national environmental goals established by NEPA.
Executive Order 12088*, Federal Compliance with Pollution Control Standards* (10/13/78)	Directs Federal agencies to comply with applicable administrative and procedural pollution control standards established by, but not limited to, the Clean Air Act (CAA), Noise Control Act, Clean Water Act (CWA), Safe Drinking Water Act, Toxic Substances Control Act, and Resource Conservation and Recovery Act (RCRA).
Executive Order 13990*, Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis* (01/20/21)	The NEPA aspect of the Order directs the CEQ to rescind its draft guidance entitled ‘‘Draft National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions,’’ 84 Federal Register (FR) 30097 (June 26, 2019), and to update its final guidance entitled ‘‘Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews,’’ 81 FR 51866 (August 5, 2016).
Executive Order 13972, *Promoting Small Modular Reactors for National Defense and Space Exploration* (01/05/21)	The policy to promote advanced reactor technologies, including small modular reactors, to support defense installation energy flexibility and energy security, and for use in space exploration.
Department of Energy (DOE) Order 231.1B, *Environment, Safety, and Health Reporting* (Change 1, 11/28/12)	Ensures timely collection, reporting, analysis, and dissemination of information on environment, safety, and health issues as required by law or regulations or as needed by DOE.
DOE Policy 450.4A, *Integrated Safety Management Policy* (Change 1, 01/18/18)	Sets forth the framework for identifying, implementing, and complying with environmental safety and health requirements so that work is performed in the DOE complex in a manner that ensures adequate protection of workers, the public, and the environment.
Water Resources	
Federal Water Pollution Control Act (Clean Water Act [CWA]), 33 U.S.C. 1251 et seq.	Establishes a national program to restore and maintain the chemical, physical, and biological integrity of navigable waters by prohibiting the discharge of toxic pollutants in significant amounts; requires Federal agencies to comply with Federal, state, and local water quality requirements; Section 404 of the CWA regulates development activities in jurisdictional surface waters and wetlands, and delegates Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (USACE) to share Section 404 enforcement authority regarding the discharge of dredged or fill material into waters of the United States; allows EPA

Table 7.1-1. Applicable Laws, Regulations, Orders, and Other Requirements (Continued)

Law, Regulation, Order, or Other Requirement	***Description***
	to delegate primary enforcement authority for National Pollutant Discharge Elimination System (NPDES) permits (Section 402) to Idaho (see NPDES discussion below).
National Pollutant Discharge Elimination System, 40 CFR 122	Creates a permit program for point-source discharges of pollutants to waters of the United States; establishes permitted effluent limits to ensure that water quality standards are met. On June 5, 2018, the EPA Administrator approved the application by the State of Idaho to administer and enforce the Idaho Pollutant Discharge Elimination System (IPDES) program. Idaho administration of the NPDES program is expected to be fully implemented by 2021 (EPA, 2019b).
Department of the Army, USACE, and EPA Final Rule: *Repeal of the 2015 Clean Water Rule: Definition of "Waters of the United States"* (12/23/19) • 33 CFR 328, 40 CFR 110, • 40 CFR 112, 40 CFR 116, • 40 CFR 117, 40 CFR 122, • 40 CFR 230, 40 CFR 232, • 40 CFR 300, 40 CFR 302, and • 40 CFR 401	Amends portions of the CFR to restore the regulatory text that existed prior to the 2015 Rule regarding the definition of *Waters of the United States.* With this final rule, the regulations defining the scope of Federal CWA jurisdiction will be those portions of the CFR as they existed before the amendments promulgated in the 2015 Rule.
Safe Drinking Water Act of 1974, as amended, 42 U.S.C. 300f et seq.	Establishes a national program to ensure the quality of drinking water in public water systems; allows EPA to delegate primary enforcement authority to Idaho.
National Primary Drinking Water Regulations, 40 CFR 141	Creates standards for maximum contaminant levels for pollutants in drinking water; used as groundwater protection standards.
Procedures for Decision-making (Permitting), 40 CFR 124	Contains EPA procedures for issuing, modifying, revoking and reissuing, or terminating all RCRA, Prevention of Significant Deterioration (PSD), and NPDES permits.
Energy Independence and Security Act of 2007, 42 U.S.C. 17001 et seq.	Directs Federal agencies to maintain or restore the pre-development site hydrology during the development process.
Executive Order 11988, *Floodplain Management* (05/24/77)	Directs Federal agencies to consider the effects of flood hazards and avoid impacts on floodplains, if practicable. Also requires Federal agencies to evaluate the potential effects of any actions to minimize impacts on the floodplain's natural and beneficial values. Applicable to any new structures built in areas that include floodplains.
Executive Order 11990, *Protection of Wetlands* (05/24/77)	Establishes wetland protection as the official policy of all Federal agencies. Directs Federal agencies to avoid construction in wetlands and to mitigate impacts of any use of wetlands. Applicable to any new structures built in areas that impact wetlands.
Idaho Water Pollution Control Act of 1983, Idaho Code (IC) 39-3600 et seq. Idaho Wastewater Rules, Idaho Administrative Procedures Act (IDAPA), 58.01.16 Idaho Recycled Water Rules, IDAPA 58.01.17	Establishes a program to enhance and preserve the quality and value of water resources. Creates procedures and requirements for the planning, design, and operation of wastewater facilities and the discharge of wastewaters and human activities which may adversely affect public health and water quality in the waters of the State.

Table 7.1-1. Applicable Laws, Regulations, Orders, and Other Requirements (Continued)

Law, Regulation, Order, or Other Requirement	*Description*
Idaho Groundwater Quality Rules, IDAPA 58.01.11	Establishes minimum requirements for protection of groundwater quality through standards and an aquifer categorization process; serves as basis for administration of programs which address groundwater quality but do not in and of themselves create a permit program.
Idaho Rules for Public Drinking Water Systems, IDAPA 58.01.08	Controls and regulates the design, construction, operation, maintenance, and quality control of public drinking water systems to provide a degree of assurance that such systems are protected from contamination and maintained free from contaminants that may injure the health of the consumer.
Air Quality	
Clean Air Act of 1970, as amended, 42 U.S.C. 7401 et seq.	Requires Federal agencies to comply with air quality regulations; includes four major programs: the National Ambient Air Quality Standards (NAAQS); State Implementation Plans; new source performance standards; and National Emission Standards for Hazardous Air Pollutants (NESHAP). Allows EPA to delegate authority for most CAA provisions to Idaho, who would issue or modify permits, as needed, for stationary sources associated with the proposed activities.
Ambient Air Quality Standards/State Implementation Plans, 40 CFR Parts 51 and 58	Establishes the NAAQS, which are divided into primary and secondary categories for carbon monoxide, lead, nitrogen dioxide, ozone, sulfur dioxide, and particulate matter. (Proposed activities would add to site emissions, whose combined ambient concentrations are then compared to the standards.)
Prevention of Significant Deterioration, 40 CFR 51.166	Establishes processes for maintaining air quality in areas already in compliance with the NAAQS (attainment areas); requires comprehensive preconstruction review and the application of best-available control technology for major stationary sources.
New Source Performance Standards, 40 CFR 60	Creates industry- and process-specific standards that apply to any new, modified, or reconstructed sources of air pollution.
National Emission Standards for Hazardous Air Pollutants and for Source Categories, 40 CFR 61 and 63	Defines hazardous air pollutants (HAPs) (such as radionuclides, mercury, and asbestos) and maximum achievable control technologies by industry or process. (Proposed activities would add to site HAPs emissions, whose combined ambient concentrations are then compared to the standards).
National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities, 40 CFR 61, Subpart H	Establishes requirements for monitoring radionuclide emissions from facility operations and analyzing and reporting radionuclide doses; limits, in Subpart H, the radionuclide dose to a member of the public to 10 millirem per year.
State Operating Permit Programs, 40 CFR 70	Defines minimum permit requirements, including air pollution control, reporting, monitoring, and compliance certification requirements; includes permitting program known as Title V for major sources of air pollution.

Table 7.1-1. Applicable Laws, Regulations, Orders, and Other Requirements (Continued)

Law, Regulation, Order, or Other Requirement	***Description***
Idaho Environmental Protection and Health Act, IC, Title 39, Health and Safety, Chapter 1, Department of Health and Welfare, Sections 39-105 Rules for the Control of Air Pollution in Idaho, IDAPA 58.01.01	Provides for development of regulations for the control and permitting of air emission sources. Provides rules and permitting programs to control air pollutant emissions in Idaho.
Ecological Resources	
Migratory Bird Treaty Act of 1918, 16 U.S.C. 703 et seq. Migratory Bird Hunting, 50 CFR 20 Migratory Bird Permits, 50 CFR 21	Implements several international treaties related to the protection of migratory birds and makes it illegal to take, capture, or kill any migratory bird, or to take any part, nest, or egg of any such birds; applies to purposeful actions, not to actions that result from otherwise lawful activities (incidental take).
Fish and Wildlife Coordination Act of 1934, 16 U.S.C. 661 et seq. Taking, Possession, Transportation, Sale, Purchase, Barter, Exportation, and Importation of Wildlife and Plants, 50 CFR Parts 10-24 Management of Fisheries Conservation Areas, 50 CFR Parts 70-71 Interagency Cooperation – Endangered Species Act of 1973, as amended, 50 CFR 402	Provides the basic authority for the involvement of the U.S. Fish and Wildlife Service (USFWS) and state agencies to evaluate impacts of proposed projects that may result in the construction, modification, or control of a natural streams or bodies of water in excess of 10 acres in surface area.
Endangered Species Act of 1973, 16 U.S.C. 1531 et seq. Taking, Possession, Transportation, Sale, Purchase, Barter, Exportation, and Importation of Wildlife and Plants, 50 CFR Parts 10-24 Interagency Cooperation – Endangered Species Act of 1973, as amended, 50 CFR 402	Requires Federal agencies to assess whether actions could adversely affect threatened or endangered species or their habitat.
Bald and Golden Eagle Protection Act of 1973, as amended, 16 U.S.C. 668-668d Eagle Permits, 50 CFR 22	Imposes criminal and civil penalties for the possession or taking of bald or golden eagles.
North American Wetlands Conservation Act of 1989, 16 U.S.C. 4401–4414	Requires the head of each Federal agency responsible for Federal lands and waters to cooperate with the Director of the USFWS to restore, protect, and enhance the wetland ecosystems and other habitats for migratory birds, fish, and wildlife within the lands and waters of the agency.
Federal Noxious Weed Act, 7 U.S.C. 28142 Noxious Weed Regulations, 7 CFR 360	Requires each Federal land-managing agency to establish integrated management systems to control or contain undesirable plant species targeted under cooperative agreements with state agencies.
Sikes Act of 1960, 16 USC 670a–670o Resource Management and Public Activities on Federal Lands, 43 CFR 24.4 Criteria for Designating Critical Habitat, 50 CFR 424.12	Calls for cooperation with state fish and game agencies in planning and managing wildlife habitat on Federal lands.
Executive Order 13112, *Invasive Species* (2/3/99)	Directs each Federal agency whose actions may affect the status of invasive species to take action to prevent the introduction of invasive species and promote restoration of native species and natural habitat. Establishes the National Invasive Species Council (NISC) to safeguard interests of the

Table 7.1-1. Applicable Laws, Regulations, Orders, and Other Requirements (Continued)

Law, Regulation, Order, or Other Requirement	***Description***
	United States by preventing, eradicating, and controlling invasive species, as well as restoring ecosystems and other assets impacted by invasive species. NISC prepares and maintains a *National Invasive Species Management Plan*.
Executive Order 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds* (01/10/01)	Requires each Federal agency whose actions have or are likely to have a measurable negative effect on migratory birds to enter into a Memorandum of Understanding with USFWS defining protective measures.
Idaho, Various Acts Regarding Fish and Game, IC, Title 36, Fish and Game, Chapter 9 – Protection of Fish, Chapter 11 – Protection of Animals and Birds, and Chapter 24 – Species Conservation	Establishes protection of wildlife from certain methods of take; establishes species management plan requirements.
Idaho Endangered Species Act, IC, Title 67, State Government and State Affairs, Chapter 8, Executive and Administrative Officers, Section 67-818 Rules for Classification and Protection of Wildlife, IDAPA 13.01.06-09	Establishes state responsibility and coordination of policy and programs related to threatened and endangered species. Establishes authority for the Idaho Fish and Game Commission to adopt rules concerning the taking of wildlife species and classification of wildlife species.
Cultural and Paleontological Resources	
American Antiquities Act of 1906, 16 U.S.C. 431 et seq. Preservation of American Antiquities, 43 CFR 3	Protects prehistoric American Indian ruins and artifacts on Federal lands; authorizes the President to designate historic areas as national monuments.
Historic Sites Act of 1935, 16 U.S.C. 461 National Historic Landmarks Program, 36 CFR 65	Provides for the preservation of historic American sites, buildings, objects, and antiquities of national significance, and serves other purposes.
National Historic Preservation Act of 1966 (NHPA), 54 U.S.C. 300101 et seq. National Register of Historic Places, 36 CFR 60 et seq. Curation of Federally Owned and Administered Archeological Collections, 36 CFR 79 Protection of Historic Properties, 36 CFR 800	Sets forth the procedural requirements for listing properties in the National Register of Historic Places; identifies the process for evaluating the eligibility of properties for inclusion in the National Register of Historic Places; requires consultation with the State Historic Preservation Officer prior to any action that could affect historic resources (this consultation is being accomplished for the proposed activities, as needed); requires Federal agencies to take into account the effects of their undertakings on historic properties.
Archaeological and Historic Preservation Act of 1974, as amended, 16 U.S.C. 469 et seq.	Requires the preservation of historical and archeological data (including relics and specimens) that might otherwise be irreparably lost or destroyed as the result of Federal construction projects.
American Indian Religious Freedom Act of 1978, 42 U.S.C. 1996	Protects and preserves, for American Indians, their inherent right of freedom to believe, express, and exercise their traditional religions, including access to sites.
Archaeological Resources Protection Act of 1979, 16 U.S.C. 470aa-mm Protection of Archaeological Resources, 43 CFR 7	Protects archaeological resources and sites on Federal and American Indian lands and establishes the uniform definitions, standards, and procedures to be followed by all Federal land managers in providing protection for archaeological resources located on public lands and American Indian lands of the United States, including collections of prehistoric and historic material remains, and associated records, recovered under the authority of the

Table 7.1-1. Applicable Laws, Regulations, Orders, and Other Requirements (Continued)

Law, Regulation, Order, or Other Requirement	***Description***
	American Antiquities Act (16 U.S.C. 431-433), the Reservoir Salvage Act (16 U.S.C. 469–469c), Section 110 of the NHPA (54 U.S.C. 300101 et seq.), or the Archaeological Resources Protection Act (16 U.S.C. 470aa-mm); could apply if such resources were to be disturbed by activities associated with the proposed facilities.
Native American Graves Protection and Repatriation Act of 1990, 25 U.S.C. 3001 et seq. Native American Graves Protection and Repatriation Regulations, 43 CFR 10	Protects American Indian burial remains and funerary objects found on Federal or tribal land; could apply if such resources were to be disturbed by activities associated with the proposed facilities.
Executive Order 11593, *Protection and Enhancement of the Cultural Environment* (05/13/71)	Requires preservation of historic and archaeological information prior to construction activities, such as those associated with the proposed facilities.
Executive Order 13007, *Indian Sacred Sites* (05/24/96) MOU Interagency Coordination and Collaboration for the Protection of Indian Sacred Sites (2016)	Requires Federal agencies to accommodate, to the extent practicable, access to American Indian sacred sites and avoid adverse impacts on such sites.
Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments* (11/06/00)	Requires consultation and coordination with American Indian Tribes prior to taking actions that affect federally recognized tribal governments.
Executive Order 13195, *Trails for America in the 21st Century* (01/18/01)	Requires Federal agencies—to the extent permitted by law and where practicable, and in cooperation with Tribes, states, local governments, and interested citizen groups—to protect, connect, promote, and assist trails of all types throughout the United States.
Executive Order 13287, *Preserve America* (03/03/03)	Promotes the protection of Federal historic properties and cooperation among governmental and private entities in preserving cultural heritage.
DOE Order 144.1, *Department of Energy American Indian Tribal Government Interactions and Policy* (Change 1, 11/06/09)	Establishes a policy committing DOE to consultation with American Indian tribal governments to solicit input on DOE issues.
DOE Policy 141.1, *Department of Energy Management of Cultural Resources* (1/28/11)	Ensures that DOE programs and field elements integrate cultural resources management into their mission and activities.
Idaho Protection of Graves, IC, Title 27, Chapter 5	Defines permitted activities and establishes guidelines for the legal removal of human remains from Idaho gravesites by qualified archaeologists or law enforcement personnel.
Infrastructure	
Solid Waste Disposal Act of 1965, as amended by RCRA and the Energy Policy Act of 2005, 42 U.S.C. 6991 et seq. Technical Standards for and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks (UST), 40 CFR Parts 280-282	Regulates construction of USTs, including for radioactive materials.
Idaho Underground Storage Tank Act, IC Title 39, Chapter 88, Health and Safety Idaho Rules Regulating Underground Storage Tank Systems, IDAPA 58.01.07	Creates standards and procedures for the regulation of underground storage tank systems.

Table 7.1-1. Applicable Laws, Regulations, Orders, and Other Requirements (Continued)

Law, Regulation, Order, or Other Requirement	*Description*
Noise	
Noise Control Act of 1972, 42 U.S.C. 4901 et seq. as amended by the Quiet Communities Act of 1978	Protects the health and safety of the public from excessive noise levels; requires Federal agencies to comply with Federal, state, and local noise abatement requirements.
Waste Management	
Low-Level Radioactive Waste Policy Act of 1980, 42 U.S.C. 2021 et seq. Criteria and Procedures for Emergency Access to Non-Federal and Regional Low-Level Waste Disposal Facilities, 10 CFR 62	Specifies that the Federal Government is responsible for the disposal of certain low-level radioactive waste, including low-level radioactive waste owned or generated; and specifies that states are responsible for the disposal of commercially generated low-level radioactive waste; pertains to waste that could be generated by the proposed activities.
Nuclear Waste Policy Act of 1982, 42 U.S.C. 10101 et seq. Disposal of High-Level Radioactive Wastes in Geologic Repositories, 10 CFR 60 Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste, 10 CFR 72	Establishes national program for the disposal of high-level radioactive waste and used nuclear fuel.
Byproduct Material, 10 CFR 962	Defines byproduct material as identified in the Atomic Energy Act, and clarifies that the hazardous portion of mixed radioactive waste is subject to RCRA.
Waste Isolation Pilot Plant Land Withdrawal Act, as amended, Pub. L. 102-579 DOE National Security and Military Applications of Nuclear Energy Authorization Act of 1980, Pub. L. 96-164, 93 Stat. 1259	Withdraws land from the public domain for the purposes of creating and operating a geologic repository in New Mexico designated as the national disposal site for defense transuranic waste. The Land Withdrawal Act also defines the characteristics and amount of waste that will be disposed of at the facility. Includes information related to the authorization basis of the WIPP facility for the disposal of contact-handled and remote-handled transuranic waste.
Solid Waste Disposal Act of 1965 as amended by the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments of 1984, 42 U.S.C. 6901 et seq. RCRA Regulations for Non-hazardous Waste, 40 CFR Parts 239-259 RCRA Regulations for Hazardous Waste, 40 CFR Parts 260-273	Establishes comprehensive management system for hazardous wastes, addressing generation, transportation, storage, treatment, and disposal; allows, per Section 3006 of RCRA (42 U.S.C. 6926), states to establish and administer permit programs with EPA approval; allows EPA to delegate primary enforcement authority to Idaho.
Federal Facility Compliance Act of 1992, 42 U.S.C. 6961 et seq.	Waives sovereign immunity for Federal facilities under RCRA; requires DoD to conduct an inventory and develop a treatment plan for mixed wastes.
Toxic Substances Control Act of 1976, 15 U.S.C. 2601 et seq. Toxic Substances Control Act, 40 CFR Parts 700-799	Gives EPA the authority to screen and regulate new and existing chemicals to protect the public from the risks of exposure to chemicals; establishes specific provisions to address polychlorinated biphenyls, asbestos, radon, and lead-based paint.

Table 7.1-1. Applicable Laws, Regulations, Orders, and Other Requirements (Continued)

Law, Regulation, Order, or Other Requirement	***Description***
Pollution Prevention Act of 1990, 42 U.S.C. 13101 et seq. Comprehensive Procurement Guidelines for Products Containing Recovered Materials, 40 CFR 247	Establishes requirement to prevent pollution by emphasizing source reduction and recycling. EPA is charged with developing measures for source reduction and evaluating regulations to promote source reduction.
DOE Order 435.1, *Radioactive Waste Management* (Change 3, 01/11/21)	Ensures that all DOE radioactive waste is managed in a manner that is protective of worker and public health and safety and the environment.
Idaho Hazardous Waste Management Act, IC Title 39, Chapter 44 Idaho Rules and Standards for Hazardous Waste, IDAPA 58.01.05	Requires proper controls for the management of solid and hazardous waste. Establishes requirements applicable to all hazardous waste management facilities in Idaho.
Idaho Solid Waste Facilities Act, IC Title 39, Chapter 74 Idaho Solid Waste Management Rules, IDAPA 58.01.06	Establishes requirements applicable to all solid waste and solid waste management facilities in Idaho.
Nuclear Materials Management	
Atomic Energy Act of 1954, as amended, 42 U.S.C. 2011 et seq.	Provides fundamental jurisdictional authority to DOE and Nuclear Regulatory Commission (NRC) over governmental and commercial use, respectively, of nuclear materials; authorizes DOE to establish standards to protect health or minimize dangers to life or property for activities under DOE jurisdiction; allows DOE to issue a series of orders to establish a system of standards and requirements that ensure safe operation of DOE facilities.
Procedural Rules for DOE Nuclear Facilities, 10 CFR 820	Governs the conduct of persons involved in DOE nuclear activities and, in particular, to achieve compliance with DOE nuclear safety requirements.
Nuclear Safety Management, 10 CFR 830	Governs the conduct of DOE contractors, DOE personnel, and other persons conducting activities (including providing items and services) that affect, or may affect, the safety of DOE nuclear facilities.
DOE Order 410.2, *Management of Nuclear Materials* (Change 1, 04/10/14)	Establishes requirements and procedures for the lifecycle management of nuclear materials within DOE.
DOE Order 425.1D, *Verification of Readiness to Start Up or Restart Nuclear Facilities* (Change 2, 10/04/19)	Establishes requirements for DOE for verifying readiness for startup of new nuclear facilities and for the restart of existing nuclear facilities that have been shut down.
DOE Order 426.2, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities* (Change 1, 07/29/13)	Establishes selection, qualification, and training requirements for management and operating contractor personnel involved in the operation, maintenance, and technical support of DOE reactors and nonreactor nuclear facilities.
DOE Order 433.1B, *Maintenance Management Program for DOE Nuclear Facilities* (Change 1, 03/12/13)	Establishes a safety management program required by 10 CFR 830 for maintenance and the reliable performance of structures, systems, and components that are part of the safety basis at Hazard Category 1, 2, and 3 DOE nuclear facilities.
DOE Policy 470.1B, *Safeguards and Security Program* (2/10/16)	Ensures that DOE efficiently and effectively meets all its obligations to protect special nuclear material, other nuclear materials, classified matter, sensitive information,

Table 7.1-1. Applicable Laws, Regulations, Orders, and Other Requirements (Continued)

Law, Regulation, Order, or Other Requirement	***Description***
	government property, and the safety and security of employees, contractors, and the general public.
DOE Order 470.4B, *Safeguards and Security Program* (Change 2, 01/17/17)	Identifies roles and responsibilities for the DOE Safeguards and Security Program.
Human Health	
Occupational Safety and Health Act of 1970, 29 U.S.C. 651 et seq. Occupational Safety and Health Standards, 29 CFR 1910, 29 CFR 1926	Ensures worker and workplace safety, including a workplace free from recognized hazards, such as exposure to toxic chemicals, excessive noise levels, and mechanical dangers. Establishes standards to protect workers from hazards encountered in the workplace (29 CFR 1910) and construction site (29 CFR 1926).
Worker Safety and Health Program, 10 CFR 851	Creates DOE's health and safety program to control and monitor hazardous materials to ensure that workers are not being exposed to health hazards, such as toxic chemicals, excessive noise, and ergonomic stressors.
Occupational Radiation Protection, 10 CFR 835	Establishes radiation protection standards, limits, and program requirements for protecting workers from ionizing radiation resulting from DOE activities.
Chemical Accident Prevention Provisions, 40 CFR 68	Provides the list of regulated substances and thresholds, and the requirements for owners or operators of stationary sources concerning the prevention of accidental releases, and the state's accidental release prevention programs approved under CAA Section 112(r).
Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Wastes, 40 CFR 191	Applies to radiation doses received by members of the public as a result of the management (except for transportation) and storage of spent nuclear fuel, transuranic, or high-level radioactive wastes.
DOE Order 420.1C, *Facility Safety* (Change 3 11/14/19)	Establishes facility and programmatic safety requirements for DOE facilities, including nuclear and explosives safety design criteria, fire protection, criticality safety, natural phenomena hazards mitigation, and the System Engineer Program.
DOE Policy 420.1, *Department of Energy Nuclear Safety Policy* (02/08/11)	Documents DOE's nuclear safety policy.
DOE Order 430.1C, *Real Property Asset Management* (Change 1, 10/04/19)	Establishes a corporate, holistic, and performance-based approach to real property life-cycle asset management that links real property asset planning, programming, budgeting, and evaluation to program mission projections and performance outcomes. To accomplish the objective, this Order identifies requirements and establishes reporting mechanisms and responsibilities for real property asset management.
DOE Order 440.1B, *Worker Protection Program for DOE (including the National Nuclear Security Administration) Federal Employees* (05/17/07; Change 2, 03/14/13)	Describes the DOE program to protect workers and reduce accidents and losses; adopts occupational safety and health standards.
DOE Order 458.1, *Radiation Protection of the Public and the Environment* (02/11/11; Change 3, 01/15/13)	Establishes requirements to protect the public and the environment against undue risk from radiation associated with radiological activities conducted under the control of

Table 7.1-1. Applicable Laws, Regulations, Orders, and Other Requirements (Continued)

Law, Regulation, Order, or Other Requirement	***Description***
	DOE, pursuant to the Atomic Energy Act of 1954, as amended.
Transportation	
Hazardous Materials Transportation Act of 1975, 49 U.S.C. 5101 et seq. Transportation, Subchapter C, Hazardous Materials Regulations, 49 CFR Parts 171–180	Provides the U.S. Department of Transportation (DOT) with authority to protect against the risks associated with transportation of hazardous materials, including radioactive materials, in commerce. Establishes DOT requirements for classification, packaging, hazard communication, incident reporting, handling, and transportation of hazardous materials.
DOE Order 460.1D, *Hazardous Materials Packaging and Transportation Safety* (12/20/16)	Describes DOE safety requirements for the proper packaging and transportation of off-site shipments and on-site transfers of radioactive and other hazardous materials.
DOE Order 460.2A, *Departmental Materials Transportation and Packaging Management* (12/22/04)	Describes DOE requirements and responsibilities for materials transportation and packaging management to ensure the safe, secure, and efficient packaging and transportation of materials, both hazardous and nonhazardous.
DOE Order 461.1C, *Packaging and Transportation for Offsite Shipment of Materials of National Security Interest* (Change 1, 10/04/19)	Affirms that the packaging and transportation of all off-site shipments of materials of national security interest for DOE must be conducted in accordance with DOT and NRC regulations that would be applicable to comparable commercial shipments, except where an alternative course of action is identified in the Order.
DOE Order 461.2, *Onsite Packaging and Transfer of Materials of National Security Interest* (11/01/10)	Establishes safety requirements and responsibilities for on-site packaging and transfers of materials of national security interest to ensure safe use of Transportation Safeguards System (TSS), non-TSS Government- and contractor-owned and/or leased resources.
Idaho Transportation of Hazardous Waste, IC Title 18, Chapter 39 Hazardous Materials/Hazardous Waste Transportation Enforcement, IC Title 49, Chapter 22	Regulates transportation of hazardous materials/hazardous waste on Idaho highways.
Environmental Justice	
Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (2/11/94), as amended by Executive Order 12948 (1/30/95)	Requires each Federal agency to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations.
Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks* (4/21/97), as amended by Executive Order 13296 (4/18/03)	Requires each Federal agency to make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children and to ensure that its policies, programs, activities, and standards address disproportionate environmental health or safety risks to children.
Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad* (1/27/21)	Requires Federal agencies make environmental justice part of their missions by developing programs, policies, activities to address the disproportionately high and adverse impacts on disadvantaged communities, as well as the accompanying economic challenges of such impacts.

Table 7.1-1. Applicable Laws, Regulations, Orders, and Other Requirements (Continued)

Law, Regulation, Order, or Other Requirement	***Description***
Emergency Management	
Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 U.S.C. 9601 et seq.	Provides broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment.
Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA), 42 U.S.C. 11001 et seq.	Requires that Federal, state, and local emergency planning authorities be provided information regarding the presence and storage of hazardous substances and their planned and unplanned environmental releases, including provisions and plans for responding to emergency situations involving hazardous materials.
Price-Anderson Act and Amendments, 42 U.S.C. 2210 Financial Protection Requirements and Indemnity Agreements, 10 CFR 140	Establishes a system of financial protection for persons who may be liable for and persons who may be injured by a nuclear incident arising out of activities conducted by or on behalf of DOE. It is incorporated into the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.). A "nuclear incident" is defined under the Atomic Energy Act as "any occurrence, including an extraordinary nuclear occurrence, within the United States causing, within or outside the United States, bodily injury, sickness, disease, or death, or loss of or damage to property, or loss of use of property, arising out of or resulting from the radioactive, toxic, explosive, other hazardous properties of source, special nuclear or byproduct material…."
Oil Pollution Prevention, 40 CFR 112	Outlines the requirements for both the prevention of and the response to oil spills; includes requirements for Spill Prevention, Control, and Countermeasure Plans, and for Facility Response Plans.
Designation, Reportable Quantities, and Notification, 40 CFR 302	Requires facilities to notify Federal authorities of spills or releases of certain hazardous substances designated under CERCLA and CWA; specifies the quantities of hazardous substance spills/releases that must be reported to authorities and delineate the notification procedures for a release that equals or exceeds the reportable quantities.
Emergency Planning and Notification, 40 CFR 355	Describes emergency planning provisions for facilities in possession of an extremely hazardous substance in a quantity exceeding a specified threshold quantity; could apply to substances to be used in the proposed facilities.
Hazardous Chemical Reporting: Community Right-To-Know, 40 CFR 370	Establishes reporting requirements for providing the public with important information on the hazardous chemical inventories in their communities.
Toxic Chemical Release Reporting: Community Right-To-Know, 40 CFR 372	Establishes reporting requirements for providing the public with important information on the release of toxic chemicals in their communities.
Radiological Emergency Planning and Preparedness, 44 CFR 351	Requires emergency plans for Federal nuclear facilities; defines additional responsibilities for assisting the Federal Emergency Management Agency.
Executive Order 12580, *Superfund Implementation* (1/23/87)	Delegates responsibility to a Federal agency for hazardous substance response activities when the release is from, or the sole source of the release is located in, any facility or vessel under the control of that agency.

Table 7.1-1. Applicable Laws, Regulations, Orders, and Other Requirements (Continued)

Law, Regulation, Order, or Other Requirement	***Description***
Executive Order 12656, *Assignment of Emergency Preparedness Responsibilities* (11/18/88)	Ensures that the United States has sufficient capabilities to meet defense and civilian needs during a national emergency, including a massive nuclear attack.
Executive Order 12856, *Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements* (8/3/93)	Requires all Federal facilities to comply with the provisions of EPCRA; requires reports to be submitted pursuant to EPCRA, Sections 302–303 (Planning Notification), 304 (Extremely Hazardous Substances Release Notification), 311–312 (Material Safety Data Sheet/Chemical Inventory), and 313 (Toxic Chemical Release Inventory Reporting).
DOE Order 151.1D, *Comprehensive Emergency Management System* (10/4/19)	Establishes policy; assigns roles and responsibilities; provides the framework for developing, coordinating, controlling, and directing DOE's emergency management system (i.e., emergency planning, preparedness, response, recovery, and readiness assurance).
DOE Order 153.1, *Departmental Radiological Emergency Response Assets* (06/27/07)	Establishes requirements and responsibilities for the DOE national radiological emergency response assets and capabilities and Nuclear Emergency Support Team assets.
Standards and Procedures for Application of Risk Based Corrective Action at Petroleum Release Sites, IDAPA 58.01.24	Establishes standards and procedures to determine whether and what risk-based corrective action measures should be applied to petroleum release sites.

Sources: (DOE, 1999; DOE, 2008; DOE, 2011a; DOE, 2015b; DOE, 2016a)

Key: CAA = Clean Air Act; CEQ = Council on Environmental Quality; CFR = Code of Federal Regulations; CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; CWA = Clean Water Act; DoD = Department of Defense; DOE = Department of Energy; DOT = U.S. Department of Transportation; EPA = Environmental Protection Agency; EPCRA= Emergency Planning and Community Right-to-Know Act; ESOH = Environment, Safety, and Occupational Health; HAPs = hazardous air pollutants; IC = Idaho Code; IDAPA = Idaho Administrative Procedures Act; IPDES = Idaho Pollutant Discharge Elimination System; NAAQS = National Ambient Air Quality Standards; NEPA = National Environmental Policy Act; NESHAP = National Emission Standards for Hazardous Air Pollutants; NISC = National Invasive Species Council; NPDES = National Pollutant Discharge Elimination System; NRC = Nuclear Regulatory Commission; PSD = Prevention of Significant Deterioration; RCRA = Resource Conservation and Recovery Act; TSS = Transportation Safeguards System; U.S.C. = United States Code; USACE = U.S. Army Corps of Engineers; USFWS = U.S. Fish and Wildlife Service; UST = underground storage tank; WIPP = Waste Isolation Pilot Plant

7.2 Applicable Permits

Implementation of the Proposed Action discussed in this EIS would require compliance with existing environmental permits and/or modifications to those permits and could require acquisition of new permits. This section identifies existing relevant environmental permits for proposed project activities, as well as potential new permits or permit modifications necessary to implement the proposed project. **Table 7.2-1** summarizes the relevant environmental permits for air, water, and hazardous waste for the proposed project site. Section 7.2.1, *Idaho National Laboratory Applicable Permits*, provides more details on the permits potentially required for the INL Site.

The INL Site currently has existing air permits, stormwater discharge permits, industrial wastewater discharge permits, and hazardous waste permits. Communication and coordination with applicable regulatory agencies, including discussion of site-specific and facility-specific permitting requirements (application for new permits or modification to existing permits), would be required.

Table 7.2-1. Summary of Relevant Environmental Permits

Permit	*INL Site*
Air	
Nonradioactive Emissions	
Existing Permit	Yes – State Issued
New Permit Application	Yes – submitted through the construction air permit process
Permit Modification	Yes
Radioactive Emissions	
Existing Permit	Yes – U.S. Environmental Protection Agency (EPA) Issued
New Permit Application	No
Permit Modification	Yes
Water	
Clean Water Act (CWA) Section 404 – State Aquatic Resources Alteration	
Existing Permit	NA – no alteration of surface water bodies or wetlands
New Permit Application	
Permit Modification	
CWA Section 402 – General Construction Stormwater	
Existing Permit	Yes – EPA Issued
New Permit Application	No
Permit Modification	Yes
CWA Section 402 – National Pollutant Discharge Elimination System	
Existing Permit	No [a]
New Permit Application	No
Permit Modification	No
Wastewater Reuse	
Existing Permit	Yes – State Issued
New Permit Application	No
Permit Modification	Yes
Hazardous Waste [b]	
Existing Permit	Yes – State Issued
New Permit Application	No
Permit Modification	Yes

Key: CITRC = Critical Infrastructure Test Range Complex; CWA = Clean Water Act; EPA = U.S. Environmental Protection Agency; INL = Idaho National Laboratory; IPDES = Idaho Pollutant Discharge Elimination System; MFC = Materials and Fuels Complex; NA = not applicable; NPDES = National Pollutant Discharge Elimination System

Notes:

[a] On June 5, 2018, the EPA Administrator approved the application by the State of Idaho to administer and enforce the IPDES program. Idaho administration of the NPDES program is expected to be fully implemented by 2021 (EPA, 2019b). There are no navigable waters near MFC or CITRC.

[b] Hazardous waste permits are also applicable to the hazardous components of mixed radioactive wastes.

7.2.1 Idaho National Laboratory Applicable Permits

INL holds environmental permits, including those for air quality, water quality, and hazardous waste. The *Idaho National Laboratory Site Environmental Report Calendar Year 2019* describes existing permits for INL in more detail (DOE-ID, 2021c). In general, IDEQ is an EPA-authorized state agency, but regulation of radionuclide air emissions at DOE facilities such as the INL Site, as prescribed in 40 CFR 61, Subpart H, has not been delegated to Idaho and is administered by the EPA.

Air – Under EPA regulations, the State of Idaho has been delegated authority under CAA to maintain the NAAQS (40 CFR 52, Subpart N), to issue PSD permits (40 CFR 52.683), to enforce performance standards for new stationary sources, and to issue permits to construct and operate. Construction or modifications of facilities that are regulated under the IDEQ, Rules for the Control of Air Pollution in Idaho (IDAPA 58.01.01), are subject to a preconstruction review and permitting under the program (IDEQ, 2019). To date, the State of Idaho does not have authority delegated from EPA to administer NESHAP Subpart H Program (radionuclide emissions); that authority remains with EPA (40 CFR 61.90–61.97) (EPA, 2019c).

The Idaho Air Quality Program is primarily administered through the permitting process. Potential sources of air pollutants are evaluated against regulatory criteria to determine if the source is specifically exempt from permitting requirements or if the source's emissions are significant or insignificant. If emissions are determined to be significant, several actions may occur: (1) permitting determinations may be made to demonstrate that the project or process is either below emission thresholds or listed as exempted source categories in State of Idaho regulations allowing self-exemption or (2) an application for a permit to construct may be submitted. If emissions are deemed major under PSD regulations, then a PSD analysis must be completed. If not deemed significant per PSD regulations, an application for only a permit to construct without the additional PSD modeling and analyses is needed (DOE, 2011b).

The operation of the INL Site includes sources that emit criteria and HAPs and require a PTC, as outlined in IDAPA 58.01.01.200–228. These sources currently operate under a PTC (PTC #P-2020.045) with a facility emissions cap. This PTC limits facility-wide emissions to below levels that would require a Title V operating permit and rescinds the previous Title V permit that regulated emission sources at the INL Site (IDEQ, 2021b).

Water – On June 5, 2018, EPA approved the application by the State of Idaho to administer and enforce the IPDES program. Transitioning regulatory authority from EPA to Idaho is being phased in over a number of years with Idaho administration of the IPDES program expected to be fully implemented by 2021 (EPA, 2019b).

INL complies with a Clean Water Act permit through the implementation of procedures, policies, and BMPs related to discharges from Idaho Falls facilities to the City of Idaho Falls–owned treatment works. This permit is not discussed further in this EIS because the Proposed Action does not involve changes in DOE activities in Idaho Falls. INL obtains coverage under the general permit for individual construction projects. Administrative authority of the NPDES program has been transferred to the State of Idaho, where it is known as the IPDES program. Construction of new facilities or modifications to existing facilities may require that INL file an NOI and obtain a new construction permit or modify an existing permit. An associated written stormwater discharge plan may also be required. Only construction projects that are determined to have a reasonable potential to discharge pollutants to regulated surface water are required to have a Stormwater Pollution Prevention Plan (DOE, 2011b). Because wastewater would not be discharged to natural surface water bodies at the INL Site, an IPDES discharge permit would not be required.

To protect human health and prevent pollution of surface water and groundwater, the State of Idaho requires a wastewater reuse permit for the land application of wastewater. The IDEQ issues the reuse permits in accordance with IDAPA 58.01.17, Recycled Water Rules, IDAPA 58.01.16, Wastewater Rules, and IDAPA 58.01.11, Ground Water Quality Rule. All wastewater reuse permits incorporate water quality standards for groundwater protection. Currently, there are three permitted wastewater facilities at the INL Site: the ATR Complex Cold Waste Pond, INTEC New Percolation Ponds, and the Materials and Fuels Complex (MFC) Industrial Waste Pond (DOE-ID, 2021c).

Hazardous/Mixed Waste – The State of Idaho is authorized by EPA to administer its own RCRA program and is responsible for reviewing applications and issuing permits under the IDEQ, Rules and Standards for Hazardous Waste (IDAPA 58.01.05). The IDEQ has issued a RCRA permit for the INL Site (DOE, 2011b).

When IDEQ receives any information (e.g., information received during facility inspection or in a permit submission), IDEQ may determine if there exists one or more of the causes for modification or revocation and reissuance, or both. If cause exists, IDEQ may modify or revoke and reissue the permit accordingly and may request an updated application, if necessary (DOE, 2011b). Hazardous and mixed waste generation Project Pele and associated facilities may trigger the need to modify the existing INL Site hazardous waste permit if the waste would be stored for more than 90 days.

Other Agreements – The DOE and the USFWS established a CCA for greater sage-grouse (DOE-ID & USFWS, 2014). DOE and USFWS continue to collaborate on sage-grouse protection at the INL Site. In compliance with the CCA, pre- and post-construction surveys are performed to establish the amounts of sagebrush restoration and other native revegetation efforts needed to rehabilitate disturbed areas.

DOE's *Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Environmental Impact Statemen*t (DOE, 1995a) (i.e., the SNF EIS) analyzed alternatives for the management of existing and reasonably foreseeable inventories of DOE's SNF. The June 1, 1995, ROD for the programmatic SNF EIS (60 FR 28680) stated in part that DOE would consolidate nonaluminum-clad SNF at the Idaho National Engineering Laboratory (now INL), and would consolidate the management of its aluminum-clad SNF at Savannah River Site.

The Federal Facility Agreement/Consent Order and Site Treatment Plan was signed by the State of Idaho on November 1, 1995, and is updated annually (DOE-ID, 2021c). The Federal Facility Agreement/Consent Order required preparation of a site treatment plan for the treatment of mixed waste stored or generated at the INL Site. The INL Site Treatment Plan would likely be updated to reflect construction and operation of Project Pele and associated facilities.

On October 16, 1995, DOE, the U.S. Navy, and the State of Idaho entered into an agreement (also known as the Idaho Settlement Agreement) that guides management of SNF and radioactive waste at the INL Site. The Idaho Settlement Agreement limits shipments of DOE and Naval SNF into the state and sets milestones for shipments of SNF and radioactive waste out of the state (DOE-ID, 2021c). In a 2019 *Supplemental Agreement Concerning Conditional Waiver of Sections D.2.e and K.1 of 1995 Settlement Agreement* between DOE and the State of Idaho (DOE-ID and Idaho, 2019), Idaho allowed receipt of a specific quantity of commercial power SNF at the INL Site and established terms and conditions under which DOE could resume and plan for additional shipments of commercial SNF pursuant to a 2011 Memorandum of Agreement.

On February 4, 2020, the *Agreement Concerning Handling of Spent Nuclear Fuel Generated by the Advanced Test Reactor* was signed between DOE-Idaho and the State of Idaho (DOE-ID and Idaho, 2020). The agreement allows ATR SNF to be stored for 6 years in the ATR Operating Canal for thermal cooling.

SNF generated by the operation of Project Pele would be managed in accordance with applicable laws and agreements.

7.3 Consultations

Consultations with other Federal, state, and local agencies and federally recognized American Indian tribal governments are usually conducted prior to the disturbance of any land and are usually related to biotic, cultural, or American Indian resources. Certain laws, such as the ESA, Fish and Wildlife Coordination Act, MBTA, and NHPA, require consultation and coordination by DoD with other governmental entities, including other Federal agencies, state and local agencies, and federally recognized American Indian governments. In addition, the DOE *American Indian and Alaska Native Government Policy* requires DOE to consult with any American Indian or Alaska Native Tribal Government with regard to any property to which the Tribe attaches religious or cultural importance that might be affected by a DOE action.

Biotic resource consultations generally pertain to the potential for activities to disturb sensitive species, migratory birds, or their habitats. Cultural resource consultations relate to the potential for disruption of important historic resources or archaeological sites. American Indian consultations are concerned with the potential for impacts on any rights and interests, including the disturbance of ancestral American Indian sites and sacred sites, traditional and religious practices of American Indians, and natural resources of importance to American Indians.

DOE completed biological field surveys in October 2020 to identify potential sensitive species within the proposed project areas and to ensure potential impacts to sensitive biological resources would be minimized and/or avoided. The results are provided in the *PELE: Ecological Summary Data and Field Surveys Report (VFS-ID-ESER-LAND-086)* released in December 2020 (Veolia, 2020) and detailed in Section 3.5, *Biological Resources*, of this EIS. The analysis determined that potential impacts to biological resources would be minimal. Existing agreements and controls would provide protection of federally, state, and locally sensitive species.

As detailed in Section 3.6.2, *Cultural Resources*, numerous cultural resource surveys have been conducted at the INL Site to identify and protect historic properties. Most recently, the DOE-ID submitted the *Cultural Resource Investigations for the Construction and Demonstration of a Prototype Advanced Mobile Nuclear Reactor (Project Pele) (INL/LTD-20-60577)* to the Idaho State Historic Preservation Officer for review in April 2021. Findings of this report and past cultural studies have been summarized in Section 3.6, *Cultural and Paleontological Resources*. These findings are used to support the “no effect” determination for all Project Pele elements except for Phase 6 at RSWF or ORSA summarized in Section 4.6, *Cultural and Paleontological Resources*, of this EIS. The RSWF area was not surveyed for archaeological resources and the potential effects to MFC historic properties within view of the ORSA area were not evaluated because an exact location for the temporary storage has not been selected yet. The necessary NHPA Section 106 consultation will be performed later when an exact location has been selected.

Additionally, DOE and SCO continue to engage in coordination with key American Indian Tribal governments regarding the project and Tribal concerns throughout the project planning process (see Appendix C, *Tribal Coordination*, for a summary of tribal meetings leading up to the publication of the Draft EIS). DOE and SCO will continue to engage tribes throughout the EIS process, including soliciting comments on the Draft EIS. As described in Section 4.6, Shoshone-Bannock Tribal representatives would also be invited to participate in the construction monitoring to ensure that the Proposed Action would have no impacts on any historic properties or culturally sensitive resources.

This page left blank intentionally.

Chapter 8
References

This page left blank intentionally.

8 REFERENCES

American Cancer Society. (2021). *Cancer Facts and Figures 2021.* Atlanta, Georgia.

American Hospital Directory. (2021). *Individual Hospital Statistics for Idaho*. Retrieved March 21, 2021, from American Hospital Directory: https://www.ahd.com/states/hospital_ID.html.

Anderson et al. (1996). Anderson, S. R., Liszewski, M. J., and Ackerman, D. J. *Thickness of Surficial Sediment at and near the Idaho National Engineering Laboratory, Idaho*. Open-File Report 96-330. U.S. Geological Survey.

Bechtel Marine Propulsion Corporation. (2017). *Environmental Summary Report for the Naval Reactors Facility.*

Bolt, Baranek and Newman, Inc. (1971). *Noise from Construction Equipment, and Operations, Building Equipment and Home Appliances.* Prepared for the U.S. Environmental Protection Agency Office of Noise Abatement and Control.

Bureau of Economic Analysis. (2020). *Personal Income by County and Metropolitan Area, 2019.* Retrieved May 2021, from Bureau of Economic Analysis - U.S. Department of Commerce: https://www.bea.gov/sites/default/files/2020-11/lapi1120_1.pdf. November 17.

Bureau of Labor Statistics. (2019a). *Injuries, Illnesses, and fatalities*. Retrieved June 3, 2021, from U.S. Bureau of Labor Statistics: https://www.bls.gov/iif/oshcfoi1.htm#rates.

Bureau of Labor Statistics. (2019b). *Injuries, Illnesses, and Fatalities*. Retrieved June 3, 2021, from U.S. Bureau of Labor Statistics: https://www.bls.gov/iif/soii-data.htm#summary.

Bureau of Labor Statistics. (2021). *Local Area Unemployment Statistics*. (U. B. Statistics, Producer) Retrieved June 17, 2021, from https://www.bls.gov/lau.

BWXT. (2021a). *BWXT NOG Lynchburg - BWX Technologies, Inc*. Retrieved July 28, 2021, from bwxt.com: https://www.bwxt.com/about/operations--locations/bwxt-nog-lynchburg.

BWXT. (2021b). *BWXT Nuclear Operations Group*. Retrieved July 28, 2021, from bwxt.com: https://www.bwxt.com/about/business-units/bwxt-nuclear-operations-group.

BWXT, Nuclear Products Division. (2004). *Environmental Report for Renewal of License SNM-42 (redacted).* Lynchburg, VA. March 10.

California Air Resources Board. (2021). *Speciation Profiles Used in CARB Modeling*. Retrieved from https://ww2.arb.ca.gov/speciation-profiles-used-carb-modeling.

CEQ. (1997). *Environmental Justice Guidance Under the National Environmental Policy Act.* Council on Environmental Quality, Executive Office of the President. Washington, D.C. December 10.

Countess Environmental. (2006). *WRAP Fugitive Dust Handbook.* Prepared for the Western Governors' Association.

Cowardin et al. (1979). Cowardin, L.M., Carter, V., Golet, F. C., & LaRoe, E. T. *Classification of wetlands and deepwater habitats of the United States*. USFWS Publication FWS/OBS-7931. Washington, D.C.: U.S. Fish and Wildlife Service.

Defense Nuclear Facilities Safety Board. (2020). *Idaho National Laboratory (INL) Report for March 2020.*

DoD. (2020). *DOD Awards Contracts for Development of a Mobile Microreactor*. Retrieved from defense.gov: https://www.defense.gov/Newsroom/Releases/Release/Article/2105863/dod-awards-contracts-for-development-of-a-mobile-microreactor/. March 9.

DoD Defense Science Board. (2016). *Task Force on Energy Systems of Forward/Remote Operating Bases.* Washington, D.C.

DoD SCO. (2020). Requests for Solutions, PELE Program Phase I. Arlington, VA: Office of the Secretary of Defense Strategic Capabilities Office. Retrieved from https://govtribe.com/opportunity/federal-contract-opportunity/request-for-solutions-pele-requestforsolutionspele.

DoD SCO. (2021). Strategic Capabilities Office Selects Two Mobile Microreactor Concepts to Proceed to Final Design. Arlington, Va. Retrieved from https://www.defense.gov/Newsroom/Releases/Release/Article/2545869/strategic-capabilities-office-selects-two-mobile-microreactor-concepts-to-proce/. March 22.

DOE. (1989). *Guidelines for Revegetation of Disturbed Sites at the Idaho National Laboratory.* Department of Energy.

DOE. (1995a). DOE/EIS-0203: Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement. Washington, D.C. April 2.

DOE. (1995b). Record of Decision DOE/EIS-0203 Programmatic Spent Nuclear Fuel Management. Washington, D.C. June 1.

DOE. (1996a). Amended Record of Decision for DOE/EIS-0203 Programmatic Spent Nuclear Fuel Management. Washington, D.C. March 8.

DOE. (1996b). DOE/EIS-0240 Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement. Washington, D.C.: U.S. Department of Energy, Office of Fissile Materials Disposition. June.

DOE. (1997a). *Final Waste Management Programmatic Environmental Impact Statement for Managing, Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (DOE/EIS-0200).* U.S. Department of Energy.

DOE. (1997b). *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement Eddy County, near Carlsbad, New Mexico (DOE/EIS-0026-S-2).* U.S. Department of Energy.

DOE. (1999). *Final Environmental Impact Statement Construction and Operation of the Spallation Neutron Source.* DOE/EIS-0247, Office of Science, Germantown, Maryland, April.: U.S. Department of Energy.

DOE. (2002a). *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18.* U. S. Department of Energy.

DOE. (2002b). *Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement.* U.S. Department of Energy.

DOE. (2002c). *Final Environmental Impact Statement for a Geological Repository for the Disposal of Spent Nuclear Fuel and High Level Radioactive Waste at Yucca Mountain, Nye County, Nevada, DOE/EIS 0250.* North Las Vegas, Nevada: U.S. Department of Energy, Office of Civilian Radioactive Waste Management, Yucca Mountain Site Characterization Office, February.

DOE. (2003). *Estimating Radiation Risk from Total Effective Dose Equivalent (TEDE), ISCORS Technical Report No. 1.* U.S. Department of Energy.

DOE. (2004a). *GENII Computer Code Application Guidance for Documented Safety Analysis, Final Report.* Washington, D.C.: U.S. Department of Energy, Office of Environment, Safety and Health. July.

DOE. (2004b). *MACCS2 Computer Code Application Guidance for Documented Safety Analysis, DOE-EH-4.2.1.4-MACCS2-Code Guidance, Office of Environmental, Safety, and Health.* Washington, D.C.: U.S. Department of Energy. June.

DOE. (2005). *Draft EIS for the Proposed Consolidation of Nuclear Operations Related to Production of Radioisotope Power Systems.* U.S. Department of Energy.

DOE. (2008). *Final Complex Transformation Supplemental Programmatic Environmental Impact Statement.* DOE/EIS-0236-S4. Washington, D.C.: U.S. Department of Energy, National Nuclear Security Administration. October.

DOE. (2011a). *Final Site-Wide Environmental Impact Statement for the Y-12 National Security Complex.* Oak Ridge, TN: U.S. Department of Energy, National Nuclear Security Administration, Y-12 Site Office. February.

DOE. (2011b). *Final Long-Term Management and Storage of Elemental Mercury Environmental Impact Statement.* Washington, D.C.: U.S. Department of Energy, Office of Environmental Management. January.

DOE. (2013a). *Final Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (DOE/EIS-0426).* U.S. Department of Energy.

DOE. (2013b). *DOE Handbook: Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities, Vol. 1: Analysis of Experimental Data, DOE HDBK-3010-94, Reaffirmed 2013, December.* U.S. Department of Energy.

DOE. (2015a). *DOE 2014 Occupational Radiation Exposure.* Oak Ridge, TN: U.S. Department of Energy, Office of Environment, Health, Safety and Security.

DOE. (2015b). *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement.* DOE/EIS-0283-S2. Washington, D.C.: U.S. Department of Energy, Office of Environmental Management and National Nuclear Security Administration. April.

DOE. (2016a). *Final Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste.* DOE/EIS-0375. Washington, D.C.: U.S. Department of Energy. January.

DOE. (2016b). DOE-STD-1020-2016 DOE Standard Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities. Washington, D.C. December.

DOE. (2016c). *Final Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling, DOE/EIS-0453-F.* Washington, D.C.: Naval Nuclear Propulsion Program.

DOE. (2016d). *DOE 2015 Occupational Radiation Exposure.* Oak Ridge, TN: U.S Department of Energy, Office of Environment, Health, Safety and Security.

DOE. (2016e). *DOE Order 151.1D Chg. 1, 10-4-2019, Comprehensive Emergency Management System.* Department of Energy. Washington, D.C., August 11.

DOE. (2016f). *DOE Order 460.1D, Hazardous Materials Packaging and Transportation Safety. December.* Washington, D.C.: U.S. Department of Energy.

DOE. (2017a). *DOE 2016 Occupational Radiation Exposure.* Oak Ridge, TN: U.S Department of Energy, Office of Environment, Health, Safety and Security.

DOE. (2017b). DOE Standard Radiological Control Technical Standard, DOE-STD-1098-2017, Change Notice 1. Washington, D.C. January: U.S Department of Energy.

DOE. (2017c). *DOE Order 450.2, Chg 1 (MinChg), Integrated Safety Management, January 17, 2017.* Washington, D.C.: U.S. Department of Energy.

DOE. (2018a). *Environmental Assessment for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste at Waste Control Specialists, Andrews County, Texas.* DOE/EA-2082. Washington, D.C.: DOE/EA-2082. U.S. Department of Energy, Office of Waste Management.

DOE. (2018b). *DOE 2017 Occupational Radiation Exposure.* Oak Ridge, TN: U.S. Department of Energy, Office of Environment, Health, Safety and Security.

DOE. (2018c). *Protective Action Criteria (PAC) with AEGLs, ERPGs, & TEELs, Office of Environment, Health, Safety & Security, Rev. 29a, Washington, D.C., June.* Washington, D.C.: U.S. Department of Energy. Retrieved May 19, 2021, from https://www.energy.gov/ehss/protective-action-criteria-pac-aegls-erpgs-teels.

DOE. (2019a). *DOE Order 425.1D, Chg 2, Verification of Readiness to Start Up or Restart Nuclear Facilities.* Washington, D.C.: U.S. Department of Energy. October 4.

DOE. (2019b). *DOE 2018 Occupational Radiation Exposure.* Oak Ridge, TN: U.S. Department of Energy, Office of Environment, Health, Safety and Security.

DOE. (2020a). *Draft Versatile Test Reactor Environmental Impact Statement.* DOE/EIS-0542. Idaho Falls: U.S. Department of Energy, Office of Nuclear Energy. December.

DOE. (2020b). *DOE Order 458.1 Chg 4 (LtdChg), Radiation Protection of the Public and the Environment, September 15, 2020.* Washington, D.C.: U.S. Department of Energy.

DOE. (2020c). Email from Brandi Dingman (DOE) to James Lovejoy (DOE), providing number of workers at the INL Site. U.S. Department of Energy. April 30.

DOE. (2020d). *DOE Order 414.1D Chg 2 (LtdChg), Quality Assurance, September 15, 2020.* Washington, D.C.: U.S. Department of Energy.

DOE. (2021a). *DOE 2019 Occupational Radiation Exposure.* Oak Ridge, TN: U.S. Department of Energy, Office of Environment, Health, Safety and Security.

DOE. (2021b). *DOE Data Dashboards*. Retrieved May 17, 2021, from U.S. Department of Energy Injury and Wellness Dashboard>Shared Sites>Injury and Illness Dashboard: https://data.doe.gov/MS/asp/Main.aspx.

DOE et al. (1995). Idaho Settlement Agreement. U.S. Department of Energy, U.S. Department of the Navy, and Idaho. October 16.

DOE-ID & USFWS. (2014). *Candidate Conservation Agreement for Greater Sage-grouse (Centrocercus urophasianus) on the Idaho National Laboratory Site Southeast Idaho.* Gonzales prepared for the Stoller Surveillance, LLC, and Wildlife Conservation Society Under the Environmental

Surveillance, Education, and Research Program, September. U.S. Department of Energy, Idaho Operations Office and U.S. Fish and Wildlife Service.

DOE-ID. (1998). Final Record of Decision Argonne National Laboratory - West. Idaho Falls: DOE Idaho Operations Office.

DOE-ID. (2011). *Idaho National Laboratory Site Environmental Report Calendar Year 2010, DOE/ID-12082(10).* Idaho Falls, Idaho: Department of Energy Idaho Operations Office, Environmental Surveillance, Education, and Research Program.

DOE-ID. (2014a). *Resumption of Transient Testing of Nuclear Fuels and Materials at the Idaho National Laboratory, Idaho (DOE/EA-1954).* U.S. Department of Energy Idaho Operations Office.

DOE-ID. (2014b). *Technical Basis for Environmental Monitoring and Surveillance at the Idaho National Laboratory Site.* U.S. Department of Energy Idaho Operations Office.

DOE-ID. (2015). *Idaho National Laboratory Site Environmental Report Calendar Year 2014, DOE/ID-12082(14).* Idaho Falls, ID. September: Prepared by VNS Federal Services, Environmental Surveillance, Education, and Research Program for the Idaho Operations Office, U.S. Department of Energy.

DOE-ID. (2016). *Idaho National Laboratory Site Environmental Report Calendar Year 2015, DOE/ID-12082(15).* Idaho Falls, ID. September: Prepared by VNS Federal Services, Environmental Surveillance, Education, and Research Program for the Idaho Operations Office, U.S. Department of Energy.

DOE-ID. (2017). *Idaho National Laboratory Site Environmental Report Calendar Year 2016, DOE/ID-12082(16).* Idaho Falls, ID. September: Prepared by VNS Federal Services, Environmental Surveillance, Education, and Research Program for the Idaho Operations Office, U.S. Department of Energy.

DOE-ID. (2018a). *Idaho National Laboratory Site Bat Protection Plan.* Idaho Falls: U.S. Department of Energy Idaho Operations Office. Retrieved from http://idahoeser.com/PDF/BatProtectionPlan2018.pdf.

DOE-ID. (2018b). *Idaho National Laboratory Site Environmental Report Calendar Year 2017, DOE/ID-12082(17).* Idaho Falls, ID. September: Prepared by VNS Federal Services, Environmental Surveillance, Education, and Research Program for the Idaho Operations Office, U.S. Department of Energy.

DOE-ID. (2019a). *Final Environmental Assessment for Expanding Capabilities at the Power Grid Test Bed at Idaho National Laboratory.* (DOE/EA-2097). Idaho Falls, ID: U.S. Department of Energy, Idaho Operations Office.

DOE-ID. (2019b). *Ecological Report for the Environmental Assessment for Expanding Capabilities at the Power Grid Test Bed at Idaho National Laborator.* Idaho Falls: U.S. Department of Energy Idaho Operations Office Environmental Surveillance, Education and Research Program.

DOE-ID. (2019c). *NEPA CX Determination Idaho National Laboratory Gravel Source and Borrow Pit Operations (Overarching).* U.S. Department of Energy Idaho Operations Office.

DOE-ID. (2019d). *FY 2020 Idaho National Laboratory Site Sustainability Plan.* Idaho National Laboratory Idaho Operations Office.

DOE-ID. (2019e). *Idaho National Laboratory Site Environmental Report Calendar Year 2018, DOE/ID-12082(18).* Idaho Falls, ID. September: Prepared by VNS Federal Services, Environmental

Surveillance, Education, and Research Program for the Idaho Operations Office, U.S. Department of Energy.

DOE-ID. (2021a). *Final Environmental Assessment for the Microreactor Applications Research, Validation and Evaluation (MARVEL) Project at Idaho National Laboratory.* (DOE/EA-2146). U.S. Department of Energy, Idaho Operations Office. June.

DOE-ID. (2021b). *Experimental Breeder Reactor (EBR)-II Modifications to Support National Reactor Innovation Center (NRIC).* Idaho Falls: U.S. Department of Energy Idaho Operations Office. DOE-ID NEPA CX Determination, DOE-ID-INL-20-219. March 17.

DOE-ID. (2021c). *Idaho National Laboratory Site Environmental Report Calendar Year 2019 DOE/ID-12082(19).* Idaho Falls, ID. September: Prepared by VNS Federal Services, Environmental Surveillance, Education, and Research Program for the Idaho Operations Office, U.S. Department of Energy.

DOE-ID. (2021d). *Summary Memorandum - Cultural Resource Investigations for the Construction and Demonstration of a Prototype Advanced Mobile Nuclear Reactor (Project Pele).* U.S. Department of Energy, Idaho Operations Office.

DOE-ID and Idaho. (2019). Supplemental Agreement Concerning Conditional Waiver of Sections D.2.e and K.1 of 1995 Settlement Agreement. U.S. Department of Energy Idaho Operations Office and State of Idaho. November 6.

DOE-ID and Idaho. (2020). Agreement Concerning Handling of Spent Nuclear Fuel Generated by the Advanced Test Reactor. State of Idaho, through the Governor of the State of Idaho and the Idaho Attorney General, and the U.S. Department of Energy Idaho Operations Office. February 4.

DOT. (2012). *High-Speed Ground Transportation Noise and Vibration Impact Assessment.* Washington, D.C.: U.S. Department of Transportation Federal Railroad Administration, Office of Railroad Policy and Development.

DOT. (2018). *Transit Noise and Vibration Impact Assessment Manual.* Prepared by John A. Volpe National Transportation Systems Center for the Federal Transit Administration, U.S. Department of Transportation.

DOT. (2019). *Traffic Safety Facts 2017, DOT HS 812 806, September.* Washington, D.C.: U.S. Department of Transportation, National Highway Traffic Safety Administration, National Center for Statistics and Analysis.

Electric Power Research Institute. (2019). *Uranium Oxycarbide {UCO) Tristructural Isotropic {TRISO) Coated Particle Fuel Performance. Topical Report EPRI-AR-1 (NP), May 2019.* Palo Alto, CA.

EPA. (1974). *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety.* Washington, D.C.: U.S. Environmental Protection Agency Office of Noise Abatement and Control, March 1974.

EPA. (2010). *Exhaust Emission Factors for Nonroad Engine Modeling - Spark-Ignition.*

EPA. (2019a). *Prevention of Significant Deterioration Basic Information*. Retrieved from https://www.epa.gov/nsr/prevention-significant-deterioration-basic-information.

EPA. (2019b). *Idaho NPDES Program Authorization*. (U. E. Agency, Producer) Retrieved January 15, 2020, from https://www.epa.gov/npdes-permits/idaho-npdes-program-authorization#schedule. December 6.

EPA. (2019c). Letter K. Viswanathan to J. Tippets, Approval of the Idaho Department of Environmental Quality's Request for Updated Delegation of Authority for National Emissions Standards for Hazardous Air Pollutants. U.S. Environmental Protection Agency. October 30.

EPA. (2021a). *NAAQS Table*. Retrieved May 13, 2021, from NAAQS Table: www.epa.gov/criteria-air-pollutants/naaqs-table.

EPA. (2021b). *Idaho Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants*. Retrieved from U.S. Environmental Protection Agency: https://www3.epa.gov/airquality/greenbook/anayo_id.html. June 3.

EPA. (2021c). *National Emission Standards for Hazardous Air Pollutants (NESHAP)*. Retrieved May 17, 2021, from https://www.epa.gov/stationary-sources-air-pollution/national-emission-standards-hazardous-air-pollutants-neshap-9.

EPA. (2021d). *Subpart H: National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities*. Retrieved May 17, 2021, from https://www.epa.gov/radiation/subpart-h-national-emission-standards-emissions-radionuclides-other-radon-department.

EPA. (2021e). *MOVES and Related Models - MOVES Versions in Limited Current Use*. Retrieved from https://www.epa.gov/moves/moves-versions-limited-current-use.

EPA. (2021f). *Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks – 1990-2019.* U.S. Environmental Protection Agency. Retrieved from https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks.

ESER. (2007). *Sensitive Animal Species Inventory on the INL Sagebrush Steppe Ecosystem Reserve.* Environmental Surveillance, Education and Research Program, S.M. Stoller Corporation.

ESER. (2019). *2018 Breeding Bird Surveys on the Idaho National Laboratory Site.* VFS-ID-ESER-WILD-030.

ESER. (2020). *Idaho National Laboratory Site Bat Protection Plan Update.* VFS-ID-ESER-WILD-084. Environmental Surveillance, Education, and Research Program.

FBI. (2021a). *2019 Crime in the United States, Table 80, Full Time Law Enforcement Employees by State, by Metropolitan and Nonmetropolitan Counties, 2016*. Retrieved May 2021, from Federal Bureau of Investigation: https://ucr.fbi.gov/crime-in-the-u.s/2019/crime-in-the-u.s.-2019/topic-pages/tables/table-80/table-80.xls/view.

FBI. (2021b). *2019 Crime in the United States, Table 78, Full Time Law Enforcement Employees by State, by City, 2019*. Retrieved May 2021, from Federal Bureau of Investigation: https://ucr.fbi.gov/crime-in-the-u.s/2019/crime-in-the-u.s.-2019/tables/table-78/table-78-state-cuts/idaho.xls.

FEMA. (2020). *National Flood Hazard Layer (NFHL)*. Retrieved from FEMA Flood Map Service Center: https://msc.fema.gov/portal/home. Federal Emergency Management Agency, U.S. Department of Homeland Security.

FireDepartment.net. (2021). *Fire Department Directory*. Retrieved from Idaho Fire Departments by County: https://www.firedepartment.net/directory/idaho. May.

Gallant et al. (2018). Gallant, E., Richardson, J., Connor, C., Wetmore, P., & Connor, L. A new approach to probabilistic lava flow hazard assessments, applied to the Idaho National Laboratory, eastern Snake River Plain, Idaho, USA. *Geology, 46(10)*, 895-898.

Global Carbon Project. (2020). *Global Carbon Budget 2019.* Retrieved from https://www.icos-cp.eu/science-and-impact/global-carbon-budget/2019.

Google Earth. (2021). Google Earth Imagery. *Google Earth Imagery of INL*. Atomic City, Idaho: Google Earth. May 14.

Hackett et al. (2002). Hackett, W. R., Smith, R. P., Khericha, S., & Bonnichsen, B. Volcanic Hazards of the Idaho National Engineering and Environmental Laboratory, Southeast Idaho. *Tectonic and Magmatic Evolution of the Snake River Plain Volcanic Province, 30*, 461-482.

Hackett, W. R., & Smith, R. P. (1992). *Quaternary Volcanism, Tectonics, and Sedimentation in the Idaho National Engineering Laboratory Area.* GSA Rocky Mountain Section Field Guide.

IDA. (2019). *International Dark-Sky Association.* International Dark-Sky Association.

Idaho Department of Agriculture. (2009). *Rules Governing Invasive Species and Noxious Weeds.* Boise: Idaho Department of Agriculture, Plant Division.

IDEQ. (2019). *Rules for the Control of Air Pollution in Idaho*. Retrieved from www.deq.idaho.gov/air-quality/planning/.

IDEQ. (2021a). *Aquifers*. Retrieved May 14, 2021, from Idaho Department of Environmental Quality: https://www.deq.idaho.gov/water-quality/ground-water/aquifers/.

IDEQ. (2021b). *Air Quality Permit to Construct, Permit Number P-2020.0045.* Idaho Department of Environmental Quality.

IDFG. (2005). *Fringed Myotis: Myotis thysanodes.* Boise: Idaho Department of Fish and Game.

IDFG. (2017). *Idaho State Wildlife Action Plan.* Boise: Idaho Department of Fish and Game.

IDFG. (2021a). *Big Brown Bat (Eptesicus fuscus)*. Retrieved from Idaho Department of Fish and Game: https://idfg.idaho.gov/species/taxa/19549.

IDFG. (2021b). *California Myotis (Myotis californicus)*. Retrieved from Idaho Department of Fish and Game: https://idfg.idaho.gov/species/taxa/18392.

IDFG. (2021c). *Little Brown Myotis (Myotis lucifugus)*. Retrieved from Idaho Department of Fish and Game: https://idfg.idaho.gov/species/taxa/15639.

IDFG. (2021d). *Hoary Bat (Lasiurus cinereus)*. Retrieved from Idaho Department of Fish and Game: https://idfg.idaho.gov/species/taxa/20017.

IDFG. (2021e). *Silver-haired Bat (Lasionycteris noctivagans)*. Retrieved from Idaho Department of Fish and Game: https://idfg.idaho.gov/species/taxa/18499.

IDFG. (2021f). *Long-eared Myotis (Myotis evotis)*. Retrieved from Idaho Department of Fish and Game: https://idfg.idaho.gov/species/taxa/77666.

IDFG. (2021g). *Townsend's Big-eared Bat (Corynorhinus townsendii)*. Retrieved from Idaho Department of Fish and Game: https://idfg.idaho.gov/species/taxa/17659.

IDFG. (2021h). *Yuma Myotis (Myotis yumanensis)*. Retrieved from Idaho Department of Fish and Game: https://idfg.idaho.gov/species/taxa/16074.

IDFG. (2021i). *Plains Milkvetch (Astragalus gilviflorus)*. Retrieved from Idaho Department of Fish and Game: https://idfg.idaho.gov/species/taxa/39497.

IDFG. (2021j). *Sepal-tooth Dodder (Cuscuta denticulata)*. Retrieved from Idaho Department of Fish and Game: https://idfg.idaho.gov/species/taxa/57061.

IDFG. (2021k). *Western Small-footed Myotis (Myotis ciliolabrum)*. Retrieved from Idaho Department of Fish and Game: https://idfg.idaho.gov/species/taxa/17751.

IDFG. (2021l). *Desert dodder (Cuscuta denticulata var. denticulata)*. Retrieved from Idaho Department of Fish and Game: https://idfg.idaho.gov/species/taxa/91756.

INL. (2006). *Development of Rock and Soil Design BasisEarthquake (DBE) Parameters for the Materials andFuels Complex (MFC).* Idaho Falls: Idaho National Laboratory.

INL. (2010a). *Idaho National Laboratory Materials and Fuels Complex Natural Phenomena Hazards Flood Assessment.* Idaho Falls.

INL. (2010b). *Seismic and Volcanic Hazards*. Retrieved from Idaho National Laboratory: https://inlportal.inl.gov/portal/server.pt/community/inl_seismic_monitoring_program/441/seismic_and_volcanic_hazards.

INL. (2015a). *Idaho National Laboratory Comprehensive Land Use and Environmental Stewardship Report.* Idaho Falls.

INL. (2015b). *INL Site Conditions and Properties.* INL/EXT-15-36721. Idaho National Laboratory.

INL. (2016a). *Data Quality Objectives Supporting the Environmental Soil Monitoring Program for the INL Site.* Idaho Falls: Idaho National Laboratory.

INL. (2016b). *Idaho National Laboratory Cultural Resource Management Plan, DOE/ID-10997, Rev. 6.* Idaho Falls: Idaho Operations Office.

INL. (2017a). Hot Fuel Examination Facility Factsheet, Post-irradiation examination of fuels and materials. Idaho Falls.

INL. (2017b). *INL Transportation Safety Document (TSD), Report No. PDD-2500, Rev. 6, October.* Idaho Falls, ID: Idaho National Laboratory.

INL. (2018). *2017 Idaho National Laboratory Water Use Report and Comprehensive Well Inventory, Rev. 26, INL/EXT-18-45157.* Idaho National Laboratory.

INL. (2019a). *INL Site Geographic Information System.* Idaho Falls: Idaho National Laboratory.

INL. (2019b). *Technical Evaluation: Utility Study for the Versatile Reactor (VTR) at MFC.* Idaho National Laboratory.

INL. (2019c). *Fiscal Year 2019 Revegetation Assessment.* Idaho Falls, Idaho: Idaho National Laboratory. INL/EXT-19-56726. U.S. Department of Energy, Idaho Operations Office. November.

INL. (2020a). *INL/EXT-20-57821 Evaluation of Sites for Advanced Reactor Demonstrations at Idaho National Laboratory.* Idaho National Laboratory. March.

INL. (2020b). *Annual Report for Permit to Construct P-2015.0023 for Calendar Year 2019.* Idaho National Laboratory.

INL. (2020c). *Comprehensive Land Use and Environmental Stewardship Report Update.* INL/EXT-20-57515. Idaho Falls: Idaho National Laboratories.

INL. (2020d). *E-mail from Lee Nelson (INL) to Doug Outlaw (EIS Manager), providing Baseline Containerized Waste Generation Data from INL Integrated Waste Tracking System reports for* *the Materials and Fuels Complex (MFC) site and INL (site wide) as of January 30, 2020.* Idaho National Laboratory (INL). March 6.

INL. (2020e). *PLN-114, Section 3, Offsite Response, May 31, 2020.* Idaho Falls, ID: Idaho National Laboratory.

INL. (2020f). *ECAR-5162, Evaluation of Pele Microreactor Inhalation Dose Consequences.* Idaho Falls, ID: Idaho National Laboratory. October 5, 2020.

INL. (2021a). *Pele Microreactor Hazards and Impacts Information in Support of National Environmental Policy Act Data Needs.* INL/EXT-21-62873. Idaho National Laboratory.

INL. (2021b). *INL/INT-21-61331 Rev 1, Pre-conceptual Evaluation of Department of Defense Pele Microreactor Sites at Idaho National Laboratory.* Idaho National Laboratory. April.

INL. (2021c). *Sample Preparation Laboratory, Post-irradiation Examination*. Retrieved from Materials and Fuels Complex, INL: https://mfc.inl.gov/SiteAssets/FACILITY_FACT_SHEETS/MFC%20factsheets%20updated%20March%202021/20-50083_SPL_R1.pdf.

INL. (2021d). *ESER Program Publications*. Retrieved from Idaho National Laboratory Environmental Surveillance, Research and Education Program: http://idahoeser.com/Publications.html.

INL. (2021e). *Memo from Lee Nelson to Jordi Roglans-Ribas, "Status of Electrical Power Supply for the Versatile Test Reactor".* Idaho National Laboratory.

INL. (2021f). *Project Pele Waste and Material Data for Environmental Impact Statement (EIS).* TEV-4257. Idaho National Laboratory.

INL. (2021h). *Economic Impact Summary FY 2020.* Report 21-50105-R4. Idaho National Laboratory.

INL. (undated). *Very High Temperature Reactor (VHTR) Factsheet.* Idaho Falls.

IPCC. (2014). *Climate Change 2014: Synthesis Report, Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Intergovernmental Panel on Climate Change (IPCC). Retrieved from www.ipcc.ch/activities/acti.

ITD. (2020). Roadway Data Section, Annual Average Daily Travel Application, AADT 1999 – Present. Idaho Transportation Department. Retrieved from https://iplan.maps.arcgis.com/apps/webappviewer/index.html?id=e8b58a3466e74f249cca6aad30e83ba2.

Jackson, S. M., & Boatwright, J. (1985). The Borah Peak, Idaho Earthquake of October 28, 1983—Strong Ground Motion. *Earthquake Spectra, 2*(1), 51-69. doi:https://doi.org/10.1193/1.1585302.

Kent et al. (2016). Kent, N. A., Arnold, W. M., Sloma, T., & Murphy C. *Developments that are making the Versa-Pac Indeed More Versatile (and More Useful to Industry)," presented in the WM2016 Conference, March 6-10*. Phoenix, Arizona. Retrieved May 21, 2021, from http://archive.wmsym.org/2016/pdfs/16267.pdf.

Kitcher, E. D. (2020). *A White Paper: Disposition Options for a High-Temperature Gas-Cooled Reactor.* Idaho Falls: INL - National Reactor Innovation Center. August 26.

Kuntz et al. (1994). Kuntz, M. A. Skipp, B., Lanphere, M. A., Scott, W. E., Pierce, K. L., Dalrymple, G. B., Champion, D. E., Embree, G. F., Page, W. R., Morgan, L. A., Smith, R. P., Hackett, W. R., & Rodgers D. W. *Geologic Map of the Idaho National Engineering Laboratory and Adjoining Areas, Eastern Idaho*. U.S. Geological Survey.

Lamancusa, J. S. (2009). 10. Outdoor Sound Propogation. In *Noise Control.* Pennsylvania State University.

Mastin et al. (2014). Mastin, L. G., Van Eaton, A. R., & Lowenstern, J. B. Modeling ash fall distribution from a Yellowstone supereruption. *Geochemistry, Geophysics, Geosystems, 15*(8), 3459-3475.

Mattson et al. (2004). Mattson, E. D., Magnuson, S. O., & Ansley, S. L. Interpreting INEEL Vadose Zone Water Movement on the Basis of Large-Scale. *Vadose Zone Journal, 3*(1), 35-46.

Mousseau, T. A., & Møller, A. P. (2020). Plants in the light of ionizing radiation: what have we learned from Chernobyl, Fukushima, and other “hot” places? *Frontiers in Plant Science, 11*, 552.

Napier, B. A. (2011). *GENII Version 2 Users’ Guide.* PNNL-14583, Rev. 3. Prepared by Pacific Northwest National Laboratory for the U.S. Department of Energy.

National Cancer Institute. (2021). *State Cancer Profiles*. (Centers for Disease Control and Prevention) Retrieved May 17, 2021, from National Institute for Health, National Cancer Institute State Cancer Profiles: https://statecancerprofiles.cancer.gov/incidencerates/index.php.

National Center for Education Statistics. (2021). *Institute of Education Services - National Center for Education Statistics*. Retrieved May 21, 2021, from Search for Public School Districts - by state and county (public and private school data): https://nces.ed.gov/ccd/districtsearch/.

National Council on Radiation Protection and Measurements. (1993). *Risk Estimates for Radiation Protection, NCRP Report No. 115, December 31.* Bethesda, Maryland.

NatureServe. (2019). *Pygmy Rabbit (Brachylagus idahoensis)*. Retrieved from NatureServe Explorer: An online encyclopedia of life [web application], Version 7.1: https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.102656/Brachylagus_idahoensis.

NewFields Government Services, LLS. (2020). *Final Public Scoping Report for the Prototype Advanced Mobile Nuclear Microreactor Project Environmental Impact Statement.* Knoxville, TN.

NRC. (1977). *Final Environmental Impact Statement on the Transportation of Radioactive Materials by Air and Other Modes, NUREG 0170 , December.* Washington, D.C.: U.S. Nuclear Regulatory Commission, Office of Standards Development.

NRC. (1987). *Shipping Container Response to Severe Highway and Railway Accident Conditions, NUREG/CR 4829, February.* Washington, D.C.: U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research.

NRC. (1990). *MELCOR Accident Consequence Code System (MACCS), NUREG/CR-4691 Vol. 3, February.* Washington, D.C.: Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, Division of Systems Research.

NRC. (1998). *Code Manual for MACCS2: Volume 1, User’s Guide, NUREG/CR-6613, May.* Washington, D.C.: Nuclear Regulatory Commission, Office of Nuclear Regulatory Research.

NRC. (2000). *Reexamination of Spent Fuel Shipping Risk Estimates, NUREG/CR 6672, March.* Washington, D.C.: U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards.

NRC. (2004). *Environmental Impact Statement for the Proposed Idaho Spent Fuel Facility at the Idaho National Engineering and Environmental Laboratory in Butte County, Idaho, NUREG-1773.* Nuclear Regulatory Commission: Washington, D.C.

NRC. (2005). *Environmental Assessment Related to the Renewal of NRC License No. SNM-42 for BWX Techologies, Inc. (BWXT). Docket No. 70-27.* Nuclear Regulatory Commission, Office of Nuclear

Material Safety and Safeguards, Division of Waste Management and Environmental Protection. August.

NRC. (2006). *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2.* Washington, D.C.: Committee on the Biological Effects of Ionizing Radiation, National Academy Press. National Research Council.

NRC. (2011a). *Final Environmental Assessment for the Proposed Renewal of U.S. Nuclear Regulatory Commission License No. SNM-124 for Nuclear Fuel Services, Inc.* U.S. Nuclear Regulatory Commission.

NRC. (2011b). *Environmental Impact Statement for the Proposed Eagle Rock Enrichment Facility in Bonneville County, Idaho.* U.S. Nuclear Regulatory Commission.

NRC. (2019). *SecPop Version 4: Sector Population, Land Fraction, and Economic Estimation Program User Guide, Model Manual, and Verification Report, NUREG/CR 6525, Rev. 2.* Washington, D.C.: U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research.

NRC. (2020). *Certificate of Compliance for Radioactive Material Packages, Model No.: Versa-Pac in two configurations: VP-55 and VP-110.* USA/9342/AF-96, Rev 15, Docket No. 71-9342. U.S. Nuclear Regulatory Commission. May 26. Retrieved from https://rampac.energy.gov/home/package-certification-information/certificates/nrc.

NWF. (2019). *Sagebrush Steppe | National Wildlife Federation*. Retrieved from National Wildlife Federation: https://www.nwf.org/Educational-Resources/Wildlife-Guide/Threats-to-Wildlife/Climate-Change/Habitats/Sagebrush-Steppe.

PACE Partners. (2018). *Stormwater BMPs: Concrete Pouring & Finishing*. Retrieved June 29, 2021, from PACE (Partners for a Clean Environment) Partners: https://www.pacepartners.com/wp-content/uploads/2018/06/concrete-pouring-and-finishing-bmps.pdf.

Payne, S. (2006). *Modeling of the Sedimentary Interbedded Basalt Stratigraphy for the Idaho National Laboratory Probabilistic Seismic Hazard Analysis.* Idaho Falls.

Peterson, S. (2018). *WebTRAGIS: Transportation Routing Analysis Geographic Information System User's Manual, ORNL/TM-2018/856, May.* Oak Ridge, Tennessee: Oak Ridge National Laboratory.

Ritchie, H., & Roser, M. (2018). *Ozone Layer*. Retrieved from Our World in Data: https://ourworldindata.org/ozone-layer.

Rodgers et al. (2002). Rodgers, D. W., Ore, H. T., Bobo, R. T., McQuarrie, N., Zentner, N., Bonnichsen, B., White, C. M., & McCurry, M. Extension and Subsidence of the Eastern Snake River Plain, Idaho. *Tectonic and Magmatic Evolution of the Snake River Plain Volcanic Province, 30*, 121-155.

Rood, A., & Sondrup, A. (2014). *Development and Demonstration of a Methodology to Quantitatively Assess the INL Site Ambient Air Monitoring Network.* Idaho Falls.

Saricks, C., & Tompkins, M. M. (1999). State Level Accident Rates for Surface Freight Transportation: A Reexamination, ANL/ESD/TM 150, April. Argonne, Illinois: Argonne National Laboratory, Energy Systems Division, Center for Transportation Research.

Spaling, H. (1994). Cumulative Effects Assessment: Concepts and Principles. *Impact Assessment, 12:3*, 231-251.

Stacy, S. M. (2000). *Proving the Principle: A History of the Idaho National Engineering and Environmental Laboratory, 1949-1999.* Idaho Falls, ID: U.S. Department of Energy, Idaho Field Office, DOE/ID-10799.

UMTRI. (2003). *Evaluation of the Motor Carrier Management Information System Crash File, Phase One, UMTRI-2003-6.* University of Michigan Transportation Research Institute, Center for National Truck Statistics.

USACE. (1987). *Corps of Engineers wetland delineation manual.* Technical Report Y-87-1. U.S. Army Corps of Engineers, Waterways Experiment Station, Environmental Laboratory, Vicksburg, MS.

USCB. (2019). *QuickFacts Population Estimates - multiple locations.* U.S. Census Bureau.

USCB. (2021a). *Population Estimates, July 1, 2019 (for select Idaho Counties and Cities).* U.S. Census Bureau.

USCB. (2021b). *American Community Survey - Data Profiles 2019.* U.S. Census Bureau.

USCB. (2021c). *Table B03002: Hispanic or Latino Origin By Race 2015-2019 American Community Survey 5-year Estimates*. Retrieved May 19, 2021, from U.S. Census Bureau: https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

USCB. (2021d). *Table C17002: Ratio of Income to Poverty Level in the Past 12 Months 2015-2019 American Community Survey 5-year Estimates.* Retrieved May 19, 2021, from U.S. Census Bureau Fact Finder: https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

USDA. (2019). *2017 Census of Agriculture.* U.S. Department of Agriculture.

USDOI. (2021). *Letter from Joyce Stanley, Regional Environmental Officer, USDOI to James Lovejoy, Document Manager, U.S. Department of Energy, RE: Comments and Recommendations on the Department of Energy VTR DEIS.* U.S. Department of Interior.

USFWS. (2008). *Birds of Conservation Concern.* Arlington, Virginia: Division of Migratory Bird Management.

USFWS. (2021a). *Wetlands Mapper*. Retrieved May 17, 2021, from U.S. Fish and Wildlife Service: https://www.fws.gov/wetlands/Data/Mapper.html.

USFWS. (2021b). *Information for Planning and Consultation (IPaC) Resource List*. Retrieved from U.S. Fish and Wildlife Service: https://ecos.fws.gov/ipac/. May 18.

USGCRP. (2018). *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Vol. II.* Washington, D.C.: U.S. Global Change Research Program. Retrieved from https://nca2018.globalchange.gov/.

Valentin, J. (2007). *The 2007 Recommendations of the International Commission on Radiological Protection ICRP Publication 103.* Elsevier Ltd.

Veolia. (2020). *PELE: Ecological Summary Data and Field Surveys Report (VFS-ID-ESER-LAND-086).* Idaho Falls: Veolia Nuclear Solutions – Federal Services.

VNSFS. (2020). *Ecological Field Surveys: Vegetation and Wildlife, Supplemental Report, Proposed Versatile Test Reactor Project Site.* Idaho Falls, Idaho.

Weiner et al. (2013). Weiner, R. F., D. Hinojosa, T. J. Heames, C. Ottinger Farnum, and E. A. Kalinina. *RADTRAN 6/RadCat 6 User Guide, Accession No. ML14286A092, SAND2013–8095*. Albuquerque, New Mexico: Sandia National Laboratories.

Weiner et al. (2014). Weiner, R. F., K. S. Neuhauser, T. J. Heames, B. M. O'Donnell, and M. L. Dennis. *RADTRAN 6 Technical Manual, SAND2013-0780, Accession No. ML14286A085*. Albuquerque, New Mexico: Sandia National Laboratories.

Whitehead, R. L. (1994). *Ground Water Atlas of the United States. Idaho, Oregon, Washington.* HA 730-H. U.S. Geological Survey.

Yuan et al. (1995). Yuan, Y. C., S. Y. Chen, B. M. Biwer, and D. J. LePoire. *RISKIND A Computer Program for Calculating Radiological Consequences and Health Risks from Transportation of Spent Nuclear Fuel, ANL/EAD 1, November*. Argonne, Illinois: Argonne National Laboratory.

Chapter 9
Glossary

This page left blank intentionally.

9 GLOSSARY

***air pollutant* —** Generally, an airborne substance that could, in high enough concentrations, harm living things or cause damage to materials. From a regulatory perspective, an air pollutant is a substance for which emissions or atmospheric concentrations are regulated, or for which maximum guideline levels have been established because of potential harmful effects on human health and welfare.

***air quality* —** The cleanliness of the air as measured by the levels of pollutants relative to standards or guideline levels established to protect human health and welfare. Air quality is often expressed in terms of the pollutant for which concentrations are the highest percentage of a standard (e.g., air quality may be unacceptable if the level of a single pollutant exceeds its standard, even if levels of other pollutants are well below their respective standards).

***alpha particle* —** Alpha particles consist of two protons and two neutrons. They can travel only a few centimeters in air and can be stopped easily by a sheet of paper or by the skin's surface. (See *neutron*.)

***ambient air quality standards* —** Regulations prescribing the levels of airborne pollutants that may not be exceeded during a specified time within a defined area.

***aquifer* —** A body of rock that is sufficiently porous and permeable (i.e., contains spaces between the rock and soil particles that permit water to move through) to store, transmit, and yield significant quantities of groundwater to wells and springs.

***archaeological resources* —** Resources that occur in places where people altered the ground surface or left artifacts or other physical remains (e.g., arrowheads, glass bottles, pottery). Archaeological resources can be classified as either sites or isolates. Isolates generally cover a small area and often contain only one or two artifacts, while sites are usually larger in size, contain more artifacts, and sometimes contain features or structures. Archaeological resources can date to either the pre-contact, ethnographic, or post-contact eras.

***architectural resources* —** Standing buildings, facilities, wells, canals, bridges, and other such structures.

***area of potential effects (APE)* —** The geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist.

***at-power testing* —** Tests performed to verify reactor/power conversion system operating performance when generating electrical power, often at the system's rated electrical power level (full power).

***attainment area* —** An area that the U.S. Environmental Protection Agency has designated as meeting (i.e., being in attainment of) the National Ambient Air Quality Standards for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter.

***average daily traffic* —** The average number of vehicles passing a specific point in both directions in a 24-hour period, normally measured throughout a year.

***average individual* —** A member of the public who receives the average dose as determined by dividing the off-site population dose by the number of people in the population.

***background man-made radiation* —** Man-made sources include medical and dental x-rays, household smoke detectors, and materials released from nuclear and coal-fired power plants.

***background natural radiation* —** Globally, humans are exposed constantly to radiation from the solar system and the Earth's rocks and soil. This natural radiation contributes to the natural background radiation that always surrounds us.

balance of plant – All of the supporting equipment and systems needed to convert the thermal energy of a power plant into electrical power.

bedrock — Solid rock underlying loose deposits, such as soil or alluvium.

beta particle — Beta particles are smaller and lighter than alpha particles and have the mass of a single electron. A high-energy beta particle can travel a few meters in air. Beta particles can pass through a sheet of paper but may be stopped by a thin sheet of aluminum or glass. (See *alpha particle*.)

blowdown — Depressurization of the mobile microreactor to equalize the pressure vessel to atmospheric pressures.

Brayton cycle — Thermodynamic cycle used to describe the workings of a constant-pressure heat engine. The main characteristic of a Brayton cycle is that the fluid being used to generate power always remains a gas. The Brayton cycle power conversion system operates by adding heat to a gas and then running a turbine generator with the heated gas. Exhaust from the turbine is a hot gas that can be reheated and input to the turbine again, but in the case of this microreactor is simply exhausted to the atmosphere. The Brayton cycle is the principle upon which jet turbine engines operate.

cancer fatality — A death resulting from cancer; also referred to as cancer mortality.

cancer incidence — The occurrence of a cancer; also referred to as cancer morbidity.

CO_2 equivalent (CO_2e) — To simplify greenhouse (GHG) analyses, total GHG emissions from a source are often expressed as a carbon dioxide (CO_2) equivalent (CO_2e), which is calculated by multiplying the emissions of each GHG by its global warming potential (GWP) and adding the results together to produce a single, combined emission rate representing all GHGs. While methane and nitrous oxide have much higher GWPs than CO_2, CO_2 is emitted in such greater quantities that it is the overwhelming contributor to global CO_2e emissions from both natural processes and human activities. (See *global warming potential*.)

collective dose — The sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation. In this document, collective dose is expressed in units of person-rem.

concentration — The quantity of a substance in a unit quantity (e.g., milligrams per liter or micrograms per kilogram).

Council on Environmental Quality regulations — Regulations found in Title 10, Code of Federal Regulations, Parts 1500–1508, that direct Federal agencies in complying with the procedures of and achieving the goals of the National Environmental Policy Act.

core — The central portion of a nuclear reactor. The active core is where nuclear fission occurs.

criteria pollutants — An air pollutant that is regulated by the National Ambient Air Quality Standards. The U.S. Environmental Protection Agency must describe the characteristics and potential health and welfare effects that form the basis for setting, or revising, the standard for each regulated pollutant. Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter (less than 10 microns [0.0004 inches] in diameter and less than 2.5 microns [0.0001 inches] in diameter). New pollutants may be added to or removed from the list of criteria pollutants as more information becomes available.

criticality — The normal operating condition of a reactor, in which nuclear fuel sustains a fission chain reaction. A reactor achieves criticality (and is said to be critical) when each fission event releases a sufficient number of neutrons to sustain an ongoing series of reactions.

cultural resources — A pre-contact or historic district, site, building, structure, or object considered to be important to a culture, subculture, or community for scientific, traditional, religious, or other reasons. Cultural resources are usually divided into three major categories: pre-contact and historic archaeological resources, architectural resources, and traditional cultural resources.

cumulative impacts — Impacts on the environment that result when the incremental impact of a proposed action is added to the impacts from other past, present, and reasonably foreseeable future actions, regardless of which agency (Federal or non-Federal) or person undertakes the other actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time (Title 40, Code of Federal Regulations*,* Section 1508.7).

curie — The basis unit used to describe the intensity of radioactivity in a sample of material; it is equal to 37 billion disintegrations per second. One trillionth of a curie is a picocurie. (See *radioactivity*.)

decibel — A unit used to measure the intensity of a sound or the power level of an electrical signal by comparing it with a given level on a logarithmic scale (in general use, a degree of loudness).

decibels A-weighted (dBA) — A-weighted decibels are an expression of the relative loudness of sounds in air as perceived by the human ear. In the A-weighted system, the decibel values of sounds at low frequencies are reduced; no correction is made for audio frequency when unweighted decibels are used. The correction is made using dBA because the human ear is less sensitive to low audio frequencies, especially those below 1,000 hertz, than high audio frequencies.

decommissioning — Removing facilities such as processing plants, waste tanks, and burial grounds from service and reducing or stabilizing radioactive contamination. Includes the following concepts: decontamination, dismantling, and return of an area to its original condition without restrictions on use or occupancy; partial decontamination; isolation of remaining residues; and continued surveillance and restrictions on use or occupancy.

decontamination — The actions taken to reduce or remove substances that pose a substantial present or potential hazard to human health or the environment, such as radioactive or chemical contamination from facilities, equipment, or soils by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques.

depleted uranium — A byproduct of the uranium enrichment process and refers to uranium in which the percentage of uranium-235 is less than occurs naturally (0.7 percent).

disposal — As used in this document, the term is used for emplacing waste in a manner that ensures its isolation from the biosphere, with no intent of retrieval; as such, deliberate action would be required to gain access after emplacement.

disposal facility — A natural and/or man-made structure in which waste is disposed. (See *disposal*.)

dose (radiation) — As used in this document, it means total effective dose, a term referring to the amount of energy absorbed by a tissue or organ adjusted by a radiation weighting factor, a tissue weighting factor, and other factors that allows radiation of different types received through different modes of exposure to be compared on a common basis.

emission — A material discharged into the atmosphere from a source operation or activity.

enriched uranium — Uranium in which the concentration of the isotope uranium-235, usually expressed as a percentage, exceeds the concentration occurring in natural uranium (0.7 percent). Low-enriched uranium (LEU), highly enriched uranium (HEU) and high assay, low-enriched uranium (HALEU) are all enriched forms of uranium.

environmental assessment (EA) — A concise public document prepared pursuant to the National Environmental Policy Act that provides sufficient evidence and analysis for determining whether a Federal agency should issue a Finding of No Significant Impact or prepare an environmental impact statement.

environmental impact statement (EIS) — A detailed written statement required by Section 102(2)(C) of the National Environmental Policy Act (NEPA) for a proposed major Federal action significantly affecting the quality of the human environment. A U.S. Department of Energy (DOE) EIS is prepared in accordance with applicable requirements of the Council on Environmental Quality NEPA regulations in Title 40, Code of Federal Regulations, Parts 1500–1508 (40 CFR 1500–1508) and the DOE NEPA regulations in 10 CFR 1021. The statement includes, among other information, discussions of the environmental impacts of the proposed action and all reasonable alternatives; adverse environmental effects that cannot be avoided should the proposal be implemented; the relationship between short-term uses of the human environment and enhancement of long-term productivity; and any irreversible and irretrievable commitments of resources.

environmental justice — The fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, state, local, and tribal programs and policies. Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,* directs Federal agencies to make achieving environmental justice part of their missions by identifying and addressing disproportionately high and adverse effects of agency programs, policies, and activities on minority and low-income populations.

ethnographic — Refers to time periods during which specific cultures existed and related information can be systematically studied and recorded. Formal study of Native American culture in the United States is considered to have begun in the late 1800s.

exposure — Being exposed to a radioactive or chemical material.

fault — Linear geologic structures along which movement of rocks has taken place. Movement, or displacement, along the fault can be a few feet or hundreds of feet.

Finding of No Significant Impact (FONSI) — A public document issued by a Federal agency that briefly presents the reasons why an action for which the agency has prepared an environmental assessment has no potential to have a significant effect on the human environment and, thus, does not require preparation of an environmental impact statement. (See *environmental assessment* and *environmental impact statement*.)

fission — A reaction during which a neutron impacts an atom, causing it to split into two smaller atoms. A tremendous amount of energy is released as each atom splits. This energy can be harnessed to produce electricity.

fresh fuel handling — Handling fuel that has not been used for operating the microreactor.

fuel (nuclear) – Fissionable material that will support a self-sustaining fission reaction when used to power a nuclear reactor, thereby producing energy.

gamma radiation — Gamma rays (and x-rays), unlike alpha or beta particles, are waves of pure energy. Gamma radiation is very penetrating and can travel several hundred feet in air. Gamma radiation requires a thick wall of concrete, lead, or steel to stop it. (See *alpha particle* and *beta particle*.)

global warming potential (GWP) — The ability of a gas or aerosol to trap heat in the atmosphere. The GWP rating system is standardized to carbon dioxide, which has a value of one. For example, methane has a GWP of 28, which means that it has a global warming effect 28 times greater than carbon dioxide on an equal-mass basis. (See *carbon dioxide equivalent*.)

glovebox — A sealed enclosure with gloves that allows an operator to manipulate materials and perform other tasks while keeping the enclosed material contained. Normally constructed of stainless steel with large acrylic/lead glass windows. In some cases, remote manipulators may be installed in place of gloves. The gloves, glass and siding material of the glovebox are designed to protect workers from radiation contamination and exposure.

greater-than-class C (GTCC) (low-level radioactive) waste — A type of low-level radioactive waste with concentrations of radionuclides that exceed the limits established in 10 CFR 61.55 for Class C low-level radioactive waste.

greenhouse gases (GHGs) — Gases that trap heat in the atmosphere by absorbing infrared radiation.

groundwater — Water below the ground surface in a zone of saturation.

half-life (radiological) — The time in which one-half of the atoms of a particular radionuclide disintegrate into another nuclear form. Half-lives for specific radionuclides vary from millionths of a second to billions of years.

haul road — Road designed for heavy or bulk transfer of materials by haul trucks.

hazardous air pollutants (HAPs) — Air pollutants that are not covered by the National Ambient Air Quality Standards, but may present a threat of adverse human health or environmental effects. Those specifically listed in Title 40, Code of Federal Regulations, Section 61.01 are asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. More broadly, hazardous air pollutants are any of the 189 pollutants listed in or pursuant to Section 112(b) of the Clean Air Act. Very generally, hazardous air pollutants are any air pollutants that may realistically be expected to pose a threat to human health or welfare.

hazardous waste — Waste that is defined as hazardous waste under the Resource Conservation and Recovery Act (Title 42, United States Code, Section 6901 et seq.) or state statute or regulation. State regulations may define a larger spectrum of materials as hazardous waste than Federal regulations.

high assay, low-enriched uranium (HALEU) — Uranium in which the concentration of the isotope uranium-235 has been increased to over 5 percent, but less than 20 percent.

historic properties — Any pre-contact or post-contact districts, sites, buildings, structures, or objects included in, or eligible for inclusion in, the *National Register of Historic Places* (Title 36, Code of Federal Regulations, Sections 800.16(l)(1) and (2)).

hot cell — A shielded structure that requires the use of remote manipulators for handling hazardous or radioactive materials.

INL and INL Site — When used alone in this EIS, the term *INL* refers to Idaho National Laboratory as a management entity. The term *INL Site* refers to the DOE Idaho Site location, which is the physical location where the Proposed Action would take place.

involved worker — A worker directly or indirectly involved with Project Pele operations at either the INL MFC or CITRC who may receive an occupational radiation exposure from direct radiation (i.e., neutron, x-ray, beta, or gamma) or from radionuclides released to the environment from normal operations.

isotope — Any of two or more variations of an element in which the nuclei have the same number of protons (i.e., the same atomic number) but different numbers of neutrons so that their atomic masses differ. Isotopes of a single element possess almost identical chemical properties, but often different physical and nuclear properties (e.g., carbon-12 and -13 are stable, but carbon-14 is radioactive).

latent cancer fatality (LCF) — Deaths from cancer resulting from and occurring sometime after exposure to ionizing radiation or other carcinogens. As reported in this EIS, these are cancer fatalities beyond what would be expected to occur in the population absent the radiation exposure.

latent cancer fatality risk (LCF risk) — Represents the probability of the occurrence of a latent cancer fatality for an individual or a population group from exposure to ionizing radiation or other carcinogens when the number of latent cancer fatalities is less than one.

level of service (LOS) — A qualitative measurement of operational conditions affecting the traffic on a roadway based on factors such as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety.

load bank — A device that develops an electrical load, applies the load to an electrical power source and converts or dissipates the resultant power output of the source; intended to accurately mimic the operational or "real" load that a power source will see in actual application.

low enriched uranium (LEU) — Uranium in which the concentration of the isotope uranium-235 has been increased above what occurs in nature (0.7 percent), but is below 20 percent.

low-level radioactive waste (LLW) — Radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or the tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material. Test specimens of fissionable material that are irradiated for research and development only, not for the production of power or plutonium, may be classified as low-level radioactive waste, provided the transuranic concentrations are less than 100 nanocuries per gram of waste (DOE Order 435.1, *Radioactive Waste Management* (Change 1, 08/28/01)).

maximally exposed individual (MEI) — A hypothetical member of the public who—because of realistically assumed proximity, activities and living habits—would receive the highest radiation dose, taking into account all pathways, for a given event, process, or facility (DOE Order 458.1, *Radiation Protection of the Public and the Environment*) (DOE, 2020b). For purposes of this document, this individual is assumed to be at the INL Site boundary during normal operations.

maximum contaminant level (MCL) — Standards that are set by the U.S. Environmental Protection Agency for drinking water quality. An MCL is the legal threshold limit on the amount of a substance that is allowed in public water systems under the Safe Drinking Water Act.

millirem — One-thousandth of a roentgen equivalent man (rem) (see *roentgen equivalent man*).

mitigation — Includes: (1) avoiding an impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of an action and its implementation; (3) rectifying an impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of an action; or (5) compensating for an impact by replacing or providing substitute resources or environments.

mixed low-level radioactive waste (MLLW) — Low-level radioactive waste that also contains hazardous components regulated under the Resource Conservation and Recovery Act (RCRA) (Title 42, United States Code, Section 6901 et seq.) or state statute or regulation. State regulations may define a larger spectrum of materials as hazardous waste than Federal RCRA regulations.

mobile microreactor — A nuclear reactor with three main features:

1) Factory fabricated: all components would be fully assembled in a factor and shipped to a location.

2) Transportable: vendors able to ship the reactor by truck, shipping vessels, airplane, or railcar.

3) Self-adjusting: do not require a large number of specialized operators, and would use passive safety systems that prevent any potential for overheating or reactor meltdown.

National Pollutant Discharge Elimination System (NPDES) — A provision of the Clean Water Act that prohibits discharge of pollutants into waters of the United States unless a special permit is issued by the U.S. Environmental Protection Agency, a state, or, where delegated, a tribal government. An NPDES permit typically includes effluent limitations based on applicable technology and water quality standards, as well as monitoring and reporting requirements, and may include other provisions such as special studies or compliance schedules.

negative reactivity – As power increases, the rate of neutron generation slows, indicating a move toward a power decrease, thus limiting the power increase.

neutron — A subatomic particle with a mass similar to that of a proton and with no electric charge. Because it has no electric charge it can travel longer distances than alpha and beta particles without interacting with matter. A neutron is most effectively stopped by materials with high hydrogen content, such as water or plastic. (See *alpha particle* and *beta particle*.)

nonattainment area — An area that the U.S. Environmental Protection Agency has designated as not meeting (i.e., not being in attainment of) one or more of the National Ambient Air Quality Standards for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants, but not for others.

nonhazardous waste — Discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations or from community activities. This category does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act (Title 42, United States Code, Section 2011 et seq.)

non-involved worker — A worker at the INL Site not involved in mobile microreactor demonstration activities who would not be subject to direct radiation exposure but could be incidentally exposed to radiological emissions from the mobile microreactor.

Notice of Intent (NOI) — A notice published in the Federal Register that an environmental impact statement (EIS) will be prepared and considered. The NOI is intended to briefly describe the proposed action and possible alternatives; describe the agency's proposed scoping process, including whether, when, and where any scoping meeting(s) will be held; and state the name and address of a person within the agency who can answer questions about the proposed action and the EIS.

nuclear reactor — An apparatus, other than an atomic weapon, designed or used to sustain nuclear fission (dividing or splitting atoms into two or more parts) in a self-supporting chain reaction.

off-link — A term used in radioactive transportation analyses to describe populations living within 0.50 mile of a shipment route.

off-site — Denotes a location, facility, or activity occurring outside of the boundary of a U.S. Department of Energy complex site.

off-site population — Comprises members of the general public who live within 50 miles (80 kilometers) of the mobile microreactor.

on-link — A term used in radioactive transportation analyses to describe pedestrians and car occupants sharing the shipment route.

on-site — Denotes a location or activity occurring within the boundary of a U.S. Department of Energy complex site.

particulate matter (PM) — Any finely divided solid or liquid material, other than uncombined (i.e., pure) water. A subscript denotes the upper limit of the diameter of particles included. Thus, PM_{10} includes only those particles equal to or less than 10 microns (0.0004 inches) in diameter; $PM_{2.5}$ includes only those particles equal to or less than 2.5 microns (0.0001 inches) in diameter.

permeability — A measure of a rock's ability to transmit fluid (in this case water); also, the rate at which the fluid can move a given distance over a given interval of time.

person-rem — A unit of collective radiation dose applied to a population or group of individuals. It is the sum of the estimated doses, in rem, received by each individual of a specified population. For example, if 1,000 people each received a dose of 0.001 rem (1 millirem), the collective dose would be 1 person-rem (1,000 persons × 0.001 rem) (see *roentgen equivalent man* and *millirem*).

population dose — See *collective dose*.

power conversion system – As used in this document, a system (set of components/equipment) that converts the thermal energy of the mobile microreactor to electrical energy.

radiation (ionizing) — Particles (alpha, beta, neutrons, and other subatomic particles) or photons (i.e., gamma, x-rays) emitted from the nucleus of unstable atoms as a result of radioactive decay. Such radiation is capable of displacing electrons from atoms or molecules in the target material (such as biological tissues), thereby producing ions.

radiation effects — Radiation can cause a variety of adverse health effects in humans. Health impacts of radiation exposure, whether from external or internal sources, generally are identified as somatic (i.e., affecting the exposed individual) or genetic (i.e., affecting descendants of the exposed individual). Radiation is more likely to produce somatic than genetic effects. The somatic risks of most importance are induced cancers. Both the U.S. Environmental Protection Agency and Centers for Disease Control and Prevention identify cancer as the primary long-term health affect associated with radiation exposure. Because fatal cancer is the most serious effect of environmental and occupational radiation exposures, estimates of cancer fatalities, rather than cancer incidence, are presented as a measure of impact in this document. These estimates are referred to as "latent cancer fatalities," because the cancer may take many years to develop.

radiation exposure — The average individual in the United States annually receives about 625 millirem of radiation dose from all background sources, of which about half is received from natural sources such as cosmic and terrestrial radiation and radon-220 and -222 in homes (National Council on Radiation Protection and Measurements, 1993).

radioactive decay — The spontaneous transformation of one radionuclide into a different nuclide or into a different energy state of the same radionuclide. The process results in a decrease, with time, of the number of the radioactive atoms in a sample. Decay generally involves the emission from the nucleus of alpha particles, beta particles, or gamma rays. (See *half-life*.)

radioactive waste — Solid, liquid, or gaseous material that contains radionuclides regulated under the Atomic Energy Act of 1954, as amended, that is of negligible economic value considering the costs of recovery.

radioactivity —

Defined as a process: The spontaneous transformation of unstable atomic nuclei, usually accompanied by the emission of ionizing radiation.

Defined as a property: The property of unstable nuclei in certain atoms to spontaneously emit ionizing radiation during nuclear transformations.

radioisotope or radionuclide — An unstable isotope that undergoes spontaneous transformation, emitting radiation. (See *isotope*.)

Record of Decision (ROD) — A concise public document that records a Federal agency's decision(s) concerning a proposed action for which the agency has prepared an environmental impact statement. The ROD is prepared in accordance with the requirements of the Council on Environmental Quality National Environmental Policy Act regulations (Title 40, Code of Federal Regulations, Section 1505.2). A ROD identifies the alternatives considered in reaching the decision, the environmentally preferable alternative(s), factors balanced by the agency in making the decision, whether all practicable means to avoid or minimize environmental harm have been adopted, and if not, why they were not. (See *environmental impact statement*.)

region of influence (ROI) — A site-specific geographic area in which the principal direct and indirect effects of actions are likely to occur and are expected to be of consequence for local jurisdictions.

rem — See *roentgen equivalent man*.

remediation — The process, or a phase in the process, of rendering land or water containing radioactive or hazardous constituents, or both, environmentally safe, whether through removal, processing, entombment, or other methods.

risk — The probability of a detrimental effect from exposure to a hazard. To describe impacts, risk is often expressed quantitatively as the probability of an adverse event occurring, multiplied by the consequence of that event (i.e., the product of these two factors). A separate presentation of probability and consequence to describe impacts is often informative.

roentgen — A unit of exposure to ionizing radiation equal to the amount of gamma or x-rays that produces one electrostatic unit charge in a cubic centimeter of air. (See *gamma radiation.*)

roentgen equivalent man (rem) — A unit of radiation dose used to measure the biological effects of different types of radiation on humans. The dose in rem is estimated by a formula that accounts for the type of radiation, the total absorbed dose, and the tissues involved. One thousandth of a rem is a millirem. (See *millirem*.)

sacred sites — Well-known areas that are associated with the cultural practices or beliefs of a living community.

safety — As used in this document, protecting workers, the public, and the environment from the effects of radiation and other hazards.

scientific notation — A way of presenting numbers that are very large or very small when written in decimal form, where the number is presented as a number between 1 and 10 multiplied by a power of 10. As an example, 2×10^{-2} in scientific notation is equal to the real number 0.02. That is, the number 2 is multiplied by "10 to the power of negative 2," and so the 2 is moved two places to the right of the decimal point (0.02). If the number is 2×10^{2} (2 multiplied by 10 to the power of 2), then the real number is 20. This approach is useful for very large or small numbers, such as one billionth (0.000000001) (i.e., 1×10^{-9}).

scope — In a document prepared pursuant to the National Environmental Policy Act, the range of actions, alternatives, and impacts to be considered.

scoping — An early and open process for determining the scope of issues and alternatives to be addressed in an environmental impact statement (EIS) (or other National Environmental Policy Act [NEPA] document) and for identifying the significant issues related to a proposed action. The scoping period begins after publication in the Federal Register of a Notice of Intent to prepare an EIS (or other NEPA document). The public scoping process is that portion of the process where the public is invited to participate.

soils — All unconsolidated materials above bedrock. Also, natural earthy materials on the Earth's surface, in places modified or even made by human activity, that contain living matter and support or are capable of supporting plants out of doors.

spent nuclear fuel (SNF) — Fuel that has been removed from a reactor after being used to produce electricity. This fuel becomes very hot and radioactive as it is used in the reactor core. After the fuel is no longer useful, it is removed and transferred underwater to a pool for storage. While in storage, the fuel cools as the radioactivity decays. In time, the spent fuel may be moved to dry storage casks.

thermal neutrons — Neutrons that are less energetic than fast neutrons (generally, less than 1 electron volt and travelling at speeds of less than 5 kilometers per second), having been slowed by collisions with other materials such as water. The thermal neutron spectrum refers to the range of energies associated with thermal neutrons.

tristructural isotropic (TRISO) fuel — Encapsulated fuel type that has been demonstrated to be capable of withstanding temperatures up to 1,800 °C. Each TRISO particle is made up of a uranium oxycarbide (a mixture of uranium dioxide and uranium carbide) fuel kernel encapsulated by three layers of carbon- and ceramic-based (silicon carbide) material. Each particle acts as its own containment system because of its triple-coated layers. This allows them to retain fission products. The particles are incredibly small (about the size of a poppy seed) and very robust. TRISO fuels are structurally more resistant to neutron irradiation, corrosion, oxidation, and high temperatures (the factors that most impact fuel performance) than traditional reactor fuels. The TRISO particles can be fabricated into cylindrical pellets or billiard ball-sized spheres called "pebbles" for use in high-temperature gas-cooled reactors.

tritium — A beta-particle-emitting radioactive isotope of hydrogen whose nucleus contains one proton and two neutrons. Because it is chemically identical to natural hydrogen, tritium can easily be taken into the body by any ingestion pathway. (See *neutron*.)

Transuranic waste (TRU) — Waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for (a) high-level radioactive waste; (b) waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the U.S. Environmental Protection Agency, does not need the degree of isolation required by the disposal regulations; or (c) waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 Code of Federal Regulations 61.

very small modular reactors — A modular nuclear fission reactor with an output of less than 10 megawatts of electric power. The components of a modular reactor can be manufactured off-site then brought to an installation site for assembly.

viewshed — The extent of the area that may be viewed from a particular location. Viewsheds are generally bounded by topographic features such as hills or mountains.

volatile organic compounds — Organic chemicals that have a high vapor pressure at ordinary room temperature. Their high vapor pressure results from a low boiling point, which causes large numbers of molecules to evaporate or sublimate from the liquid or solid form of the compound and enter the surrounding air.

wetland — An area that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Chapter 10
List of Preparers

This page left blank intentionally.

10 LIST OF PREPARERS

This chapter identifies organizations and individuals who contributed to the overall effort of producing this EIS.

JEFF WAKSMAN, U.S. DEPARTMENT OF DEFENSE, STRATEGIC CAPABILITIES OFFICE
EIS RESPONSIBILITIES: *PROGRAM MANAGER (SCO)*

JOHN MENDENHALL, U.S. DEPARTMENT OF DEFENSE, STRATEGIC CAPABILITIES OFFICE
EIS RESPONSIBILITIES: *NEPA LEAD (SCO)*

EMBER KORVER, U.S. ARMY CORPS OF ENGINEERS
EIS RESPONSIBILITIES: *PROJECT MANAGER/CONTRACTING OFFICER'S TECHNICAL REPRESENTATIVE (USACE)*

MELISSA LESLIE, U.S. ARMY CORPS OF ENGINEERS
EIS RESPONSIBILITIES: *TECHNICAL LEAD (USACE)*

ARLENE WIENER, U.S. ARMY CORPS OF ENGINEERS
EIS RESPONSIBILITIES: *PROGRAM MANAGER (USACE)*

JASON ANDERSON, U.S. DEPARTMENT OF ENERGY, IDAHO OPERATIONS OFFICE
EIS RESPONSIBILITIES: *NEPA LEAD (DOE-ID)*

GORDON MCCLELLAN, U.S. DEPARTMENT OF ENERGY, IDAHO OPERATIONS OFFICE
EIS RESPONSIBILITIES: *USACE – DOE CONTRACT LIAISON*

GARRETT KROPP, U.S. DEPARTMENT OF ENERGY, IDAHO OPERATIONS OFFICE
EIS RESPONSIBILITIES: *SUPERVISOR (DOE-ID)*

JAMES LOVEJOY, U.S. DEPARTMENT OF ENERGY, IDAHO OPERATIONS OFFICE
EIS RESPONSIBILITIES: *PROGRAM MANAGER (DOE-ID)*

JUSTIN COLEMAN, IDAHO NATIONAL LABORATORY
EIS RESPONSIBILITIES: *SENIOR TECHNICAL ADVISOR (INL)*

JENIFER NORDSTROM, IDAHO NATIONAL LABORATORY
EIS RESPONSIBILITIES: *NEPA LEAD (INL)*

JASON ANDRUS, IDAHO NATIONAL LABORATORY
EIS RESPONSIBILITIES: *NUCLEAR SAFETY (INL)*

LEE NELSON, IDAHO NATIONAL LABORATORY
EIS RESPONSIBILITIES: *TECHNICAL DOCUMENT SUPPORT (INL)*

BRAYDON WILLIAMS, IDAHO NATIONAL LABORATORY
EIS RESPONSIBILITIES: *TECHNICAL DOCUMENT SUPPORT (INL)*

DOUGLAS A. OUTLAW, LEIDOS
EIS RESPONSIBILITIES: EIS MANAGER

Education: Ph.D., Nuclear Physics, North Carolina State University
M.S., Nuclear Physics, North Carolina State University
B.S., Nuclear Physics, North Carolina State University

Experience/Technical Specialty:
Forty-three years. Nuclear physics, safety analysis, and risk assessment.

ERNEST HARR, LEIDOS
EIS RESPONSIBILITIES: DEPUTY EIS MANAGER

Education: B.S., Zoology, University of Maryland

Experience/Technical Specialty:
Forty years. NEPA analysis; radiological analyses – normal operation, accidents and intentionally destructive acts; human health and safety – worker and public; radioactive and mixed waste management; transportation – radiological and nonradiological; remediation; decontamination and decommissioning; and regulatory and compliance analyses.

FREDERICK CAREY, P. E., POTOMAC-HUDSON ENGINEERING, INC.
EIS RESPONSIBILITIES: TECHNICAL REVIEW

Education: M.S., Environmental Engineering, Johns Hopkins University
B.S., Civil Engineering, University of Maryland

Experience/Technical Specialty:
Thirty years. NEPA project management and technical review of critical environmental and human health issues related to various types of federal actions.

BRAD BOYKIN, LEIDOS
EIS RESPONSIBILITIES: AIR QUALITY TECHNICAL REVIEW

Education: Master of Biotechnology, Texas A&M University
B.S., Biomedical Science, Texas A&M University

Experience/Technical Specialty:
Fifteen years. Development of criteria pollutant and greenhouse gas emissions inventories, air dispersion modeling, air permitting support, NEPA analyses, determination of project compliance with air pollution standards and regulations, including General Conformity Regulation.

JENNIFER COMBS, LEIDOS
EIS RESPONSIBILITIES: COPYEDITOR

Education: B.S., Communications, Journalism, University of Tennessee
Certificate, Advanced Substantive Editing Class, EEI Communications
Certificate, Scientific Editing Class, EEI Communications

Experience/Technical Specialty:
Thirty years. Technical editing, environmental studies associated with state and federal requirements.

Chris Crabtree, Leidos
EIS Responsibilities: Air Quality

Education: B.A., Environmental Studies, University of California Santa Barbara

Experience/Technical Specialty:
Thirty years. Source emission quantifications, dispersion modeling, health risk assessments, greenhouse gas and climate change analyses, mitigation evaluations, determination of project compliance with air pollution standards and regulations, including NEPA, CEQA, General Conformity Regulations, and regional air pollution agencies.

Daniel Dehn, Leidos
EIS Responsibilities: Land Use and Aesthetics; Infrastructure

Education: M.A., English, University of Maine
B.S., Geology, University of New Mexico
B.A., English, Rutgers College

Experience/Technical Specialty:
Ten years. Administrative record management and reference management for multiple NEPA documents, geology and earth resources, soil resources.

John DiMarzio, Leidos
EIS Responsibilities: Geology and Soils Lead; Chapter 1 and Chapter 5 Manager

Education: M.S., Geology, George Washington University
B.S., Geology, University of Maryland

Experience/Technical Specialty:
Thirty-five years. Project management, NEPA compliance, geology, water resources, waste management, cumulative impacts, and environmental regulations.

Paul DiPaolo, Potomac-Hudson Engineering, Inc.
EIS Responsibilities: Environmental Justice Lead

Education: M.S., Environmental Planning and Management, Johns Hopkins University
B.S., Environmental Science and Policy, University of Maryland-College Park

Experience/Technical Specialty:
Eleven years. Environmental compliance and assessment including NEPA project management and resource analyst for environmental justice, socioeconomics, waste, soils, and water.

Vicky Frank, Leidos
EIS Responsibilities: Quality Assurance Manager

Education: B.S., Biochemistry, University of California

Experience/Technical Specialty:
Thirty-two years. Data management/reporting/validation, Quality Assurance/Control, environmental health safety (EHS), hazardous materials/wastes (HAZWOPER), environmental planning (NEPA/CEQA), analytical chemistry/instrumentation, biology, and field sampling.

DAN GALLAGHER, LEIDOS

EIS RESPONSIBILITIES: HUMAN HEALTH – NORMAL OPERATIONS LEAD; CHAPTER 2 AND APPENDIX B MANAGER

Education: M.E., Nuclear Engineering, Rensselaer Polytechnic Institute
B.S., Nuclear Engineering, Rensselaer Polytechnic Institute

Experience/Technical Specialty:
Forty years. Nuclear risk analysis.

GREG JACKSON, POTOMAC-HUDSON ENGINEERING, INC.

EIS RESPONSIBILITIES: WASTE AND SPENT NUCLEAR FUEL MANAGEMENT LEAD

Education: M.S., Environmental Management and Planning, Johns Hopkins University
B.S., Environmental Earth Science, California University of Pennsylvania

Experience/Technical Specialty:
Eight years. Environmental compliance and NEPA analysis, including waste management analysis.

JOSEPH JIMENEZ, LEIDOS

EIS RESPONSIBILITIES: CULTURAL RESOURCES AND PALEONTOLOGICAL RESOURCES LEAD

Education: M.A., Anthropology, Idaho State University
B.A., Anthropology, Idaho State University
Register of Professional Archaeologists (RPA #15644)

Experience/Technical Specialty:
Thirty-four years. Cultural resource project management, NEPA analysis, NRHP evaluations, Historic American Building Survey documentation review, Integrated Cultural Resource Management Plans, documentation/consultation support per NHPA Section 110; documentation/consultation support per NHPA Section 106; field and laboratory archaeology, project management and coordination, data collection, research, reporting, and writing.

ROY KARIMI, LEIDOS

EIS RESPONSIBILITIES: HUMAN HEALTH – TRANSPORTATION LEAD

Education: Sc.D., Nuclear Engineering, Massachusetts Institute of Technology
N.E., Nuclear Engineering, Massachusetts Institute of Technology
M.S., Nuclear Engineering, Massachusetts Institute of Technology
B.S., Chemical Engineering, Abadan Institute of Technology

Experience/Technical Specialty:
Forty years. Nuclear power plant safety, risk and reliability analysis, design analysis, criticality analysis, accident analysis, consequence analysis, spent fuel dry storage safety analysis, transportation risk analysis, and probabilistic risk assessment.

ERIN KOUVOUSIS, POTOMAC-HUDSON ENGINEERING, INC.

EIS RESPONSIBILITIES: WATER RESOURCES LEAD

Education: M.S., Ecology, Kent State University
B.S., Conservation, Kent State University

Experience/Technical Specialty:
Eleven years. Environmental compliance and assessment and water resources impacts assessment.

ROB NAUMANN, POTOMAC-HUDSON ENGINEERING, INC.
EIS RESPONSIBILITIES: CHAPTER 4 MANAGER, CHAPTER 7 MANAGER (LAWS AND REGULATIONS)

Education: M.S., Environmental Science, Johns Hopkins University
B.S., Resource Ecology & Management, University of Michigan

Experience/Technical Specialty:
Twenty-three years. NEPA project management and resource analyst for biological resources and water resources.

SARAH RAUCH, LEIDOS
EIS RESPONSIBILITIES: BIOLOGICAL RESOURCES

Education: B.S., Plant Biology Environmental Science and Ecology, Arizona State University

Experience/Technical Specialty:
Fifteen years. Environmental permitting, regulatory compliance and assessment, National Environmental Policy Act (NEPA) reviews, natural resources fieldwork, and research.

CHRIS RUA, POTOMAC-HUDSON ENGINEERING, INC.
EIS RESPONSIBILITIES: TRAFFIC LEAD

Education: M.S., Environmental Management, University of Maryland-University College
B.S., Environmental Planning & Design, Rutgers University

Experience/Technical Specialty:
Twenty years. Soil and groundwater investigations; NEPA analysis; performing regulatory compliance inspections and evaluations.

GEORGE SANTEE, LEIDOS
EIS RESPONSIBILITIES: HUMAN HEALTH – FACILITY ACCIDENTS; TECHNICAL ADVISOR; IDAHO FALLS POC

Education: M.S., Nuclear Science and Engineering, Idaho State University
B.S., Applied Physics, Idaho State University

Experience/Technical Specialty:
Forty-two years. Safety and risk analysis, radiological and hazardous material consequence analysis, nuclear safety, regulatory compliance, health and safety assessment.

TARA SCHOENWETTER, LEIDOS
EIS RESPONSIBILITIES: BIOLOGICAL RESOURCES LEAD

Education: Ph.D., Lincoln University, Centre for Research Excellence and Ecology Division
M.S., Frostburg State University, Applied Ecology and Conservation Biology
B.S., Biology (Ecology emphasis), University of California Irvine

Experience/Technical Specialty:
Twenty-one years. Biological and ecological impact analyses for EIS, Habitat Conservation Plans, Biological Assessments, EAs, Species and Climatic Modeling. Compliance with NEPA, CWA, ESA, MBTA, and state, local, county and international standards and regulations. ESA Section 7 consultation support, assessment and management of sensitive environments, streams, wetlands, species and habitat modeling, natural resources permitting and project management.

MELISSA SECOR, POTOMAC-HUDSON ENGINEERING, INC.
EIS RESPONSIBILITIES: NOISE LEAD; CHAPTER 3 MANAGER

Education: B.S., Meteorology, Florida State University
B.S., Management, George Mason University

Experience/Technical Specialty:
Fourteen years. NEPA project management and resource analyst for noise, air quality, greenhouse gases, land use, waste, and water.

DEBBIE SHINKLE, POTOMAC-HUDSON ENGINEERING, INC.
EIS RESPONSIBILITIES: GEOGRAPHIC INFORMATION SYSTEM (GIS) ANALYST

Education: B.A., Environmental Studies, University of Pittsburgh

Experience/Technical Specialty:
Sixteen years. NEPA analysis, land use, utilities, Geographic Information Systems (GIS) and mapping, and graphics.

SUSAN SMILLIE, POTOMAC-HUDSON ENGINEERING, INC.
EIS RESPONSIBILITIES: SOCIOECONOMICS LEAD

Education: M.En., Environmental Science, Miami University of Ohio
B.S., Biology, Smith College

Experience/Technical Specialty:
Thirty-five years. Environmental compliance and assessment, NEPA guidance and training, public involvement, energy and policy analysis, socioeconomics and environmental justice, land use, aesthetics, transportation/infrastructure, floodplains, wetlands, ecology, and power plant siting and permitting/licensing (nuclear, oil and gas pipelines, hydroelectric).

TARA UTSEY, LEIDOS
EIS RESPONSIBILITIES: DOCUMENT PRODUCTION MANAGER, SENIOR EDITOR, SHAREPOINT SITE MANAGEMENT

Education: B.A., Liberal Arts, DePaul University

Experience/Technical Specialty:
Twenty-eight years. Document publishing, editing, and production team management.

JEN WALLIN, LEIDOS
EIS RESPONSIBILITIES: COPYEDITING AND ADMINISTRATIVE RECORD MANAGEMENT

Education: M.S., Environmental Toxicology, Clemson University
B.S., Biology, Pacific Lutheran University

Experience/Technical Specialty:
Twenty-two years. Aquatic ecologist and environmental scientist, focus on EIS and ecological risk assessment preparation.

Appendix A
Federal Register Notices

This page left blank intentionally.

A. Federal Register Notices

A.1. Notice of Intent

12274 **Federal Register** / Vol. 85, No. 41 / Monday, March 2, 2020 / Notices

5. The purpose of the Canister Launcher (LCHR) and the High Mobility Launcher (HML) is to transport, aim, and fire the AMRAAM missiles. Under the remote control of the Fire Distribution Center (FDC), the LCHR/HML permits rapid launching of one or more missiles against single or multiple targets. The LCHR/HML provides 360-degree, all weather, day and night, missile launch capability.

6. The AN/AAS-52 and AN/AAS-44C(V) Multi-Spectral Targeting System-A (MTS-A) is a multi-use infrared (IR), electro optical (EO), and laser detecting ranging-tracking set originally developed and produced for use by airborne platforms. This advanced EO and IR system provides long-range surveillance, target acquisition, target tracking, range finding, and laser designation. It has been adapted for towers, aerostats, and ground based applications.

7. The AIM-120C-7/C-8 Advanced Medium Range Air-to-Air Missile (AMRAAM) is a supersonic, aerial intercept, guided missile featuring digital technology and micro-miniature solid-state electronics that is also able to operate as a ground-based air defense missile capable in all-weather against multiple targets in a sophisticated electronic attack resistance to electronic countermeasure, and interception of high- and low-flying maneuvering targets. The AIM-120C-8 is a form, fit, function refresh of the AIM-120C-7 and is the next generation to be produced.

8. The VSHORAD system consists of the four Dual Mount Stinger (DMS) systems, two Rapid Ranger (RR) Stinger Mobile Integrated Defense Systems, and the Stinger 92L Reprogrammable Micro-Processor (RMP) Block I missile.

9. The Stinger 92L Reprogrammable Micro-Processor (RMP) Block I missile is an infrared homing surface-to-air missile that can be adapted to fire from a wide variety of ground vehicles.

10. The DMS System provides a man-transportable pedestal system that can be used day or night in any environment. The DMS fires two Stinger missiles, and includes fully integrated day/night sights with optical zoom capability. Included as part of the DMS is a ruggedized tablet from which video output from the visible band day-sight, IR scene from the night-sight, and target cueing data are integrated. Slew-to-cue-information provides guidance to the gunner for target selection. The DMS can interface with the NASAMS FDC for Target Designation and Target Engagement Authorization as well as autonomous operation.

11. The Rapid Ranger (RR) consists of a High Mobility Vehicle operated by a crew of three. The RR is integrated by Raytheon with two Stinger Vehicle Universal Launchers (SVULs), a Fire Control System (FCS), and a Command, Control and Communications (C3) System. The RR can interface with NASAMS FDC for Target Designation and Target Engagement Authorization as well as autonomous operation.

12. This sale is necessary in furtherance of the U.S. foreign policy and national security objectives outlined in the Policy Justification. Moreover, the benefits to be derived from this sale, as outlined in the Policy Justification, outweigh the potential damage that could result if the sensitive technology were revealed to unauthorized persons.

13. All defense articles and services listed in this transmittal have been authorized for release and export to the Government of India.

[FR Doc. 2020–04167 Filed 2–28–20; 8:45 am]

BILLING CODE 5001–06–P

DEPARTMENT OF DEFENSE

Office of the Secretary

Notice of Intent To Prepare an Environmental Impact Statement for Construction and Demonstration of a Prototype Advanced Mobile Nuclear Microreactor

AGENCY: Strategic Capabilities Office, Office of the Secretary of Defense, Department of Defense (DoD).

ACTION: Notice of intent.

SUMMARY: The DoD, Office of the Secretary of Defense, acting through the Strategic Capabilities Office (SCO), and in partnership with the U.S. Department of Energy, Office of Nuclear Energy (DOE), proposes to construct and demonstrate a prototype advanced mobile nuclear microreactor (prototype microreactor) to support DoD domestic energy demands and DoD operational energy demands (Proposed Action).

SCO, as lead agency, in partnership with DOE, as a cooperating agency, intends to prepare an Environmental Impact Statement (EIS) in accordance with the requirements of the National Environmental Policy Act (NEPA) and applicable implementing regulations for the Proposed Action. The EIS also will cover the planned disposition of the prototype microreactor following operation and demonstration. Through this EIS process, SCO will identify measures to avoid, minimize, or mitigate any negative impacts to human health or the environment associated with the Proposed Action.

DATES: SCO invites public comment on the scope of this EIS during a 30-day public scoping period commencing March 2, 2020, and ending on April 1, 2020. Public comment may also be made at the public scoping meeting on March 18, 2020, in Fort Hall, Idaho (see "Public Scoping Meeting," in the **SUPPLEMENTARY INFORMATION** section). In defining the scope of the EIS, SCO will consider all comments received or postmarked by the end of the scoping period. Comments received or postmarked after the scoping period end date will be considered to the extent practicable.

ADDRESSES: Written comments regarding the scope of the EIS and comments or questions on the scoping process may be sent by any of the following methods:

- *Email: PELE_NEPA@sco.mil.* Include "Prototype Microreactor EIS Comments" in the subject line.
- *Mail:* OSD Strategic Capabilities Office, ATTN: Prototype Microreactor EIS Comments, 675 N Randolph Street, Arlington, Virginia 22203–2114.

FOR FURTHER INFORMATION CONTACT: Dr. Jeff Waksman, Program Manager; address: SCO, 675 N Randolph St, Arlington, Virginia 22203–2114; email: *PELE_NEPA@sco.mil.* Persons who use a telecommunications device for the deaf (TDD) may call the Federal Relay Service (FRS) at 1–800–877–8339 to contact the above individual during normal business hours. The FRS is available 24 hours a day, 7 days a week, to leave a message or question. You will receive a reply during normal business hours.

SUPPLEMENTARY INFORMATION:

Purpose and Need for Agency Action

The purpose of the Proposed Action is to construct and demonstrate a prototype microreactor that would be capable of producing 1–10 megawatts of electrical power. Pursuant to the National Defense Authorization Act for Fiscal Year 2018, Public Law 115–91, 131 Stat. 1283, 1857, section 2831, codified in 10 U.S.C. 2911, the Secretary of Defense has the authority to "ensure the readiness of the armed forces for their military missions by pursuing energy security and energy resilience." Further, pursuant to the Consolidated Appropriations Act, 2020, Public Law 116–93, section 4, and the Act's accompanying congressional explanatory statement, 165 Congressional Record H10613, H10886 (daily edition December 17, 2019), SCO received an appropriation for this prototype microreactor.

Federal Register / Vol. 85, No. 41 / Monday, March 2, 2020 / Notices 12275

The DoD is one of the largest users of energy in the world, and projections for future military operations predict energy demand will increase significantly in coming years. DoD installations need the capability to reduce their present reliance on local electric grids, which are highly vulnerable to prolonged outages from a variety of threats, placing critical missions at unacceptably high risk of extended disruption. Backup power is often based on diesel generators that have limited on-site fuel storage, are undersized for new homeland defense missions, are not prioritized to critical loads, and are inadequate in duration and reliability. Advanced nuclear power is capable of meeting the DoD's need to increase energy security and resilience, but must demonstrate its technical and safety specifications at full size and power.

The microreactor must keep radiation exposure during power operation, abnormal operations, or upset conditions, as low as reasonably achievable. SCO seeks to produce a prototype that will minimize consequences to the nearby environment and population in case of kinetic or non-kinetic action affecting structural integrity or release of contamination. Further, SCO seeks to utilize nuclear materials in the construction of a prototype microreactor that, if damaged, do not generate and impose excessive training and equipping burdens on forward area first responders, site medical facilities, or supported military personnel and the civilian population.

Proposed Action

The prototype microreactor is expected to be a small advanced gas reactor (AGR) using high-assay low enriched uranium (HALEU) tristructural isotropic (TRISO) fuel and air cooling. TRISO fuel is encapsulated and has been demonstrated in the laboratory to be able to withstand temperatures up to 1,800 degrees Celsius, allowing for an inherently safe prototype microreactor. The Proposed Action includes construction of the prototype microreactor and demonstration activities. The demonstration activities may include testing of project materials, startup and transient testing and evaluation of the constructed prototype microreactor, transportation and operational testing of the prototype microreactor or its components within the boundaries of the selected site to test and evaluate prototype microreactor mobility, and post-irradiation testing of project materials. The EIS also will cover the planned disposition of the prototype microreactor following operation and demonstration.

Additionally, there are expected to be ancillary activities necessary to support the Proposed Action. These include the fabrication of reactor fuel, the assembly of test/experimental modules at existing, modified, or newly constructed test/experiment assembly facilities, and the management of waste and spent nuclear fuel. After irradiation of the prototype microreactor, test/experimental cartridges would be transferred to post-irradiation examination facilities. SCO would make use of existing post-irradiation facilities to the extent possible, but existing post-irradiation examination facilities may require expansion or modification.

Two locations are required for the prototype construction and demonstration. One would be inside an existing structure, and the second would be outside. The potential indoor location would utilize existing infrastructure for initial deployment in a containment structure. The second location would be an outdoor site and would also utilize existing facilities and infrastructure.

The joint effort between SCO and DOE established by interagency agreement will make use of DOE expertise, material, laboratories, and authority to construct and demonstrate this prototype microreactor. DOE will provide SCO regulatory oversight and expertise on technical, safety, environmental, and health requirements applicable to the construction and demonstration of the prototype microreactor. DoD plans to request authorization from the DOE pursuant to its authority under the Atomic Energy Act (42 U.S.C. 2121(b), 2140) and National Security Decision Directive 282, September 30, 1987, for the acquisition and operation of a prototype reactor. The Nuclear Regulatory Commission (NRC), consistent with its role as an independent safety and security regulator, is participating in this project to provide SCO with accurate, current information on the NRC's regulations and licensing processes in connection with construction and demonstration of a prototype advanced mobile nuclear microreactor. Consistent with an authorization by the Secretary of Energy, the prototype microreactor does not require a NRC license.

Alternatives

SCO will evaluate a range of reasonable alternatives for the Proposed Action in the EIS. As required by NEPA, the alternatives will include a No Action Alternative to serve as a basis for comparison with the action alternatives. Under the No Action Alternative, SCO would not pursue the construction or demonstration of a prototype microreactor. The following site features are considered necessary for the Proposed Action and will be used as screening criteria to identify a range of reasonable action alternatives:

- A site that has been previously used for nuclear activities that has sufficient infrastructure to support nuclear operations, including the planned disposition of the prototype microreactor following operation and demonstration.
- Access to an electrical grid and a grid independent from the commercial grid capable of performing research.
- An established control zone (to facilitate emergency planning for reactors with safety features not previously demonstrated).
- Adjacent nuclear facilities available for examination and characterization of radioactive components and materials (*e.g.*, hot cells, analytical chemistry).
- Ability to manufacture and test shielding for the prototype microreactor.
- Variable climate conditions that are suitable demonstration conditions.
- Sufficient space for transportation and operational testing and evaluation of the mobility of the prototype microreactor or its components within the boundaries of the site, including both indoor and outdoor testing facilities.
- A site that is or can be subject to DOE authority or control.

The range of action alternatives may consider multiple sites or multiple locations within one site. SCO has identified the following potential sites as locations for the Proposed Action: Idaho National Laboratory (INL), and Oak Ridge National Laboratory (ORNL). Within the INL site, the following specific options for indoor and outdoor facilities have been identified for inclusion in the range of alternatives to be considered:

The following indoor locations at INL will be considered:

(a) Chemical Processing Plant 691 (CPP–691) situated within the Idaho Nuclear Technology and Engineering Center (INTEC);

(b) Experimental Breeder Reactor II (EBR II) situated within the Materials and Fuels Complex (MFC);

(c) Power Burst Facility 613, situated within the Critical Infrastructure Test Range Complex (CITRC); or

(d) Alternate facilities and infrastructure identified during the scoping process.

The following outdoor locations at INL will be considered:

12276 Federal Register / Vol. 85, No. 41 / Monday, March 2, 2020 / Notices

(a) Near the Materials and Fuels Complex (MFC);

(b) Within the Critical Infrastructure Test Range Complex (CITRC); or

(c) Alternate facilities and infrastructure identified during the scoping process.

The indoor and outdoor locations at INL were identified during preliminary planning for the preparation of this notice. If multiple indoor or outdoor locations at ORNL prove suitable as action alternatives during the EIS process, SCO will analyze those locations individually in the same manner.

Through the EIS process, the required site features will be used to identify a range of reasonable action alternatives to be considered in the EIS. SCO will consider any scoping comments on alternative sites, and plans to evaluate multiple locations to ensure specific facilities and infrastructure are recommended that minimize environmental impacts.

Impacts Analysis

The EIS will include an analysis of potential impacts to the quality of the human environment from the range of reasonable Action Alternatives, and the No Action Alternative. Because the specific design of the prototype will be unknown during the preparation of the EIS, SCO will consider potential environmental impacts from all reasonable designs that are under consideration. The EIS will analyze impacts of the Proposed Action to natural and cultural resources, to include Native American resources and concerns; to public health from potential exposure to radionuclides under routine and credible accident or emergency scenarios including natural disasters such as floods, hurricanes, tornadoes, or seismic events; any disproportionately high and adverse effects on minority and low-income populations (*i.e.*, environmental justice impacts); and potential impacts of intentional destructive acts, including sabotage and terrorism, as well as other issues that may emerge during the scoping process.

Public Scoping Process

SCO invites Federal agencies, state, local, and tribal governments, and the general public to comment on the scope of the EIS. This includes any comments on the identification of reasonable alternatives and specific environmental issues to be addressed. Analysis of written and oral public comments provided during the scoping period will help further identify concerns and potential issues to be considered in the Draft EIS.

Public Scoping Meeting

SCO, acting on behalf of DoD, will host a public scoping meeting to provide the public with information about the NEPA process and to invite public comments on the scope of this EIS. The public meeting will begin with a presentation on the NEPA process and then a presentation on the Proposed Action and the alternatives. Following the presentations, there will be a moderated session during which members of the public can provide oral comments on the scope of the EIS analysis. Commenters will be allowed three minutes to provide comments, which will be recorded.

The public meeting will be held on March 18, 2020, at 5:00 p.m. Mountain Daylight Time at: Shoshone-Bannock Event Center, Fort Hall Indian Reservation, 777 Bannock Trail, Fort Hall, Idaho 83203.

For those who cannot attend the public meeting in-person but are interested in watching the presentations, there will be two options for viewing. The first option is a live webcast of the public meeting. The second option is viewing a recording of the public meeting. The internet address for the live webcast and rebroadcast of the public meeting presentations is *https://www.cto.mil/pele_eis/*.

EIS Preparation and Schedule

Following the scoping period announced in this Notice of Intent, and after consideration of all comments received during scoping, SCO will prepare a Draft EIS for the construction and demonstration of the prototype microreactor. Once the Draft EIS is completed, it will be made available for a 45-day public review and comment period. SCO will announce the availability of the Draft EIS in the **Federal Register** and local media outlets. SCO expects the Draft EIS will be available for public review and comment in 2021. All interested parties are encouraged to respond to this notice and provide a current address if they wish to be notified of the Draft EIS circulation.

Dated: February 20, 2020.

Aaron T. Siegel,

Alternate OSD Federal Register Liaison Officer, Department of Defense.

[FR Doc. 2020–03809 Filed 2–28–20; 8:45 am]

BILLING CODE 5001–06–P

DELAWARE RIVER BASIN COMMISSION

[Docket D–2017–009–2]

Adjudicatory Hearing and Additional Written Comment Period

AGENCY: Delaware River Basin Commission.

ACTION: Notice.

SUMMARY: The Delaware River Basin Commission will hold an adjudicatory hearing (a trial-like proceeding) commencing April 15, 2020 on Docket D–2017–009–2, issued by the Commission on June 12, 2019, to Delaware River Partners, LLC for the project known as Gibbstown Logistics Center Dock 2. The purpose of the hearing is to afford objectors an opportunity to show that the Commission's docket approval should be changed. The Commission will accept additional written comment on this matter during the pendency of the hearing, through April 24, 2020.

DATES: The hearing commencing on April 15, 2020 will run from 9 a.m. until no later than 4 p.m. and will continue on successive business days until complete. The start time on successive days will be determined by the Hearing Officer at the close of each day's proceedings and will be posted on the DRBC website, *www.drbc.gov* (see link under "Recent Postings") each day after 4 p.m. Additional written comments on Docket D–2017–009–2 will be accepted through 5 p.m. on April 24, 2020.

ADDRESSES: The hearing will take place at the State of New Jersey Office of Administrative Law, Quakerbridge Plaza Building 9, Mercerville (Hamilton), NJ 08619, Hearing Room 1. Additional written comments on Docket D–2017–009–2 may be submitted through the Commission's web-based comment system, a link to which is provided at *www.drbc.gov*. Use of the web-based system ensures that all submissions are captured in a single location and their receipt is acknowledged. Exceptions to the use of this system are available based on need, by writing to the attention of the Commission Secretary, DRBC, P.O. Box 7360, 25 Cosey Road, West Trenton, NJ 08628–0360. For assistance, please contact Giselle Hernandez at *giselle.hernandez@drbc.gov*.

SUPPLEMENTARY INFORMATION: The Commission on June 6, 2019 held a duly noticed public hearing on a draft of Docket D–2017–009–2 for the Gibbstown Logistics Center Dock 2. The Commission accepted written comment on the draft docket through 5 p.m. on

This page left blank intentionally.

Appendix B
Environmental Resources

This page left blank intentionally.

B. Environmental Resources

This appendix summarizes some of the information necessary to determine the environmental impacts of the Project Pele mobile microreactor demonstration at the Idaho National Laboratory (INL) site. General information applicable to all phases of the project is presented first. Information specific to individual phases of the demonstration effort follow. Unless indicated otherwise, information was provided by INL (INL, 2021a).

It is anticipated that an average of 18 radiation workers from each project phase would receive a dose of 0.5 to 1 roentgen equivalent man (rem) over three years for a total of approximately 10 person-rem for the project. The as low as reasonably achievable (ALARA) principles would be applied per the INL *Radiological Control Manual* (LRD-15001) to reduce exposure.

Water requirements for the demonstration of the mobile microreactor are primarily limited to sanitary water used by project workers and water used for radiation shielding. Since the mobile microreactor is gas cooled, water is not required for operation of the microreactor. No contaminated water would be discharged to surface or groundwater.

Modifications to the facilities used in support of the mobile microreactor demonstration would consist of the construction of two concrete pads (one at the Critical Infrastructure Test Range Complex [CITRC] of 40,000 square feet or less and one at the temporary storage locations of about 2,500 square feet). In addition, a perimeter fence at the CITRC test pad would be required and either an alarm system or additional security checks would be required at one of the temporary storage locations (Outdoor Radioactive Storage Area).

Ground disturbance would be primarily limited to the areas in which the concrete pads are poured. The use of temporary laydown areas would be minimal outside of the footprint of microreactor operations.

There is no need for stormwater collection as all activities at CITRC will be performed above or near grade and existing stormwater collection would be sufficient.

Manpower requirements during the mobile microreactor would be 54 or less for each phase of the demonstration (see **Table B-1**). These workers would be a combination of INL staff, contractors, and visitors. Current water supply and sewer systems are adequate to accommodate the additional load from the relatively small numbers of employees and from cleaning and maintenance activities.

In general, equipment would be placed in noise reducing enclosures with a goal of noise levels of less than 80 decibels (dB) outside enclosures. Consistent with 29 Code of Federal Regulations [CFR] 1910.95, a hearing conservation program would be established for workers who are exposed to a time-weighted average noise level of 85 dB or higher over an 8-hour work shift. The main source of vibrational noise would be the equipment used to perform CITRC site preparations and site setup. The vibrational noise during all project phases would be intermittent and minimal.

Minor amounts of waste would be generated during construction consisting of waste construction materials and general garbage. Materials would be recycled to the extent possible. The remaining waste would be disposed of in appropriate landfills. Details of waste generation associated with each project phase are presented in the following sections.

The mobile microreactor demonstration at the INL Site would involve the use of standard industrial chemicals, all of which are already in use at the INL Site and Materials and Fuels Complex (MFC). The use of these chemicals has been estimated to increase the quantity of chemicals currently used at MFC by no more than about 5 percent during portions of the 3-year demonstration.

B.1. Environmental Resources to Fuel Mobile Microreactor at MFC

No facility modifications would be required to perform fueling and final assembly of the microreactor at the proposed facilities (Hot Fuel Examination Facility or Transient Reactor Test Facility). Any special equipment and tools required to perform this operation would be brought in and would not necessitate any modifications.

During the fueling of the mobile microreactor, workers would not be exposed to a radiation environment, as the mobile microreactor materials have not been activated and the fuel is fresh. Therefore, no workers in this phase of the project would require a radiation worker qualification. **Table B-1** estimates the number of workers required for all phases of the mobile microreactor demonstration at the INL Site.

Table B-1. Project Staff by Phase

Phase		*Total*	*INL Workers*	*Contractors*	*Oversight*	*Visitors*	*Security*	*Safety*	*Radiation Workers* [a]
Core Fueling and Final Assembly	Assembly	48	15	9	9	3	3	9	No
	Core Fueling	48	15	9	9	3	3	9	No
Reactor Operations – DOME [b]		45	9	9	9	6	3	99	Yes
Disassembly and transfer from the DOME to CITRC	Disassembly	51	15	9	9	3	6	9	Yes
	Transport	54	15	9	9	3	9	9	Yes
Reactor Operations - CITRC	CITRC Modification	36	15	9	3	3	0	6	No
	Assembly	51	15	9	9	3	6	9	Yes
	Operation	51	9	9	9	9	6	9	Yes
Disassembly and Transport	Disassembly	51	15	9	9	3	6	9	Yes
	Transport	54	15	9	9	3	9	9	Yes
Temporary Storage at INL		11	5	2	1	1	1	1	Yes
PIE and Disposition	PIE	13	6	1	1	1	3	1	Yes
	Disposition	17	7	2	1	2	3	2	Yes

Key: CITRC = Critical Infrastructure Test Range Complex; DOME = Demonstration of Operational Microreactor Experiments; INL = Idaho National Laboratory; MFC = Materials and Fuels Complex; PIE = post-irradiation examination

Note:

[a] Not all workers in each phase would be radiation workers. An estimated 18 workers per year would receive a work-related dose.

[b] Alternately startup testing could be performed at CITRC.

The core fueling phase of Project Pele, during which up to 400 kilogram (kg) of HALEU fuel would be loaded into the mobile microreactor, is expected to last 4 weeks from arrival of the components to completed assembly of the microreactor. During this time, the needed materials and utilities would include:

- Electricity usage: 10,000 kilowatt-hours (kWh) with a peak demand of 50 kilowatts (kW)
- Fuel usage: propane - 4,000 pounds
- Water usage: sanitary water for office use - 1,500 gallons

- Irreversible and irretrievable materials (unless otherwise specified, all materials quantities are expected to be minimal):
    - Helium
    - Steel
    - Conduit
    - Cable
    - Nitrogen

During core fueling, there should not be a significant increase in the baseline noise measurements.

Table B-2 presents a list of air pollutant emitting equipment use data for all project phases.

Table B-2. Air Pollutant Emitting Equipment Usage for Demonstration of a Mobile Microreactor at the INL Site

Activity	*Project Duration (hours)*	*Equipment*	*Quantity*	*Fuel Type*	*Percentage of Duration (%) or Power Rating (hp)*	*Duration per Machine (hours)*
Core Fueling						
Core Fueling and Final Assembly	160	Overhead Crane (30 kW)	1	Electricity	100%	160
		Scissor Lift	4	Propane	70%	112
		Forklift	2	Propane	50%	80
Reactor Assembly for DOME Operations						
Reactor Transport and Assembly	70	Army Forklift	5	Diesel	200	49
		Army Semi	4	Diesel	500	49
Reactor Operations—CITRC						
CITRC Preparations	60	Cement Truck	3	Diesel	300 hp	18
		Grader	1	Diesel	500 hp	12
		Excavator	2	Diesel	500 hp	24
		Dump Truck	5	Diesel	400 hp	24
		Compactor	1	Diesel	200 hp	6
		Power Trowel	3	Unleaded	40 hp	18
Shielding Preparation	16	Excavator	2	Diesel	500 hp	16
		Dump Truck	4	Diesel	400 hp	16
Site Electrical Hookup	40	Boom Truck	2	Diesel	500 hp	16
		Backhoe	2	Diesel	125 hp	16
		Mobile Crane	1	Diesel	500 hp	10
		Pickup Trucks	3	Unleaded	400 hp	24
Modular Office and Sanitary Facilities	20	Tractor Hauler	3	Diesel	500 hp	4
		Pickup Trucks	2	Unleaded	400 hp	8
Reactor Grid Testing	2,500	500 kW Diesel Generator	2	Diesel	700 hp	500
Disassembly and Transport						
Disassembly and Transport	70	Army Forklift	5	Diesel	200 hp	49
		Army Semi	4	Diesel	500 hp	49
Site Restoration	100	Grader	1	Diesel	500 hp	10
		Excavator	2	Diesel	500 hp	80
		Dump Truck	5	Diesel	400 hp	80
		Tractor Hauler	3	Diesel	500 hp	10
		Pickup Trucks	2	Unleaded	400 hp	70

Table B-2. Air Pollutant Emitting Equipment Usage for Demonstration of a Mobile Microreactor at the INL Site (Continued)

Activity	*Project Duration (hours)*	*Equipment*	*Quantity*	*Fuel Type*	*Percentage of Duration (%) or Power Rating (hp)*	*Duration per Machine (hours)*
PIE and Disposition						
PIE and Disposition	4,160	Overhead Crane (30kW)	1	Electricity	50%	2,080
		Scissor Lift	2	Propane	30%	1,248
		Forklift	2	Propane	30%	1,248
Temporary Storage Pad Excavation						
Temporary Storage Pad Excavation	20	Cement Truck	3	Diesel	300	6
		Grader	1	Diesel	500	4
		Excavator	2	Diesel	500	8
		Dump Truck	5	Diesel	400	8
		Compactor	1	Diesel	200	2
		Power Trowel	3	Unleaded	40	6

Source: (INL, 2021b)
Key: CITRC = Critical Infrastructure Test Range Complex; DOME = Demonstration of Operational Microreactor Experiments; hp = horsepower; INL = Idaho National Laboratory; kW = kilowatts; PIE = post-irradiation examination

A total of 14 shipments (4 for the mobile microreactor modules and a maximum of 10 for fuel) are anticipated for the initial shipment of the mobile microreactor components and fresh fuel from the suppliers to the INL Site. The shipments would be by tractor-trailer. No additional shipments are anticipated during this phase of the demonstration of the mobile microreactor.

Estimated cold (nonradioactive) and radioactive waste generated during the fueling of the mobile microreactor are provided in **Table B-3**. Estimated waste volumes are scaled from the waste generation rates for MFC and take into consideration the short duration of the fueling activity.

Table B-3. Wastes Generation During Mobile Microreactor Fueling

Waste Type	Net Volume (cubic meters)	Gross Volume (cubic meters)	Net Weight (pounds)	Gross Weight (pounds)
Industrial	0.20	0.20	130	160
Universal	0.01	0.01	8.6	9.8
Hazardous [a]	0.16	0.49	150	240
Recyclable	0.11	0.12	190	200
TSCA	0.01	0.01	7.29	9.1
LLW	6.5	7.9	3,600	6,900
MLLW	0.33	0.66	450	600

Source: (INL, 2021b)
LLW = low-level radioactive waste; MLLW = mixed low-level waste; TSCA = Toxic Substance Control Act material
Note:
a hazardous waste — waste that is defined as hazardous waste under the Resource Conservation and Recovery Act (Title 42, United States Code, Section 6901 et seq.) or state statute or regulation. State regulations may define a larger spectrum of materials as hazardous waste than Federal regulations.

B.2. Environmental Resources for Mobile Microreactor Startup Testing

No modifications would be necessary to the DOME at MFC, as it is designed for the purpose of testing reactors similar to the mobile microreactor.

Table B-1 estimates the number of workers required for all phases of the mobile microreactor demonstration at the INL Site. All workers in this project phase would require a radiation worker qualification. The radiation workers would be working under the requirements of the INL Laboratory Requirements Document LRD-15001, *Radiological Control Manual*, which is compliant with 10 CFR 835 to maintain radiation exposure to ALARA.

During this time, the needed materials and utilities would include:

- Electricity usage: 15,000 kWh with a peak demand of 20 kW
- Water usage: sanitary - operations (60,000 gallons), office (8,000 gallons), and shielding (15,000 gallons)

Temporary shielding consisting of steel bladders containing up to 15,000 gallons of water may be used during startup testing at the DOME. These same bladders, but not the water, would be used at CITRC during testing operations there. (INL, 2021b)

During mobile microreactor operations at the DOME, the main increase in noise would come from the power generation module, located outside of the DOME. The power generation module would generate approximately 110 dB above background noise levels up to 50 feet from the unit. The remaining control module and ancillary equipment container, exterior to the DOME, would contain instrumentation and storage.

Personnel would not be in close proximity to the system during operation except for occasional maintenance, precluding the need for noise control. It should be assumed that any personnel conducting maintenance on the system would require hearing protection. Listed below are approximate sound pressure levels (dB) directly in the exhaust path, with no obstacles:

- 50 feet: 110 dB
- 400 feet: 90 dB
- 1,500 feet: 80 dB

See **Table B-2** at the INL Site for a list of air pollutant emitting equipment to be used during this phase of the demonstration.

No additional shipments of material or wastes are anticipated during the startup testing of the mobile microreactor. Wastes could be generated during the reclamation of the DOME location after startup testing has been completed. These waste would include (INL, 2021b) the following.

- Liquid low-level radioactive waste (LLW) – about 15,000 gallons of water (the water used in the water bladders for neutron shielding during startup testing)
- LLW consisting of
    - Piping – 250 feet;
    - Connectors – 50; and
    - Spent ion exchange resin and reverse osmosis systems used to treat the radiologically contaminated water from the bladders. If the water requires treatment it is anticipated that this waste would fit into three 55-gallon drums.
- Industrial or recycle waste consisting of
    - Piping – 250 feet
    - Wire conduit – 250 feet
    - Wiring – 500 feet

B.3. Environmental Resources for Disassembly and Transport to CITRC

Table B-1 estimates the number of workers required for all phases of the mobile microreactor demonstration at the INL Site. All workers in the disassembly and transport phase would require a radiation worker qualification. The radiation workers would be working under the requirements of the INL Laboratory Requirements Document LRD-15001, *Radiological Control Manual*, which is compliant with 10 CFR 835 to maintain radiation exposure to ALARA.

Electricity usage is estimated to be minimal. Internal combustion motor powered equipment and vehicles would be used for most of the disassembly and transport activities. See **Table B-2** for a list of air pollutant emitting equipment to be used during this project phase. During this time, the needed materials and utilities would include:

- Fuel usage: diesel (21,000 gallons) and gasoline (3,500 gallons)
- Water usage: operations (1,000 gallons)

The following activities during disassembly and transport would increase the noise baseline:

- Microreactor system disassembly and packaging
- Site restoration activities, such as removal of shielding and any remaining materials.

Depressurization (blowdown) of the microreactor would require the use of up to 10 high-efficiency particulate air (HEPA) filters for each event, of which two may occur before transport. Each depressurization would result in the generation of two 55 gallon drums of LLW, a total of about 5 cubic yards. This LLW would be included in the LLW estimates provided in **Table B-4**. The shipment of the mobile microreactor would be expected to generate up to 40 cubic yards of industrial waste. (INL, 2021b)

B.4. Environmental Resources for Mobile Microreactor Operations at CITRC

Table B-1 estimates the number of workers required for all phases of the mobile microreactor demonstration at the INL Site. During the CITRC site preparation subphase of this project, workers would not be exposed to a radiation field and would not require a radiation worker qualification. (The site preparation would take about six months and is not a part of the two-and-a-half year duration of operations at CITRC.) All workers in the assembly and operation phases would require a radiation worker qualification. The radiation workers would be working under the requirements of the INL Laboratory Requirements Document LRD-15001, *Radiological Control Manual*, which is compliant with 10 CFR 835 to maintain radiation exposure to ALARA.

A water jacket (water bladders containing no more than 15,000 gallons of water) would be used to minimize activation of materials exterior of the microreactor. Concrete and HESCO® bags would be used as gamma shielding, exterior of the water jacket, to maintain radiation levels below the requirements outlined in 10 CFR 835.202. The completed structure would have an overall height of 30 feet.

Depending on the status of the surface used for deployment of the mobile microreactor system, leveling and surface preparation may be necessary. Sufficient soil to level the surface would be excavated and then backfilled with the necessary standard underlayment. The minimal amount of soil excavated from these activities would be recycled and used at other locations on the site; quantities are listed below. Construction laydown areas outside the designated mobile microreactor system footprint would be minimal.

During this time, the needed materials and utilities would include:

- Concrete: between 1,000 and 3,000 cubic feet[61]
- Electricity usage: 10,000 kWh with a peak demand of 20 kW
- Fuel usage: diesel (30,000 gallons) and gasoline (2,000 gallons)
- Water usage: sanitary: operations (95,000 gallons) and office (37,000 gallons); shielding (35,000 gallons)
- Irreversible and irretrievable materials:
  - A 200-foot by 200-foot steel-reinforced concrete pad 8 inches thick poured for microreactor operations
  - 3,000 cubic yards of underlayment for the concrete and gravel pads; materials would be sourced primarily from reuse of on-site soils from the excavation as a first priority, then from the on-site gravel pit (approximately 20 miles away) and finally from local construction sources (up to 40 miles away)
  - 250 concrete T-walls for shielding
  - Steel reinforced concrete for roof shielding (25 roof panels; 4 feet by 50 feet by 2 feet thick)
  - 100 jersey barriers
  - 600 concrete wall blocks (2 feet by 2 feet by 6 feet)
  - Steel bladders for water shielding
  - HESCO® bags, filled with soil (removed during concrete pad construction or other local sources)

See **Table B-2** for a list of air pollutant emitting equipment to be used during this project phase.

The following activities at CITRC would increase the noise baseline:

- Excavation and pad preparation activities
- Shielding placement
- Microreactor system setup
- Diesel generators
- Mobile microreactor operation

The power conversion module would be the primary source of noise. Due to radiation shielding and radiation standoff distances, the majority of the noise associated with mobile microreactor operation would be attenuated at locations accessible during microreactor operation.

Personnel would not be in close proximity to the system during operation except for occasional maintenance, precluding the need for noise control. It should be assumed that any personnel conducting maintenance on the system would require hearing protection. Listed below are approximate sound pressure levels (dB) directly in the exhaust path, with no obstacles:

- 50 feet: 110 dB
- 400 feet: 90 dB
- 1,500 feet: 80 dB

The main source vibrational noise would be the equipment used to perform CITRC site preparations and site setup. The vibrational noise during all project phases would be intermittent and minimal.

[61] The concrete pad would require about 1,000 cubic feet of concrete. A bounding estimate for concrete (3,000 cubic feet) (INL, 2021f) assumes that all concrete structures are poured at the site and no prefabricated concrete structures are used.

Construction would be limited to daylight hours with very limited or nonexistent nighttime or weekend work.

Shipments of material such as concrete for shielding and construction materials would occur during site preparations. A bounding estimate of 75 cement truck trips a maximum of 75 miles one-way would be required to transport the required concrete to CITRC during CITRC site preparations. A bounding estimate of 100 semi-truck trips a maximum of 75 miles from CITRC would be required to transport the prefabricated concrete shielding materials to CITRC. An average frequency of three shipments per day during the 2 months of construction and site preparation stages are expected. After the preparation stage, additional shipments are not expected.

Estimated cold and radioactive waste generated during mobile microreactor operations at CITRC are provided in **Table B-4**. Estimated waste volumes are scaled from the waste generation rates for MFC.

Table B-4. Wastes Generation During Mobile Microreactor Operations at CITRC

Waste Type	Net Volume (cubic meters)	Gross Volume (cubic meters)	Net Weight (pounds)	Gross Weight (pounds)
Industrial	1.0	1.05	690	820
Universal	0.063	0.071	45	51
Hazardous [a]	0.84	2.6	790	1,300
Recyclable	0.59	0.62	970	1,100
TSCA	0.029	0.030	38	48
LLW	27	32	18,000	34,000
MLLW	1.7	3.4	2,200	3,000

Source: (INL, 2021b)

LLW = low-level radioactive waste; MLLW = mixed low-level waste; TSCA = Toxic Substance Control Act material

Note:

[a] hazardous waste — waste that is defined as hazardous waste under the Resource Conservation and Recovery Act (Title 42, United States Code, Section 6901 et seq.) or state statute or regulation. State regulations may define a larger spectrum of materials as hazardous waste than Federal regulations.

In addition to the above-listed wastes, activities associated with mobile microreactor operations at CITRC would be expected to generate the following wastes (INL, 2021b):

- Liquid LLW – 35,000 gallons of water (the water used in the water bladders for neutron shielding)
- LLW - Spent ion exchange resin and reverse osmosis systems used to treat the radiologically contaminated water from the steel bladders. If the water requires treatment, it is anticipated that this waste would fit into three 55-gallon drums.
- Industrial waste – 120 cubic yards from site preparation
- Waste concrete – 3,100 cubic yards (3,000 cubic yards from site reclamation and 60 cubic yards from construction)

B.5. Environmental Resources Disassembly and Transport from CITRC to Temporary Storage

Resource requirements for this phase would be the same as those presented in Section B.3 for the disassembly and transport of the mobile microreactor to CITRC with the exception of the HEPA-related waste. Depressurization (blowdown) of the microreactor could require the use of up to 10 HEPA filters for each event, four of which may occur before transport. Each depressurization could result in the generation of two 55 gallon drums of LLW, a total of about 5 cubic yards. This LLW would be included in the LLW estimates provided in **Table B-4**.

B.6. Environmental Resources for Temporary Storage at INL

Following completion of demonstration operations, all four CONEX containers would be stored at Radioactive Scrap and Waste Facility (RSWF) or at Outdoor Radioactive Storage Area (ORSA). The mobile microreactor module would be stored for at least 3 years to allow the fuel to cool sufficiently before the defueling process begins.

Table B-1 estimates the number of workers required for all phases of the mobile microreactor demonstration at the INL Site. Electricity usage during this phase of the project would be minimal, as the mobile microreactor would be placed on a pad and stored. Electricity usage would be limited to a few street lights and a security system, equating to an average draw of 2,000 kWh per year.

The CONEX containers would be placed on a concrete pad at the temporary storage location. Concrete sufficient for a steel-reinforced 50-foot by 50-foot pad 8 inches thick would be required. Approximately 200 cubic yards of underlayment would be necessary and would likely be sourced from the same locations as the underlayment for the CITRC pads. Equipment used to construct the storage pad would consume 1,600 gallons of diesel fuel and 50 gallons of gasoline.

See **Table B-2** for a list of air pollutant emitting equipment at the INL Site to be used during pad excavation and construction.

Additional inspections would require only 5 hours, twice per year. Therefore, fuel and water usage would be minimal.

The only wastes generated from the temporary storage of the mobile microreactor would be about 40 cubic yards of industrial waste and 2 cubic yards of concrete, all from site preparation work.

B.7. Environmental Resources for Post-Irradiation Examination and Disposition

Table B-1 estimates the number of workers required to perform all phases of the microreactor demonstration at the INL Site. All workers in the post-irradiation examination (PIE) and disposition phase would require a radiation worker qualification. The radiation workers would be working under the requirements of the INL Laboratory Requirements Document LRD-15001, *Radiological Control Manual*, which is compliant with 10 CFR 835 to maintain radiation exposure to ALARA.

During this time, the needed materials and utilities would include:

- Electricity usage: 100,000 kWh with peak demand of 50kW
- Fuel usage: propane (30,000 pounds)
- Water usage: office (7,000 gallons)

PIE activities would not increase the noise baseline at the Hot Fuel Examination Facility. The disposition of the mobile microreactor would increase noise levels at the proposed location as the mobile microreactor is disassembled and associated waste is disposed of.

See **Table B-2** for a list of air pollutant emitting equipment to be used during this project phase.

Table B-5 provide estimates of the annual use of these materials during Post-Irradiation Examination of mobile microreactor fuel and components.

Table B-5. PIE Chemical Use and Disposal Materials

Category	***Unit***	***Estimated Annual Use Rate***	***Category***	***Unit***	***Estimated Annual Use Rate***
Absorbent	pound	1.50E-01	Lubricant	pound	5.00E-01
Alcohol	gallon	5.50E-01	Magnesium Oxide	pound	9.00E-01
Antifreeze/Coolant	gallon	3.50E-01	Mineral Oil	gallon	2.80E+00
Argon	gallon	4.90E+02	Nde	pound	3.25E-01
Backfill	pound	7.00E-01	Nde Developer	pound	2.95E-01
Cadmium Shot	pound	1.95E-01	Neutralizer	pound	8.00E-01
Calibration Standard	gallon	5.00E-01	Nitric Acid	gallon	7.00E-01
Carbon Dioxide	gallon	2.30E+02	Nitrogen	gallon	6.50E+02
Concrete	pound	3.15E-01	Non-Flammable Gas Mixture	gallon	1.90E-01
Descaler	gallon	1.65E+00	Oil	gallon	6.50E-01
Desiccant	pound	1.25E+00	P-10 - 10% Methane, 90% Argon	gallon	9.00E+02
Fire Protection	pound	1.60E+00	Paint/Paint Thinner	pound	3.65E-01
Gas Mix: Chlorine In Nitrogen	gallon	1.90E-01	Photo Developing	gallon	8.50E-01
Gas Mix: Air, Iso-Butylene	gallon	1.90E-01	Silica Gel	pound	4.95E-01
Grease	pound	4.05E-01	Soda Lime	pound	6.00E-01
Helium	gallon	3.35E+00	Sodium Polyacrylate	gallon	1.40E+00
Hydraulic Fluid	gallon	2.75E+00	Solidifier	pound	1.90E+00
Hydrochloric Acid	gallon	2.20E-01	Solvent Adsorbent	pound	3.60E-01
Laboratory Application	pound	1.25E+00	Sulfur Hexafluoride	gallon	1.50E+01
Liquid Nitrogen	gallon	4.50E+01	Water Treatment	pound	5.50E-01
Lithium Chloride-Potassium Chloride	pound	2.75E+00			

Table B-6. Post-Irradiation Examination Non-Hazardous Gas Use

Product Name	***Unit of Measure***	***Estimated Annual Use Rate***
Argon / carbon dioxide / hydrogen / methane / methanol /	liter	9.50E+02
Argon, compressed	standard cubic feet	1.25E+02
Gas mix: argon, hydrogen	standard cubic feet	3.40E-02
Gas mixture	liter	2.15E-01
Gas, argon liquid	standard cubic feet	7.50E+03
Hydrogen	standard cubic feet	2.70E-01
Hydroxylamine hydrochloride	gram	5.00E+00
Hydroxylamine sulfate	gram	6.50E+00
Krypton	standard cubic feet	3.40E-02
Nitrogen, compressed gas	standard cubic feet	3.80E+01
Noble gas mix	liter	6.00E+00
Nonflammable gas mix: AR/CO2/H/CH4/CH4O/N/O	liter	1.05E+01
Nonflammable gas mixture: nitrogen 99% / Trimethylamine 1-9999ppm	standard cubic feet	1.20E+01
Oxygen, compressed gas	standard cubic feet	3.75E+01

Estimated cold and radioactive wastes generated during the PIE and disposition phase are provided in **Table B-7.** Estimated waste volumes are scaled from the waste generation rates for MFC.

Table B-7. Wastes Generation During Mobile Microreactor Component Post-Irradiation Examination

Waste Type	Net Volume (cubic meters)	Gross Volume (cubic meters)	Net Weight (pounds)	Gross Weight (pounds)
Industrial	1.0	1.0	640	750
Universal	0.058	0.065	41	47
Hazardous [a]	0.77	2.37	720	1,200
Recyclable	0.54	0.57	890	970
TSCA	0.027	0.027	35	43
LLW [b]	24	29	1,700	32,000
MLLW	1.5	3.1	2,000	2,700

Source: (INL, 2021b)

GTCC = greater-than-Class-C; LLW = low-level radioactive waste; MLLW = mixed low-level waste; TRU = transuranic; TSCA = Toxic Substance Control Act material

Note:

[a] hazardous waste — waste that is defined as hazardous waste under the Resource Conservation and Recovery Act (Title 42, United States Code, Section 6901 et seq.) or state statute or regulation. State regulations may define a larger spectrum of materials as hazardous waste than Federal regulations.

[b] LLW would include GTCC-Like or TRU waste generated from the PIE of a single fuel pin.

During PIE, intermittent cask shipments would occur via tractor-trailer truck. Waste shipments on a tractor-trailer would occur on an average of once per week through disposition of the mobile microreactor.

Disposition of the Mobile Microreactor

Following storage, the microreactor module within its CONEX container would be transported to the defueling facility where the microreactor module would be defueled. As indicated in Chapter 2, *Description of Alternatives*, there are several facilities at the INL Site that are options for use as the defueling facility. During defueling, spent fuel and moderator blocks would be removed from the microreactor vessel and packaged in standard spent nuclear fuel canisters. This approach would be used regardless of whether the moderator blocks contained beryllium.

The mobile microreactor is composed of up to four modules, with each module housed in a standard CONEX container (total of four CONEX containers). All waste generated during post-operations work would use existing processes and procedures from the certified INL waste management program. The following provides a description of the waste types and quantities expected to be generated from each module during post-operations disposition of the mobile microreactor.

Reactor Module

- **Spent Nuclear Fuel:** The spent nuclear fuel (SNF) and moderator blocks removed from the mobile microreactor have a volume of less than 120 cubic feet. While the details of SNF packaging and storage have not yet been developed, it is anticipated this quantity of material would fit into no more than three standard Department of Energy SNF canisters. The three canisters (or alternate interim storage capsule) would be stored in existing SNF storage locations such as the Radioactive Scrap and Waste Facility or the Idaho Nuclear Technology and Engineering Center. Irradiated fuel would ultimately be made road ready (e.g., overpack of the interim storage canister into a Department of Energy-standard canister), and then shipped to an interim storage facility or deep geologic repository when one becomes available (INL, 2021b).

- **Transuranic or Greater-than-Class-C-like Waste:** Other mobile microreactor components that could be considered transuranic (TRU) waste or greater-than-Class C (GTCC)-like waste would be separated from the remaining LLW and analyzed. If the survey results indicate that these other mobile microreactor components contain transuranic elements in sufficient quantity, they would be managed as TRU or GTCC-like waste. It is anticipated waste of this type would not exceed 120 cubic feet. This material likely would be packaged in 55-gallon drums, overpacked in appropriate casks, and shipped to a disposal location. This type of waste could be packaged in 0 to 15 (55-gallon) drums if beryllium is used in core reflector materials (INL, 2021b).
- **Low Level Radioactive Waste**: The defueled microreactor module (including the microreactor vessel and internal components) is anticipated to be classified as LLW. This expectation of microreactor vessel and other microreactor internal components being LLW is consistent with the Decommissioning & Decontamination experience at Fort Saint Vrain, Colorado. These other materials would remain inside the microreactor pressure vessel or the microreactor module CONEX container and would be shipped off-site for disposal as LLW. The CONEX container and contents may be stored on-site to allow for radioactive decay prior to shipment. The microreactor module may be shipped in a Type B configuration or may be allowed to decay until such time as it can be characterized as a Type A quantity. In either case, the shipment will comply with the requirements of 10 CFR 71, including the requirement that the package meet direct radiation dose requirements of 200 millirem/hour on contact and 10 millirem/hour at 2 meters. Disposal would occur at a suitable waste disposal facility such as the Nevada National Security Site (INL, 2021b).
- **Hazardous Waste:** Items that would be considered hazardous waste as per the Idaho Hazardous Waste Management Act/Resource Conservation and Recovery Act, which would preclude direct disposal of the microreactor module at an off-site facility, would be removed from the microreactor module and would be managed as a separate waste stream. These items would be treated, stored, and disposed of in full compliance with the Idaho Hazardous Waste Management Act/Resource Conservation and Recovery Act, including compliant storage on the INL Site, on-site treatment in permitted INL facilities, off-site treatment at permitted vendor facilities, and ultimate disposition in compliance with land-disposal restrictions.
- **Mixed Low Level Radioactive Waste:** Electronics within the microreactor CONEX container would be sampled for activation products prior to disposal. If microreactor module electronics contain activation products, they would be disposed of as mixed low-level waste (MLLW).

Power Conversion Module

- Piping and equipment that contacted the secondary coolant would be evaluated and managed as LLW or nonradioactive waste, as appropriate. LLW will be disposed of off-site in configurations that comply with the disposal facility waste acceptance criteria.
- Other contents of this module, including the CONEX container, are anticipated to be nonradioactive waste and would be recycled or disposed of as per standard INL industrial waste processes.

Control Module

- Materials in this module are anticipated to be nonradioactive waste and would be recycled or disposed of as per standard INL industrial waste processes.

Ancillary Equipment Module (if used)

- It is anticipated that all materials in this module would to be nonradioactive waste and would be recycled or disposed of as per standard INL industrial waste processes.

Materials Other Than Radioactive Waste

Materials other than the radioactive waste from the disposition of the mobile microreactor and the CONEX containers would be disposed of as industrial waste or recycled if possible. This material includes:

- Piping – 500 feet
- Wire conduit – 500 feet
- Wiring – 1,000 feet
- CONEX containers – 3 (INL, 2021b).

The treatment and disposal pathways are depicted in **Figure B-1**. Waste identified as LLW include the MLLW associated with microreactor module electronics.

B.8. References

INL. (2021a). *Pele Microreactor Hazards and Impacts Information in Support of National Environmental Policy Act Data Needs.* INL/EXT-21-62873. Idaho National Laboratory.

INL. (2021b). *Project Pele Waste and Material Data for Environmental Impact Statement (EIS).* TEV-4257. Idaho National Laboratory.

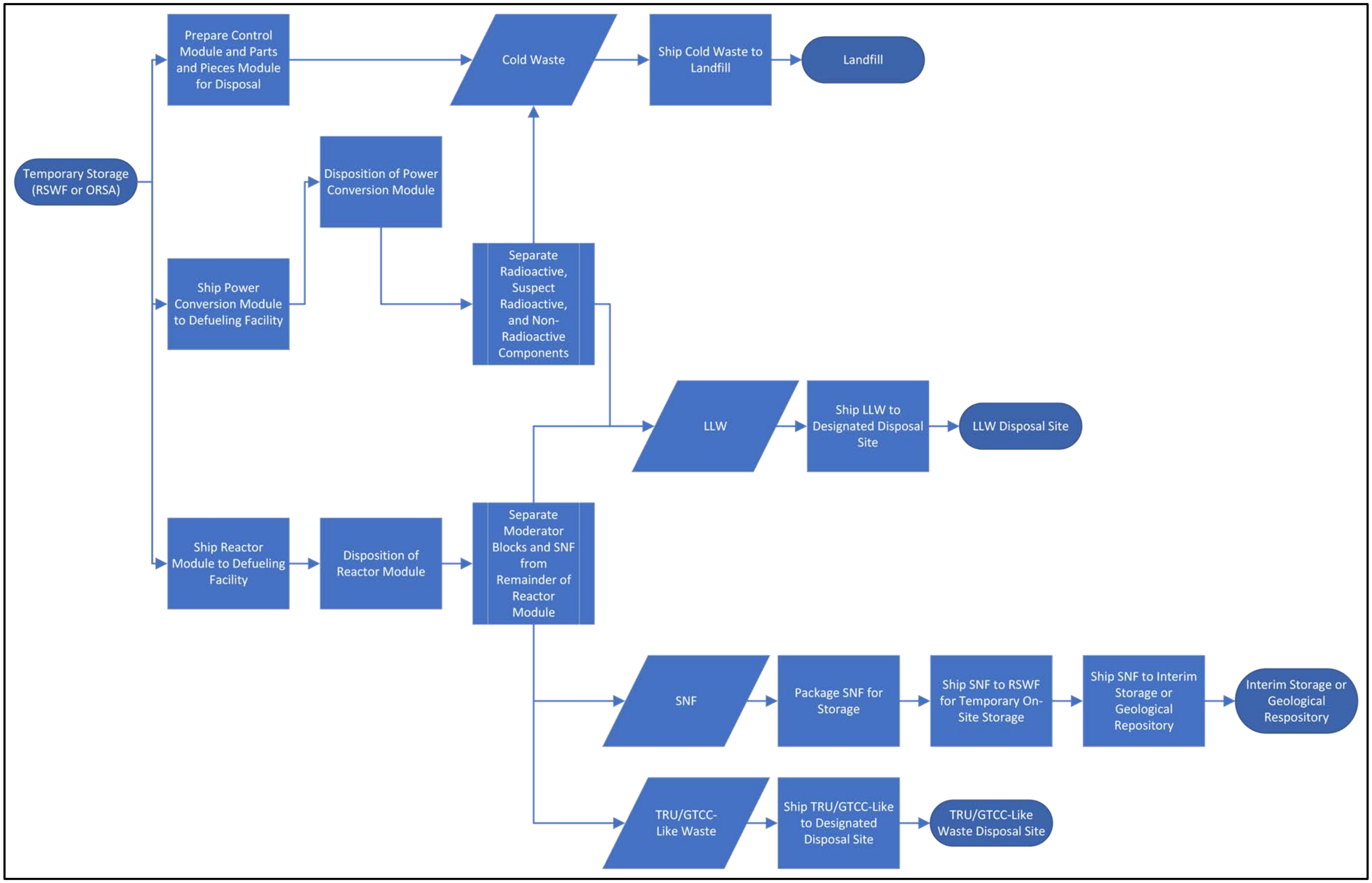


Figure B-1. Treatment and Disposal Pathway for the Mobile Microreactor

Appendix C
Tribal Coordination

This page left blank intentionally.

C. Tribal Coordination

C.1. List of SCO Meetings with the Shoshone-Bannock Tribes/Tribal Representatives for Project Pele

C.1.1. Monday, July 26, 2021

Time: 4:00 PM-5:00 PM Mountain Time

Purpose: SCO Briefing to the Fort Hall Business Council on the Status of Project Pele

Location: Fort Hall Business Center, Tribal Conference Room, Fort Hall, Idaho

Participants:

SCO

- Jeff Waksman, Program Manager, Strategic Capabilities Office

INL

- Justin Coleman, Senior Technical Advisor, Microreactors

DOE

- Bob Boston, Manager, DOE-ID Operations Office
- Betsy Holmes, DOE-ID Cultural Resources Coordinator
- Willettia Amos, DOE-ID Tribal Liaison

Shoshone-Bannock Fort Hall Business Council:

- Chairman: Devon Boyer
- Vice Chairman: Marlene Skunkcap
- Treasurer: Elma Thompson
- Secretary: Ladd Edmo
- Sargent of Arms: Roland Marshall
- Councilman: Nathan Small
- Councilman: LeeJuan Tyler

Shoshone-Bannock Tribal DOE Staff:

- Talia Martin, Tribal DOE Director
- LaRae Bill, Cultural Resources Specialist
- Carolyn Smith, Cultural Resources Coordinator
- Lori Howell, Air Quality Manager
- Christina Cutler, Environmental Coordinator

C.1.2. Wednesday, April 28, 2021

Time: 9:00 AM-11:00 AM Mountain Time

Purpose: DOE, SCO, and Tribal Cultural Resources Meeting at INL

Location: INL Site, Critical Infrastructure Test Range Complex (CITRC) Pad C

Participants:

SCO

- Jeff Waksman, Program Manager, Strategic Capabilities Office
- SCO and USACE team members

INL

- Justin Coleman, Senior Technical Advisor, Microreactors
- INL team members

DOE

- Nicole Hernandez, Director, DOE-ID Environmental Support Division
- Betsy Holmes, DOE-ID Cultural Resources Coordinator
- Willettia Amos, DOE-ID Tribal Liaison

Shoshone-Bannock Tribal DOE Staff:

- Talia Martin, Tribal DOE Director
- LaRae Bill, Cultural Resources Specialist
- Carolyn Smith, Cultural Resources Coordinator

C.1.3. Friday, November 8, 2019

Time: 10:00 AM-11:00 AM Mountain Time

Purpose: SCO Initial Briefing to the Fort Hall Business Council on Project Pele

Location: Fort Hall Business Center, Tribal Conference Room, Fort Hall, Idaho

Participants:

SCO

- Jeff Waksman, Program Manager, Strategic Capabilities Office

INL

- Justin Coleman, Senior Technical Advisor, Microreactors

DOE

- Jihad Aljayoushi, Director, DOE-ID Nuclear Programs Support Division
- Brad Bugger, DOE-ID Tribal Liaison
- Willettia Amos, DOE-ID Tribal Liaison

Shoshone-Bannock Fort Hall Business Council:

- Chairman Ladd Edmo
- Councilman Nathan Small
- Councilman LeeJuan Tyler
- Councilman Tino Batt

- Councilman Darrell Dixey
- Councilman Kevin Callahan
- Councilman Donna Thompson

Shoshone-Bannock Tribal DOE Staff:

- Talia Martin, Tribal DOE Director
- LaRae Bill, Cultural Resources Specialist
- Carolyn Smith, Cultural Resources Coordinator
- Christina Cutler, Environmental Coordinator

This page left intentionally blank.