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U.S. Department of Energy
Idaho Operations Office

Draft Environmental Assessment for the Demonstration of Microreactor Experiment (DOME) Test Bed Operations

October 2024

Idaho National Laboratory

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Prepared for the
U.S. Department of Energy
DOE Idaho Operations Office

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ACRONYMS

ALARA	As Low as Reasonably Achievable
APAD	Air permitting and applicability determination
ARDP	Advanced Reactor Demonstration Program
ATP	Acceptance Test Procedure
BEA	Battelle Energy Alliance, LLC
BLM	Bureau of Land Management
CEJST	Climate and Economic Justice Screening Tool
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CH-LLW	Contact handled low level waste
CRMO	Cultural Resource Management Office
CY	calendar year
dBA	A-weighted decibel
DID	defense-in-depth
DOE	Department of Energy
DOE-ID	Department of Energy Idaho Operations Office
DOE-NE	Department of Energy Office of Nuclear Energy
DOME	Demonstration of Microreactor Experiments
DOT	Department of Transportation
DSA	Documented Safety Analysis
EA	Environmental Assessment
EBR	Experimental Breeder Reactor
EIS	Environmental Impact Statement
EJ	Environmental Justice
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act

ESRP	Eastern Snake River Plain
FAT	Factory Acceptance Test
FONSI	Finding of No Significant Impact
FRACAS	Failure Reporting and Corrective Action System
GHG	Greenhouse gas
HEPA	High-efficiency particulate air
HFEF	Hot Fuel Examination Facility
HTTF	High Temperature Test Facility
IDAPA	Idaho Administrative Procedures Act
IDFG	Idaho Department of Fish and Game
IMCL	Irradiated Materials Characterization Laboratory
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
ISO	International Organization for Standardization
LCF	Latent cancer fatality
LLW	Low-level waste
M&O	Management and operations
MEI	maximally exposed individual
MFC	Materials and Fuels Complex
MLLW	Mixed low-level waste
MWe	Megawatt electric
MWth	Megawatt thermal
NEICA	Nuclear Energy Innovation Capabilities Act
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NRAD	Neutron Radiography Reactor
NRC	Nuclear Regulatory Commission
NRF	Naval Reactors Facility
NRHP	National Register of Historic Places

NRIC	National Reactor Innovation Center
O&M	Operation and maintenance
ORSA	Outside Radioactive Storage Area
OSHA	Occupational Safety and Health Administration
PIE	post-irradiation examination
PM	Particulate matter
PPE	Plant Parameter Envelope
R&D	Research and Development
RCRA	Resource Conservation and Recovery Act
RD&D	Research, Development, and Demonstration
ROI	Region of Influence
RSWF	Radioactive Scrap and Waste Facility
SDC	Seismic Design Category
SHPO	State Historic Preservation Office
SNF	Spent nuclear fuel
SSC	Structures, systems, and components
TED	Total effective dose
TRIGA	Training Research Isotope General Atomics
TRISO	Tri-structural isotropic
TRU	transuranic
TSCA	Toxic Substance Control Act
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
VAC	Volt alternating current
WAC	Waste acceptance criteria
WMP	Waste Management Program

HELPFUL INFORMATION FOR THE READER

Scientific Notation

Scientific notation expresses numbers that are very small or very large. Negative exponents, such as 1.3×10^{-6}, express very small numbers. To convert the number to decimal notation, move the decimal point to the left by the number of places equal to the exponent, in this case, six. Thus, the number becomes 0.0000013. For large numbers, those with a positive exponent, move the decimal point to the right by the number of places equal to the exponent (e.g., the number 1.3×10^{6} becomes 1,300,000).

Number	Power	Name
1,000,000,000,000,000	10^{15}	quadrillion
1,000,000,000,000	10^{12}	trillion
1,000,000,000	10^{9}	billion
1,000,000	10^{6}	million
1,000	10^{3}	thousand
10	10^{1}	ten
0.1	10^{-1}	tenth
0.01	10^{-2}	hundredth
0.001	10^{-3}	thousandth
0.000001	10^{-6}	millionth
0.000000001	10^{-9}	billionth
0.00000000001	10^{-12}	trillionth
0.000000000000001	10^{-15}	quadrillionth

Units

The document uses Imperial units with conversion to metric units given below. Occasionally, metric units are used if metric is the common usage (i.e., when discussing waste volumes or when commonly used in formulas or equations).

Unit	Abbreviation
foot	ft
inch	in
kilometer	km
pound	lb
meter	m
Gray	Gy
millirem	mrem
Roentgen-equivalent-man	rem
yard	yd
year	yr

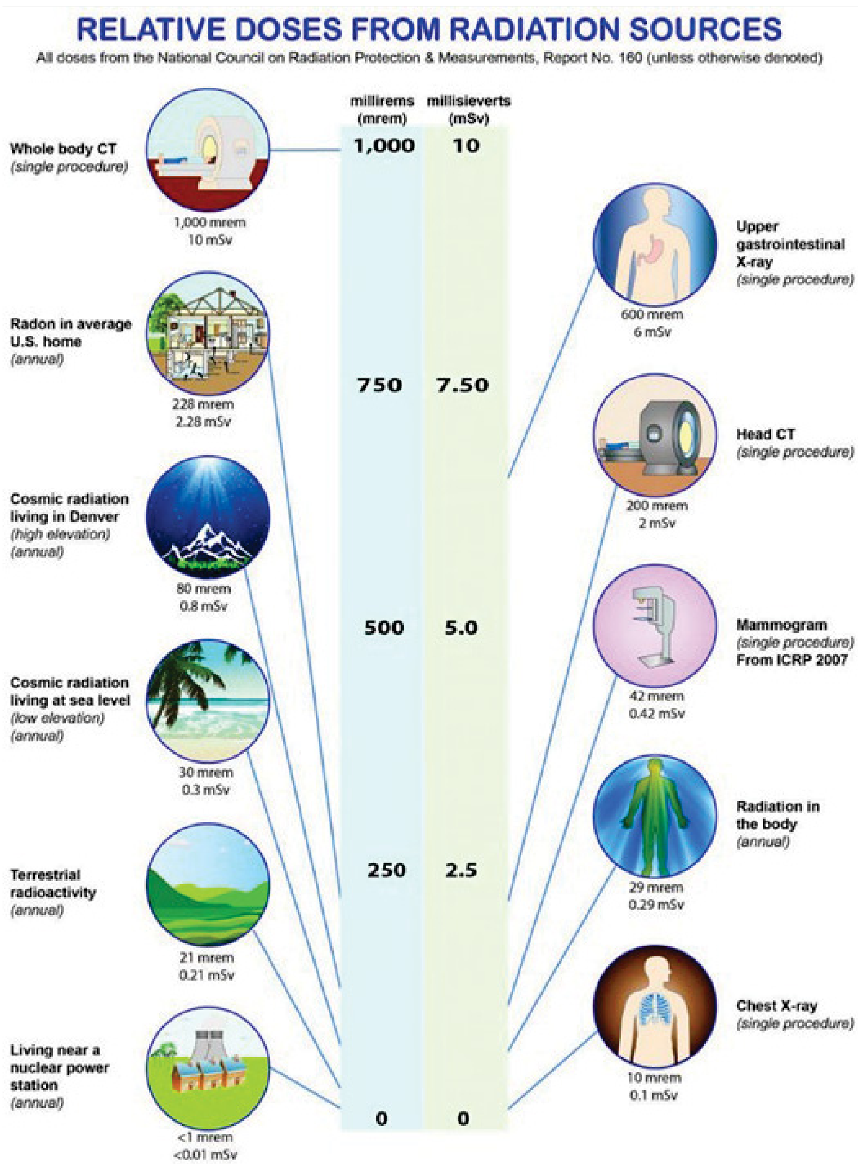
Conversions

To Convert	Multiply By	To Obtain
ft	3.048×10^{-1}	m
lb	4.536×10^{2}	grams
gallons	3.785	liters
mi	1.609334	km
square mi	2.590	square km
yd	9.144×10^{-1}	m
m	3.28084	ft
grams	2.204×10^{-3}	lb
liters	2.641×10^{-1}	gallons
km	6.214×10^{-1}	mi
square km	3.861×10^{-1}	square mi
m	1.093613	yd

UNDERSTANDING DOSE (MILLIREM DOSES) AND LATENT CANCER FATALITY

Relative Dose

A dose[a] is the amount of ionizing radiation energy absorbed by the body. The United States (U.S.) unit of measurement for ionizing radiation dose is the Roentgen equivalent man (rem). In the U.S., doses are most reported in millirem (mrem). A millirem is one thousandth of a rem (1000 mrem = 1 rem). The inset diagram describes radiation doses from common radiation sources, both natural and human sources, for comparison. According to the National Council on Radiation Protection and Measurements, the average annual radiation dose per person in the U.S. is 620 mrem. This information is to help the reader understand and compare dose information described in this document.



[a] https://www.epa.gov/radiation/radiation-sources-and-doses.

Latent Cancer Fatality

A latent cancer fatality (LCF) is a death from a cancer that results from, and occurs an appreciable time after, exposure to ionizing radiation. Death from radiation-induced cancers can occur any time after the exposure. Based on a dose-to-risk conversion factor of 0.0006 LCF per person-rem,[b] and assuming the linear no-threshold model, an exposed worker receiving a dose of 1 rem would have an estimated lifetime probability of radiation-induced fatal cancer of 0.0006 or 1 chance in 1,700.

THE BASICS OF NUCLEAR POWER REACTORS

In some elements the nucleus of an atom can split as a result of absorbing an additional neutron through a process called nuclear fission. Such elements are called fissile materials. When a nucleus fissions it causes three events that release energy: release of ionizing radiation, release of (usually two or three) neutrons, and formation of two new nuclei (fission products). Some of the released neutrons collide with other atoms in the fissile materials, causing them to fission and release more neutrons. The fission process also releases a large amount of heat.

Nuclear reactors contain fissile material in the nuclear fuel. A nuclear reactor achieves criticality (and is said to be critical) when each fission event releases enough neutrons to sustain a steady state, ongoing series of reactions. This is called a chain reaction. Generally, the heat produced from fission is removed from the reactor by various methods, sometimes a circulating fluid, and can be used to produce electricity.

Not every arrangement of fuel can be brought to criticality. A critical concentration of fissile material must be present to bring the reactor to a critical state, otherwise neutrons can be absorbed by other reactor components, which can inhibit a sustained fission chain reaction. Similarly, even where there is a high-enough concentration of fissile material for criticality, a nuclear reactor must have an appropriate volume and a prescribed geometric form, or interactions between neutrons and fissile material would not be sufficient to sustain a chain reaction. This imposes a limit on the minimum critical volume and critical mass within a reactor.

The several different types of nuclear reactors have many common characteristics, including a supply of fissionable fuel in the reactor core. Some nuclear reactors also have neutron moderators, which are materials that slow neutrons to increase their probability of causing fissions or neutron absorbers, which are materials that absorb neutrons and shut down the nuclear reactions and the heat it creates. Reactor control is normally achieved using components made from neutron-absorbing material such as cadmium, hafnium, or boron. Some nuclear designs also contain a coolant that absorbs and transports heat from the reactor for electric power production and cools the reactor core to ensure the fuel and core structures maintain their integrity. Finally, a nuclear reactor must have specifically designed shielding around it to absorb and reflect radiation to protect plant personnel from exposure.

An advanced nuclear reactor is defined in legislation enacted in 2018 as "a nuclear fission reactor with significant improvements over the most recent generation of nuclear fission reactors" or a reactor using nuclear fusion (P.L. 115–248, 2018). Advanced nuclear reactors include molten salt reactors (MSRs) designs that are far smaller than existing nuclear reactors, and that use different moderators, coolants, and types of fuel. Many of these advanced designs are small, transportable, and often self-adjusting reactors capable of producing less than 20 MW of thermal energy that can be used as heat, to produce electricity, or to scale larger commercial nuclear reactors. In contrast, existing commercial nuclear reactors generate an average of about 3,000 MW of thermal energy. Many advanced reactor concepts also include safety, efficiency, and other improvements over existing commercial reactors. These concepts include gas-cooled reactors, liquid-metal cooled reactors, MSRs, and fusion reactors.

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[b] Estimating Radiation Risk from Total Effective Dose Equivalent (TEDE) ISCORS Technical Report No. 1 (DOE 2003).

Draft Environmental Assessment for the Demonstration of Microreactor Experiments (DOME) Test Bed Operations

1. INTRODUCTION

The U.S. Department of Energy (DOE) Office of Nuclear Energy (DOE-NE)-sponsored National Reactor Innovation Center (NRIC) Program is tasked with enabling the experimentation and testing of private sector reactor designs, validating advanced nuclear reactor concepts, resolving technical challenges of those concepts, and offering resources to improve innovative technologies. Headquartered at Idaho National Laboratory (INL), the NRIC Program provides access to the world-class capabilities of the U.S. national laboratory system, including the needed infrastructure and resources for private sector nuclear energy technology developers.

DOE's Advanced Reactor Demonstration Program (ARDP) establishes the framework for public-private cost sharing in several projects that are characterized by having reliable, cost-effective, licensable designs. The objective of the ARDP is to stimulate enterprises in advanced reactor deployment and enable a market environment in which safe and affordable reactor services are made available to government and private sector customers. NRIC is a key partner in this effort by offering resources, including test bed facilities, for private sector customers to exhibit and test innovative reactor designs.

As the nation's premier nuclear science and technology laboratory, INL supports efforts for research, development, and demonstration (RD&D) projects to maintain and expand the use of nuclear energy. INL offers a unique research environment with capabilities and facilities to advance nuclear energy. INL has dedicated facilities focused on nuclear research and development (R&D), including nuclear fuel fabrication, examination, and handling facilities. Battelle Energy Alliance, LLC (BEA) is the management and operations (M&O) contractor at INL. As the M&O contractor, BEA is accountable to DOE for assuring INL's performance.

In accordance with the Council on Environmental Quality (CEQ) regulations at 40 Code of Federal Regulations (CFR) §§ 1500-1508 and DOE National Environmental Policy Act (NEPA) implementing procedures at 10 CFR § 1021, DOE has prepared this environmental assessment (EA) to analyze the potential environmental impacts associated with the operation of the Demonstration of Microreactor Experiments (DOME) test bed facility to accommodate testing of advanced nuclear reactor designs at the Materials and Fuels Complex (MFC) at the INL Site (Figure 1). Depending on the results of this EA, DOE could (1) determine that the potential environmental impacts of the proposed action would be significant to human health and the environment, in which case DOE would prepare an environmental impact statement (EIS); or (2) determine that a finding of no significant impact (FONSI) is appropriate, in which case DOE could proceed with the proposed action with no additional NEPA documentation.

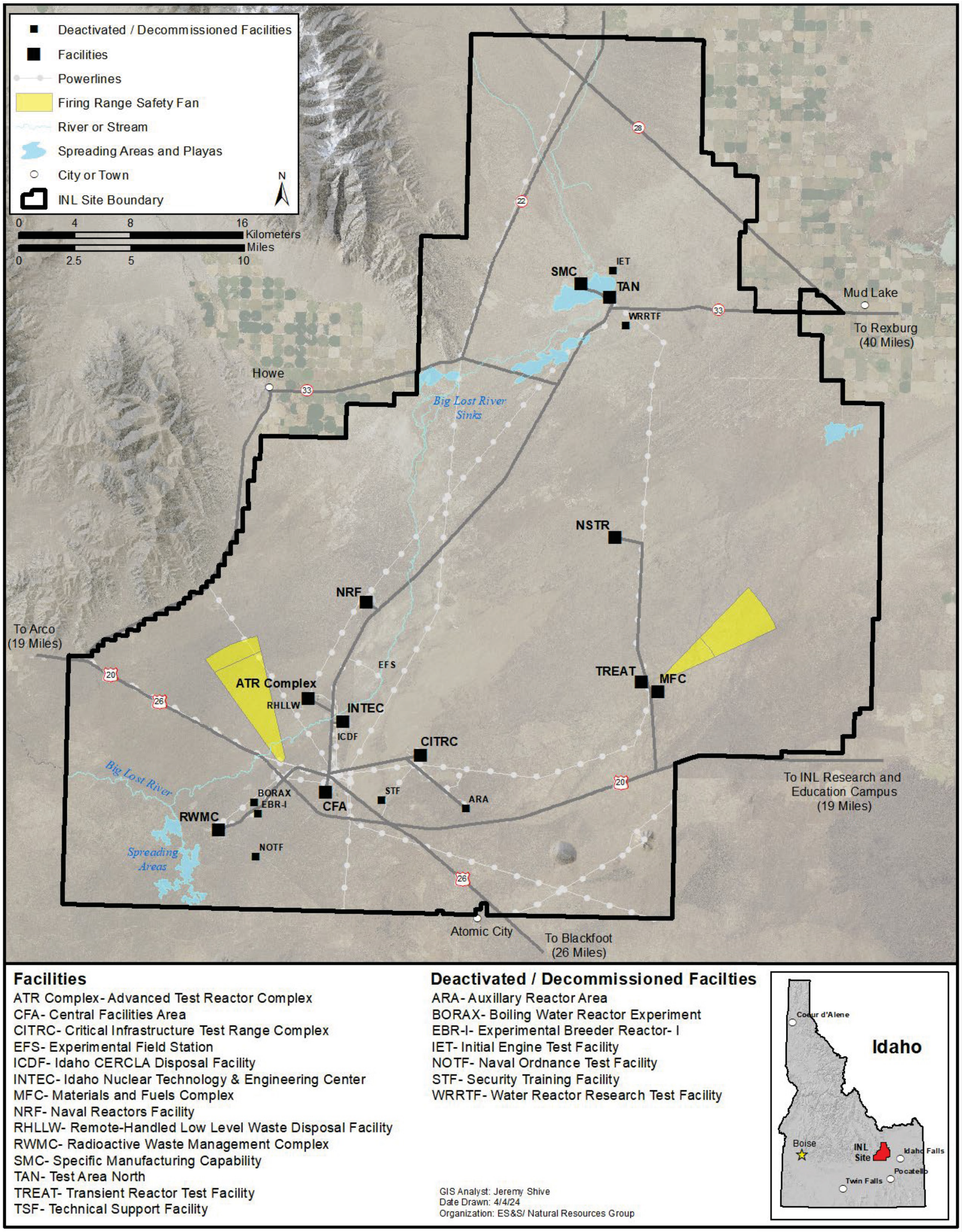

Figure 1. INL Site and facility locations.

1.1 Background

The Nuclear Energy Innovation Capabilities Act (NEICA) of 2017 enabled civilian R&D of advanced nuclear energy technologies by private and public institutions, expanded theoretical and practical knowledge of nuclear physics, and increased confidence for public safety of nuclear energy systems. In addition, the NEICA established NRIC to provide private sector technology developers access to the strategic infrastructures and assets of the U.S. national laboratory system.

To meet the requirements of the NEICA, NRIC is developing advanced reactor experiment capabilities in the former Experimental Breeder Reactor (EBR)-II Reactor Plant Building at MFC (Figure 2). The EBR-II facility was scheduled for demolition in 2019. However, that same year, INL identified the need for increased facility availability for potential future research activities and refurbished the EBR-II facility to support potential future projects. Based on the facility's unique capabilities, including the containment dome, configuration, and proximity to other facilities at MFC, the former EBR-II facility has been selected by NRIC for testing advanced reactor concepts and is now identified as the NRIC DOME test bed. The DOME test bed is co-located near nuclear facilities with fuel fabrication and post-irradiation examination (PIE) capabilities, enabling a wide range of experimental reactor projects. The baseline objective is for the DOME test bed to act as a containment structure capable of siting advanced nuclear reactor designs (up to 20-megawatt thermal [MWth]).

Figure 2. EBR-II reactor plant building in foreground

Multiple reactor developers throughout the U.S. are developing advanced nuclear reactor technologies to establish a zero-emission clean energy source. First-of-a-kind nuclear technology needs a safe, reliable, and affordable location for experimentation and testing to advance. Therefore, the DOME test bed is an essential part in advancing this technology.

In preparing for use of the DOME test bed, NRIC developed a program where interested reactor developers, referred to in this document as a DOME user or user, can use the test bed to evaluate their advanced nuclear reactor technologies. A potential DOME user would submit a proposal that includes the experiment's design, funding, authorization plan, regulatory compliance strategies, and expected support from other entities that may be required to complete the project. DOE gives the final authorization for all reactor projects. This evaluation would be based on criteria including, reactor type and size, reactor technology maturity level, fuel type availability, previous industry experiences, company profile and funding levels, and funding source and viability. Many of these criteria are based on the capabilities of the DOME and form the basis of the plant parameter envelope (PPE). The PPE is a set of operational, engineered, and site parameters that are expected to bound the characteristics of any reactor project using the DOME test bed.

1.2 Purpose and Need

The DOE-NE mission is to advance the nuclear energy science and technology and to meet U.S. energy, environmental, and economic needs. Many advanced nuclear reactor conceptual designs under development in the U.S. anticipate commercial deployment within the next decade. To advance the deployment of this advanced nuclear reactor technology, DOE needs to resolve technical challenges by evaluating reactor designs and better enable reactor developers to integrate this technology into end-user applications for broad deployment and use.

The purpose of the operational activities within the DOME test bed is to address technical and regulatory topics associated with advanced nuclear reactor technology by integrating and operating privately developed reactor experiments in a controlled test environment. Operational activities within the DOME test bed would be used to increase the knowledge level of key phenomena that are essential to the successful Nuclear Regulatory Commission (NRC) licensing of advanced reactor technologies.

1.3 Scope of the EA

This EA documents the proposed action and alternatives, describes the affected environment where the proposed action would take place, evaluates the environmental consequences to the affected environment from implementing the proposed action, and references DOE's statutory obligations and authorities as required by current DOE NEPA implementing procedures described in 10 CFR 1021. This EA focuses on analyzing the effects of the proposed action and describes the environmental impacts with enough detail to support the decision to prepare either a FONSI or EIS.

Integration and operation of advanced nuclear reactor experiment projects in the DOME test bed are technology independent and the specifics of future experiment projects are currently unknown. Integration in this EA means activities necessary to install the reactor experiments and related components at the DOME test bed and outdoor yard area. The proposed project activities described in this EA may not necessarily reflect what is implemented. Therefore, this EA uses a bounding approach to evaluate the potential environmental impacts of DOME test bed operations to the affected environment. When this approach is used, reasonable maximum assumptions are made regarding project activities, potential emissions, waste streams, and other impacts to human health and the environment. This type of analysis generally gives an overestimation of potential effects. Any proposed future actions that may exceed the assumptions (i.e., the bounds of this effects analysis) would require additional NEPA review before DOE decides to proceed with those actions.

This bounding approach is consistent with the CEQ's *Final Guidance for Effective Use of Programmatic NEPA Reviews* (CEQ, 2014), which states,

> *"Programmatic NEPA reviews assess the environmental impacts of proposed policies, plans, programs, or projects for which subsequent actions would be implemented either based on a [corresponding NEPA document] or based on subsequent NEPA reviews tiered to the programmatic*

review (e.g., a site- or project-specific document)." Per CEQ's guidance, "in the absence of certainty regarding the environmental consequences of future proposed actions, agencies may be able to make broad program decisions and establish parameters for subsequent analyses based on a programmatic review that adequately examines the reasonably foreseeable consequences of a proposed program, policy, plan, or suite of projects."

To verify projects do not exceed the bounding conditions established in this EA, DOE has established a review process to accept advanced nuclear reactor projects into the DOME test bed. Figure 3 shows the NEPA review process for advanced nuclear reactor experimentation projects in the DOME test bed. If, at the conclusion of the review process DOE determines the bounding parameters analyzed in this EA are exceeded by a proposed experimentation project, then a project specific NEPA review and review under Section 106 of the National Historic Preservation Act (NHPA) per 36 CFR § 800 would be required.

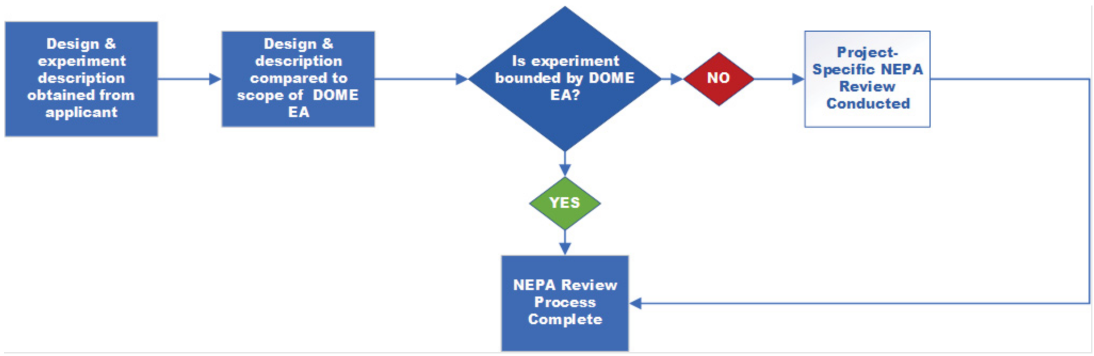

Figure 3. NEPA review process for advanced nuclear reactor projects in the DOME test bed

2. ALTERNATIVES

The following sections describe the proposed action, the no action alternative, and alternatives not considered for further analysis. The information on the proposed action section is organized as follows: program overview, PPE overview, project siting and safety measures, operational lifecycle, and waste management.

2.1 Proposed Action

2.1.1 Program Overview

The DOME test bed is designed to act as a containment structure for the testing of advanced reactor experiments capable of producing energy up to 20-MWth. This energy limit allows DOE to classify the DOME test bed as a Hazard Category 2 nuclear facility per 10 CFR 830, *Nuclear Safety Management*, and DOE-STD-1027, *Hazardous Categorization of DOE Nuclear Facilities*. For acceptance into the DOME test bed, advanced reactor experiments would be decentralized energy sources and have self-contained geometry that requires minimal maintenance. DOE anticipates these advanced reactor experiments would be factory manufacturable and easily transported to the INL Site for integration into the DOME test bed.

DOE would support advanced reactor experiment testing in the DOME test bed by (1) assisting in the development of advanced nuclear reactor projects, (2) integrating projects into the DOME test bed, (3) operating the project reactor, and (4) dispositioning project components and waste and storing spent nuclear fuel (SNF) until a long-term repository is available.

The entirety of proposed activities would occur at INL; however, user sponsored offsite facilities may be used to develop and manufacture some project components. This EA assumes these facilities would be operated in accordance with applicable federal, state, and local laws, regulations, and ordinances. INL personnel would support project proponents by offering expertise in reactor design; inspecting components before, during, and after fabrication; and validating project plans and procedures. DOME users would transport equipment to the INL Site. Transportation of equipment to the INL Site would be similar to other types of equipment transports that occur at the INL Site on a daily basis.

2.1.2 PPE Overview

As stated above, the PPE is a set of operational, engineered, and site parameters that are expected to bound the characteristics of the reactor projects proposed for testing in the DOME test bed. The PPE is designed to facilitate early review of the environmental impacts of DOME advanced reactor projects.

2.1.2.1 Assumptions

DOE used several bounding assumptions in the development of the plant parameters for the DOME test bed to minimize speculation about future conditions when identifying the long-term characteristics of multiple reactor projects. These assumptions are based on DOME test bed attributes, current understanding and anticipated needs of future reactor projects, and regulatory requirements. The assumptions are as follows:

1. The DOME test bed is designed for the deployment of reactor projects that meet the PPE.

Users applying to use the DOME test bed would meet the plant parameters and other project requisites identified in the DOME User Guide (Schoonover, 2023). As part of this assumption, DOE anticipates project plans and procedures for each reactor experiment would be developed with NRIC assistance. Offsite facilities would manufacture reactors to meet relevant requirements. Once manufactured, DOME users would transport the reactor and associated equipment to the INL Site without fuel, and the reactor would be staged at a designated area. From the staging area, equipment would be integrated into the DOME test bed following project-specific plans and procedures. The reactor would be fueled at the DOME test bed or another appropriate facility at the INL Site and then transferred to the DOME test bed. Reactors would not be refueled. Following reactor experiments, the reactors would be prepared for removal from the DOME test bed and transferred to the Radioactive Scrap and Waste Facility (RSWF) receiving area, the Outside Radioactive Storage Area (ORSA), or another location at MFC to cool prior to decommissioning. A specific facility for defueling activities has not been identified at this time.

2. The designed lifespan of the DOME test bed is 20-years.

Reactor experiments would occur within the designed lifespan of the DOME test bed. During that time, experiments would occur sequentially, not simultaneously. The specific timeframe for each experiment would be dependent on the complexity of the reactor design, the arrival of needed equipment, testing requirements, and waste program needs. DOE does not expect to limit the number of experiments that may be performed within DOME. However, for the purpose of impact analysis, DOE assumes the operational lifecycle of an individual reactor experiment would be about 36 months with approximately 24 months of reactor operations in the DOME test bed during its operational lifespan. DOE estimates that each reactor experiment would need up to 6 months for integration into the DOME test bed and up to 6 months for decommissioning for a total of about 12 months for both.

3. Reactor operations would be performed by INL personnel with the assistance of the user.

Once the reactor and associated equipment arrives onsite, INL personnel would begin to integrate project components into the DOME test bed. Training to install, test, operate, and remove the reactor module would be provided. INL personnel would perform operational activities, including fueling, commissioning, transient testing, and PIE as identified in project plans and procedures. In addition, INL would manage waste, air emissions, and other aspects of the project, including SNF, project decommissioning, and the dispositioning of project waste.

2.1.2.2 PPE

The PPE generally represents the largest parameter values of a potential reactor experiment. For example, the thermal output (in MWth) is based on the design features of the DOME test bed (e.g., the physical size of a reactor). The PPE is a set of engineered parameters that bound the characteristics of a reactor experiment that might later use the DOME test bed.

Table 1 lists the bounding PPE values for a single maximum surrogate reactor experiment inside the DOME test bed. The PPE is broken down into three parts: integration, testing, and decommissioning. These parts represent the three major phases of the operational lifecycle of a reactor experiment in the DOME test bed. The values listed in the PPE are not meant to imply that an actual reactor with these parameters would be constructed and operated; rather, these values represent the largest parameter values of a potential reactor project and are intended to capture the upper limit of any potential impact to human health and the environment.

Table 1. Bounding plant parameters for DOME test bed operations

Operational Lifecycle Phase	Plant Design Parameter	Definition	Bounding Value
Integration	Duration	Duration of integration activities onsite	3-6 months
Experiment	Fuel	Reactor Fuel	Tri-structural isotropic (TRISO) particle fuel <20% enrichment
	MWth	Maximum thermal power generated by one experimental nuclear reactor	20 MWth
	MW-electric (MWe)	Best estimate of maximum megawatt electric generator output	10 MWe
	Operational Life	Operational life for which the project is designed or anticipated to be operated in the DOME test bed	6-24 months
	Planned Modules	Number of reactors that would be installed and operated during one project run	1
	Offsite Utilities	Power from utility systems essential to support safety-class structures, systems, and components (SSCs), such as electrical power supply and water supply	Required per General Design Criterion 17 (DOE Order 420.1)
	Normal Plant Heat Sink	Technology for the normal plant heat sink	Anticipate use of adjustable load banks, a water heat sink, or dissipated through air
	Water Consumption	Average consumptive use of water for heat sinks or shielding and service water	DOME is capable of providing 10 gpm at 60 psi

Operational Lifecycle Phase	Plant Design Parameter	Definition	Bounding Value
		systems (potable, fire, and sanitary water)	
Decommissioning	Project Disassembly and Decommissioning	Disassembly and removal of project components from DOME following operational testing. The reactor and components would be placed in temporary storage at the INL Site, awaiting eventual disposition.	3-6 months

2.1.3 Project Siting and Safety Measures

2.1.3.1 DOME Test Bed

Proposed reactor experiments would be integrated within the DOME test bed at MFC. Figure 4 shows the location of the DOME test bed at MFC within the INL Site. The DOME test bed is about 5,000-ft^2, has an 80-ft diameter, and is 100-ft tall. It is constructed of 1-in. steel plating with a 1-ft thick reinforced concrete inner structure. The EBR-II dome was constructed in 1961 as an engineering facility to demonstrate the feasibility of fast reactors for central station power plant applications. The EBR-II Dome was scheduled for demolition in 2019. The *Action Memorandum for the EBR-II Final End State* (DOE, 2010) evaluated alternatives for the final end state of the EBR-II reactor and reactor building. *End State* (DOE-ID 2010) The Action Memorandum was prepared in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 United States Code [USC] § 9601 et seq.), as amended by the "Superfund Amendments and Reauthorization Act of 1986 (SARA)" (Public Law 99- 499), and in accordance with the "National Oil and Hazardous Substances Pollution Contingency Plan" (40 CFR 300). This action is consistent with the joint U.S. Department of Energy (DOE) and U.S. Environmental Protection Agency (EPA) Policy on Decommissioning of Department of Energy Facilities Under the Comprehensive Environmental Response, Compensation, and Liability Act (DOE and EPA 1995), which establishes CERCLA non-time-critical removal action (NTCRA) process as an approach for decommissioning. This approach satisfied environmental review requirements, provided for stakeholder involvement, and provided a framework for selecting the decommissioning alternative.

Alternative 3, “Grouting the EBR-II Reactor Vessel in Place,” was recommended and became the selected alternative after agency reviews and public participation. Under Alternative 3, most systems and structures above the reactor building floor were removed and most of the remaining systems and structures below floor level, including the EBR-II reactor vessel, were grouted in place. Also in 2019, DOE began refurbishing the EBR-II facility to support programmatic research needs at MFC. In 2020, DOE began further modifications to the EBR-II dome to support potential future advanced reactor demonstrations. DOE evaluated the environmental impacts of refurbishing the EBR-II dome in Categorical Exclusion CX-028326 (DOE-ID, 2022).

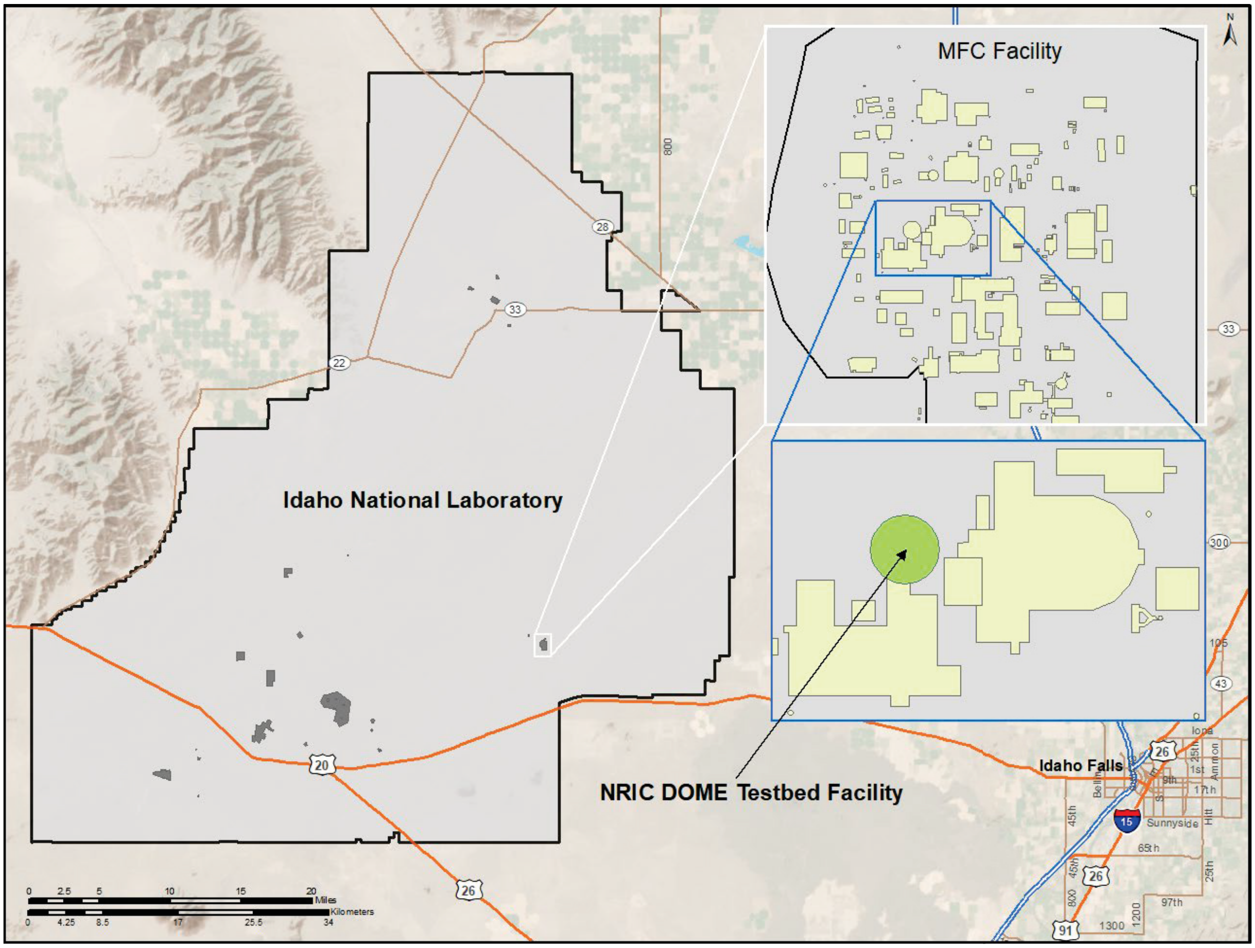

Figure 4. DOME test bed location at MFC at the INL Site

MFC would serve as the operation and maintenance (O&M) facilitator for the DOME test bed. The scope of O&M activities includes planned preventative and predictive maintenance and repair required to keep reactor experiments and supporting infrastructure in a condition required to meet NRIC's goals and DOE orders.

The DOME test bed system includes the containment structure where an experimental reactor would be installed, containment cooling and ventilation equipment, mechanical equipment, and module handling system (see Figure 5). The systems would facilitate the gathering of information from reactor experiments that is necessary for future permitting, licensing, and safety analyses, as well as the development of installation, testing, and decommissioning activities.

The DOME test bed also includes a designated outdoor yard area (see Figure 6) that would be used for system equipment and temporary storage outside the DOME test bed. Major items located in the yard area would include the control module (a temporary structure designed by reactor developers specific to their reactor design to house instrumentation and controls equipment), cooling equipment, ventilation and mechanical equipment, reactor loading equipment, user equipment, and equipment staging areas. The temporary staging yard is graveled.

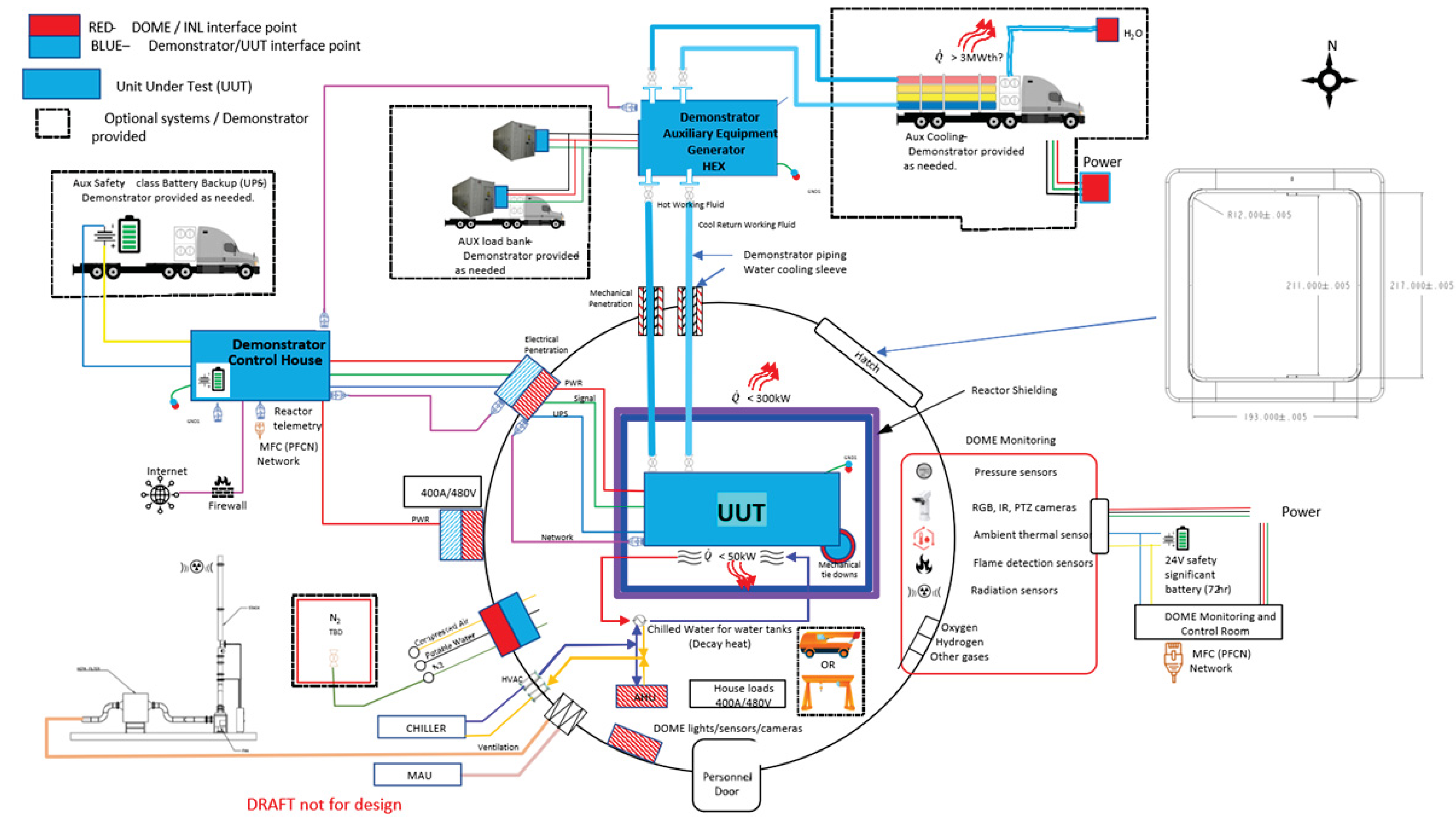

Figure 5. Dome test bed major systems and site layout

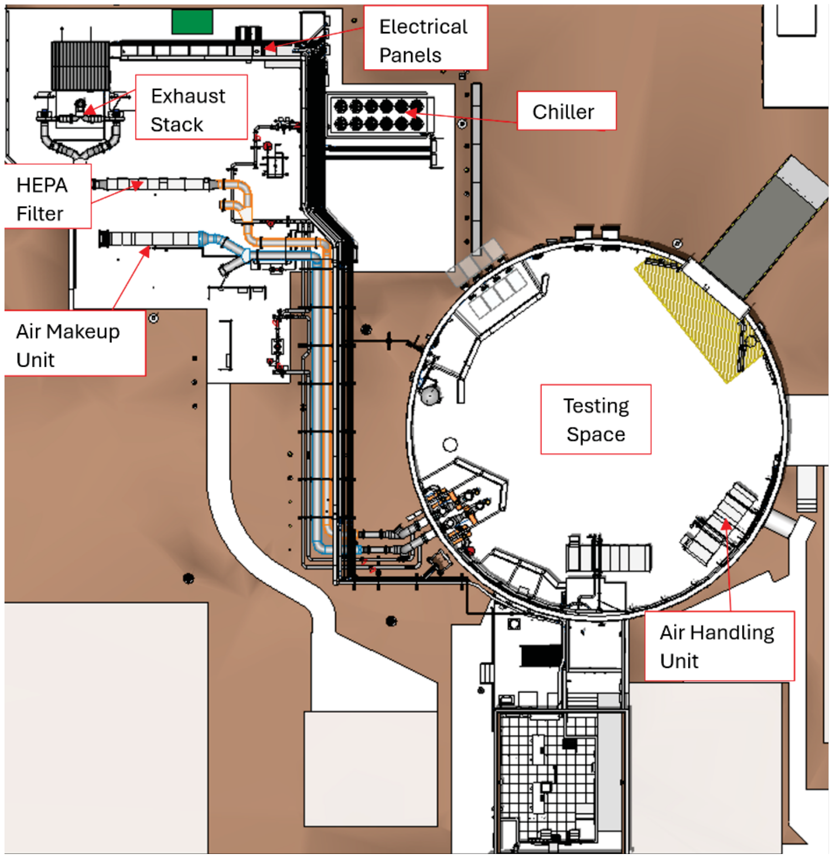

Figure 6. DOME test bed major equipment locations and designated yard area

2.1.3.2 Major Test Bed Systems

Mechanical Systems

DOME mechanical systems would include, but not be limited to, those needed for loading and removing the reactor, decay heat removal, cooling systems, fire protection, compressed air, ventilation, and other necessary components. Penetrations into the containment structure are available for reactor project mechanical systems. Penetrations are generally open pass-throughs where mechanical conduits or other system components can be safely installed to support project requirements. As part of the facility specifications, system components using these penetrations may not exceed 212°F (100°C) at any time. Fluid connections (i.e., cover gas systems) that pass through these penetrations must account for any isolation, insulation, and active or passive cooling required to maintain the surface temperatures below 212°F (100°C).

Decay Heat Removal

Advanced reactor experiment projects would not require a safety-class decay heat removal system. The DOME containment is evaluated to tolerate the anticipated decay heat produced by an experimental reactor under operational conditions. To meet the DOME test bed requirements, decay heat from a reactor test is assumed to be transferred to the air through convection from the DOME atmosphere (passive heat removal). Heat generation due to decay in the reactor core is assumed to be transferred to the interior surface of the containment structure. Decay heat removal may also occur using adjustable load banks or water heat sink, both of which would be provided by the user and would meet project requirements.

Heat Rejection and Cooling Systems

The heat rejection and cooling systems would consist primarily of a central plant with a chilled water and glycol system. The chilled water and glycol system can maintain air in the test bed below 40°C. These systems would be designed to extract about 300 kW of heat from the containment structure during reactor operations. Reactor projects would be designed to integrate with the DOME test bed cooling system.

The cooling system would be combined with the ventilation system to maintain a negative pressure inside the containment structure, supply fresh air, route exhaust through a series of high-efficiency particulate air (HEPA) filters and out a stack, and provide stack monitoring and over- and under-pressure protection. The ventilation system exhaust stack would have an effluent monitoring system compliant with ANSI/HPS N13.1-2021, *Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities*. This standard states that sources with an unmitigated effective dose equivalent to any member of the public greater than 5 mrem/yr requires continuous sampling for a record of emissions and in-line, real-time monitoring with alarm capability, and consideration of separate accident monitoring system, and sources with an unmitigated dose of 0.1 mrem/year require continuous sampling for record of emissions, with retrospective, off-line periodic analysis.

The stack would have an internal diameter of 15.25 in. and be about 25 ft tall. The stack and ventilation system would be designed to exhaust 1300 to 2500 ft^3 per minute. Stack emissions would be continuously sampled and recorded. If further filtration is required, it would be evaluated as part of future experiment system design. A second stage of HEPA filters may also be installed upstream of the exhaust fans on an outdoor skid.

Outside air would be supplied to the dome by a typical industrial make-up air unit. The outdoor air intake flow would be based on a building occupancy of 40 people when the reactor is not running; personnel would not be in the DOME while reactor experiments are running.

During reactor operations, negative air pressure would be maintained in the containment structure. The ventilation control system would monitor differential pressure, flow rates, and radiation levels in the exhaust stack, and modulate valves and dampers, as necessary.

For each reactor experiment, DOE would develop an air permitting and applicability determination (APAD) for each applicable source of radiological air emissions associated with the project to verify compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAP), Subpart H (40 CFR 61). The APAD would also demonstrate compliance with the facility emissions cap sitewide permit (P2020.0045) for any non-radiological emissions. In the event a Permit to Construct is required, an application for the Permit to Construct would be submitted to the Idaho Department of Environmental Quality, pursuant to Idaho Administrative Procedures Act (IDAPA) 58.01.01, "Rules for the Control of Air Pollution in Idaho," and an Approval to Construct application would be submitted to the EPA pursuant to 40 CFR 61.96, "Applications to Construct or Modify."

Fire Protection

A fire suppression system is not planned for inside the containment structure because the various reactor designs and materials may react with water or other suppression agent. A fire monitoring and detection system would be employed. This type of fire safety system relies on flame-detection and fire-detection sensors that signal to the monitoring and detection system.

Electrical System

Reactor experiments would have access to a 480-volt alternating current (VAC)/400 A three-phase power grid panel inside the DOME test bed. The exterior control module and auxiliary models would have access to a 480-VAC/400 A three-phase grid panel. A backup power system is not included as part of the DOME test bed. If required, a safety significant backup power system would be integrated into the DOME test bed for individual projects.

Instrumentation and Controls

The reactor project and control system would send signals to the DOME monitoring and control system located in the DOME control room, enabling DOME systems to monitor the reactor state and take any actions for the DOME containment. The DOME facility would provide similar monitoring and signals to the experiment users.

Safety

DOME test bed reactor projects would primarily rely on passive means to ensure safety from nuclear accident events and would also incorporate active prevention and recovery controls.

Hazard evaluations as part of the Documented Safety Analysis (DSA), as defined by 10 CFR 830.3, would be performed to support each phase of the advanced reactor experiment project design efforts to ensure safe operating standards and safeguarding of nuclear material. A reactor hazard evaluation would comply with the requirements in DOE-STD-1189-2016, "Integration of Safety into the Design Process," and would follow the guidance of DOE-STD-1237, "Documented Safety Analysis for DOE Reactor Facilities." The project DSA would comply with 10 CFR 830, "Nuclear Safety Management," and DOE-STD-1189-2016. This approach would give reasonable assurance of meeting the requirements of DOE-STD-1189-2016 for protection of the public, worker, and environment for the DOME test bed.

In addition, a reactor hazard evaluation would be performed to identify the safety classification of structures, systems, and components (SSCs), SSC safety functions, and design basis accidents applicable to each experiment. As required by 10 CFR 830, safety SSCs are systems that perform important defense-in-depth (DID) functions, relied on for the safe operation and safe shutdown of a nuclear facility, and for maintaining the facility in a safe shutdown condition as documented in the safety basis. Support systems to SSCs that are required for safety functions are also included. With these SSCs identified, the reactor can be built and operated safely in the DOME test bed. An advanced reactor experiment's safety-in-design approach would implement a DID strategy by adopting the five layers of DID in DOE Guide 420.1-1A guidance to ensure adequate capability DID in the reactor design. The DID layers are an integral part of the SSC classification and performance requirement determination.

Any reactor experiment would also be designed to maintain reliability during a seismic event and other environmental hazards. Systems are designed to have a high confidence of low probability for failure for a seismic event of 1.66 times the safe shutdown earthquake (SSE). Per 10 CFR 100.23 Appendix S Part 50, the SSE is defined as the vibratory ground motion for which certain SSCs must be designed to remain functional. SSEs are developed using guidance that satisfies 10 CFR 100.23. It is also expected that the DOME test bed would have adequate protection from other natural external hazards, such as high winds, flooding, and fire.

2.1.4 Operational Life Cycle

The operational life cycle of the typical advanced reactor testing in the DOME test bed is described in three phases: integration, testing, and decommissioning.

2.1.4.1 Project Integration

Project integration consists of installing and commissioning the reactor within the DOME test bed system.

Modifications

To prepare for each user system, the DOME test bed may be modified to accommodate specific equipment and components. Any modifications would follow the major modification determination process guidance of DOE-STD-1189. Reconfiguring and installing temporary or moveable shielding or equipment would be accomplished in the interim periods between testing or unit installations, and as part of the user's integration period. Modifications to the DOME test bed that would require review under Section 106 of the NHPA per 36 CFR § 800 are not covered by this EA and would require separate NEPA analysis.

Delivery and Assembly

The user would be accountable for permitting and transporting the reactor units and their support equipment to the DOME test bed using a DOE approved method. Upon arrival and acceptance, the reactor unit and associated components would be unloaded, assembled, stored, and installed. Reactor loading into the test bed would occur using a variety of systems designed to move objects from the designated staging areas into the containment facility and subsequently to remove those objects at the end of the experiment. These systems would be designed to handle a standard International Organization for Standardization (ISO)-668 shipping container-sized package. DOE anticipates the use of such standard heavy equipment as self-propelled or remote-controlled jacks and dollies and a hydraulic slide, which would be able to move most of the project components. Access to the containment facility would be through a 15-ft wide by 17-ft high equipment hatch installed to one side of the building.

Prior to a reactor experiments, acceptance test procedures (ATP), or equivalent, would be performed on individual project components prior to fueling to verify there is no damage or malfunctioning systems prior to fueling of the reactor at DOME or any other facility. The ATP would be compared with the applicable factory acceptance test (FAT) results to confirm project components have similar performance and characteristics when delivered as it had when shipped.

Cold Commissioning

INL staff would perform installation, commissioning, and cold testing in accordance with the user's specifications and laboratory safety guidelines and procedures. The user would supply onsite engineering consultation and subject matter expertise to verify project components are properly installed and operated within specifications. Test plans and procedures from the user would be submitted for review and acceptance by the DOE with sufficient time to allow for any reconfigurations and training to be planned and completed prior to testing. Cold testing would give assurance that the reactor has been properly fueled, transported, installed, and checked prior to hot operations.

Fuel Types

The reactor fuel for advanced reactor experiment projects would be TRISO particle fuel at less than 20% enrichment. TRISO fuel is encapsulated and has been demonstrated to be capable of withstanding temperatures up to 3,300 °F, allowing for a reactor design that relies primarily on simple passive features and inherent physics to ensure safety. TRISO fuel would be manufactured under the direction of INL personnel according to the user and INL specifications. Reactors would be fueled inside an existing facility at MFC following project-specific procedures. Once the project is complete, the reactors would be defueled at the INL Site. DOE anticipates a total of 10.4 metric tons of irradiated fuel would be stored and managed at the INL Site.

Prior to experimenting within the DOME, DOE will have title to the fuel materials.

Regardless of the manufacturer, TRISO fuel would be shipped to the INL Site in shipping containers that meet applicable NRC and U.S. Department of Transportation (DOT) requirements for shipping radiological material. Based on the expected number of projects that could be sited in the DOME test bed, the number of fuel shipments to the INL Site is estimated to be approximately 60 truck shipments throughout the life of the DOME test bed.

Fueling

A project reactor would be delivered unfueled to the INL Site; there it would be fueled, cold-tested, and then prepared for further testing. Transportation and safety analysis would be completed by INL personnel with user support and review.

Fueling methods may be unique to each reactor and design, and planning for the fueling process would be developed with INL personnel to allow for minimum variation in equipment and facility needs to achieve the required result (e.g., side-loading versus top-loading of the core or fuel).

Hot Commissioning

Hot commissioning would occur once the reactor is installed and cold-tested in the DOME test bed. Simulations of the various operational and emergency use cases would be performed before proceeding to higher levels of operation. Commissioning test and simulation plans would be developed by the INL personnel working with the user and approved by DOE.

2.1.4.2 Experiment

Users may design development experiments or tests of their equipment for execution in the DOME test bed. All elements of the testing campaign must be documented by the users and approved and authorized by DOE.

The test campaign would be fully documented in an NRIC-approved test plan. Test plans would detail each phase of a test program including ATP and FAT procedures, start-up, normal and emergency shutdown procedures, and individual procedures for each unique test evolution. Each time a test procedure is executed, a test report would be submitted to document the results, anomalies, and any actions required. The user would provide a documented methodology for root-cause analysis and a failure reporting and corrective action system (FRACAS). FRACAS is the process by which failures are reported in a timely manner and analyzed with corrective actions devised and implemented to eliminate or mitigate the recurrence of failures.

Documented plans and procedures would be developed for normal and off-normal conditions and would be reviewed and approved prior to installing experiments in the DOME test bed. The plans would cover the full test space of nominal conditions expected, such as load-following tests, power ramping up or down to a baseline, maximum running power, and contingencies for known failure modes during off-nominal conditions.

Following testing cycles, PIE samples of fuel may be collected and examined at the various research facilities at MFC (e.g., the Hot Fuel Examination Facility [HFEF], Irradiated Materials Characterization Laboratory [IMCL], Electrometallurgical Laboratory, Analytical Laboratory). PIE includes the analysis and examination of fuel samples. To measure reaction rates and neutron spectrum measurements, small foils containing fissile and non-fissile materials may be examined as part of PIE activities. If a determination to pursue PIE of project components and TRISO fuel is made, the reactors would need to be defueled and deconstructed at the INL Site and components and fuels transferred to HFEF, Analytical Laboratory, the Sample Preparation Laboratory, or the IMCL. PIE activities would not bring in additional fuels to support the advanced nuclear reactor projects.

Proposed activities also include scheduled inspection, maintenance, repair, replacement, and reconfiguration of the test bed facility as a part of reactor installation and testing. Normal maintenance required by the reactor would be defined and scheduled as part of the test plan.

2.1.4.3 Decommissioning

Following operational testing, a reactor would be deactivated with the termination of reactor critical operations. Project components would be allowed to cooldown and decontaminated, and the systems would be dismantled and removed from the DOME test bed.

Following removal, the reactor, fuel, and project components may be placed in temporary storage at MFC awaiting eventual disposition. Temporary storage would occur at the RSWF receiving area, the ORSA, or another location at MFC. During storage project related material would need to be regularly inspected to verify safety, cooling, and shielding SSCs are functional. Workers may be exposed to a radiation field during inspections.

There is no defined duration for temporary storage, but it would continue until components meet offsite disposal facility waste acceptance criteria (WAC). It is anticipated that the reactor and irradiated project components would be disposed of as low-level waste (LLW). Ultimate disposal of irradiated materials that have been declared waste would be in accordance with similar DOE-owned irradiated materials and experiments at MFC. Components that have not been irradiated would be disposed of as nonradioactive waste using appropriate waste streams (hazardous, nonhazardous, etc.).

Each reactor may present a different design, level of use or operation, and general physics. To address the many variables of this process, a detailed decommissioning plan would be developed to explain the strategy, requirements, and roles and responsibilities for the post-experiment handling, storage, and disposal of the units as appropriate. Similarly, fuel processing procedures would be used for the storage of irradiated fuel.

Irradiated Fuel

Reactors would need to be defueled and deconstructed to facilitate disposal of project components. The irradiated fuel, which will remain under DOE's ownership following reactor experimentation, will have significant value for future advanced reactor fuel or advanced fuel cycle R&D material. As such, it is proposed that these materials be managed and stored for future programmatic use at an appropriate INL storage facility. If the material should be determined to no longer have programmatic value (either as TRISO fuel or advanced fuel cycle R&D material), then the DOE waste determination process would be invoked, and the material would be managed accordingly and stored in a compliant manner while awaiting final disposition.

Spent nuclear fuel (SNF) is nuclear fuel that has been withdrawn from a nuclear reactor following irradiation and the constituent elements have not been separated. SNF contains unreacted uranium and radioactive fission products. Because of its radioactivity (primarily from gamma rays), it must be properly shielded. DOE's inventory of SNF is from development of nuclear energy technology (including foreign and domestic research reactors), national defense, and other programmatic missions. At the INL Site, SNF is managed by the Idaho Cleanup Project Core contractor at the Idaho Nuclear Technology and Engineering Cener (INTEC), the Naval Nuclear Propulsion Program at the Naval Reactors Facility, and BEA, the INL Site's contractor at the ATR Complex and MFC.

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, U.S. Navy, State of Idaho, 1995). The 1995 Idaho Settlement Agreement put into place milestones for the management of radioactive waste and SNF at the INL Site.

To resume shipments of SNF to Idaho, including SNF rods for research purposes from the Byron Nuclear Generating Station in Illinois, DOE and the State of Idaho developed the 2019 Supplemental Agreement (DOE-ID and State of Idaho, 2019) to the 1995 Settlement Agreement.

To resolve uncertainty about how commitments made in the 1995 Settlement Agreement to eliminate wet storage of SNF apply to operations of ATR, DOE and the State of Idaho entered into the 2020 Advanced Test Reactor Spent Nuclear Fuel Agreement (DOE-ID and State of Idaho, 2020).

An initial plan for the management of post-irradiated fuel from the DOME experimental reactors has been developed and identifies that the reactors and fuel will be removed from DOME, stored temporarily at RSWF, defueled, identified post irradiation examinations performed, returned to temporary storage, have a fuel determination, and disposed of as SNF if it is determined as SNF. The specific facility for any defueling activity has not been identified nor have any procedures been developed for such activity. The INL Site has extensive experience handling SNF. The INL Site has facilities for handling SNF, 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, the Fuel Conditioning Facility, and HFEF.

Any SNF designated for disposal would be packaged in standard casks, transferred to a storage location on the INL Site, likely at INTEC or RSWF, to await shipment to an interim storage facility or geologic repository. Any SNF would be managed in accordance with applicable laws and other requirements.

2.1.5 Waste Management

Waste generated during or following operation of a reactor experiment would be permanently disposed of in accordance with all applicable regulations and DOE orders. Waste management may involve the ultimate disposal of PIE wastes, reactor components, and project equipment. Projects sited in the DOME test bed would use existing INL Waste Management Program (WMP) processes and procedures.

Waste generated at user affiliated facilities would be managed in accordance with all applicable federal, state, and local laws, regulations, and ordinances.

Transuranic (TRU) waste is not anticipated to be generated during DOME test bed operations.

The ultimate disposition of waste generated during the operations at the DOME test bed would be the responsibility of DOE.

2.2 No Action Alternative

The no-action alternative is not to site advanced nuclear reactors in the DOME test bed or to perform associated experimentation. The consequences of the no-action alternative serve as a baseline, enabling decision makers to compare the magnitude of environmental effects of the proposed action alternative.

2.3 Alternatives Considered and Eliminated from Analysis

As part of the NEPA process, DOE must evaluate potential reasonable alternatives to the proposed action. For alternatives to be considered reasonable, they must meet the purpose and need for agency action (see Section 1.2). There are no other alternatives beyond implementing the program for DOME test bed operations or DOE taking no action. Therefore, no other alternatives were identified.

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

This section presents the affected environment and the environmental consequences of the proposed action and the no-action alternative to that environment. The affected environment is addressed in the proposed action section, the Regional Setting section and briefly described in specific resource area sections.

The environmental consequence analysis builds upon the information provided in Sections 1 and 2. Compliant with DOE's NEPA guidance, this EA applies a sliding-scale approach to impacts analysis consistent with DOE's *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements* (DOE, 2004). Specifically, more information is provided regarding the resources that have a greater potential to be impacted by the proposed action and the no-action alternative while less depth and breadth of analysis are applied to resource areas having clearly no or minor environmental impacts. This approach focuses on significant environmental issues and alternatives and discusses impacts in proportion to their significance.

Under the no-action alternative, activities at the INL Site would continue under present-day operations, and advanced reactor experiments would not be operated in the DOME test bed. The no-action alternative would not result in impacts to resources at the INL Site beyond those captured in the discussion of the affected environment. The environmental impacts of future activities at the INL Site would be evaluated in project- or program-specific analyses in compliance with NEPA. Therefore, impacts from the no-action alternative are not discussed further in this EA.

Consideration of direct, indirect, or cumulative effects, or impacts, of the proposed action to the affected environment is the basis of this document. The purpose of describing direct, indirect, and cumulative effects is to ensure that the full range of reasonably foreseeable effects are considered in any decision to proceed or not with the action. The degree of potential impact includes both short- and long-term effects, both beneficial and adverse effects, effects on public health and safety, and effects that would violate federal, state, tribal, or local law protecting the environment. The evaluation of potential impacts is discussed in terms of *potentially affected environment* and *degree*. Potentially affected environment is described in terms of the geospatial area of an impact. Degree refers to the severity of an impact of the proposed action. When both potentially affected environment and degree are used to describe an impact in this document, the following definitions apply:

- NEGLIGIBLE. The anticipated impacts, or effects, are not detectable in the affected environment or do not differ from existing INL Site operations.
- LOW. Any anticipated impacts, or effects, are minor and would not destabilize or noticeably alter any important attribute of the resource.
- MODERATE. Any anticipated impacts, or effects, are sufficient to noticeably alter, but not destabilize, important attributes of the resource.
- HIGH. Any anticipated impact, or effect, are clearly noticeable and are sufficient to destabilize important attributes of the resource. These impacts would be considered significant.

To determine whether the proposed action would result in a potentially significant impact to a particular resource, resource specific criteria are applied. Resource-specific criteria are described in the impacts section for each resource area analyzed.

For this document, a cumulative effect is defined as an impact on the environment which results from the incremental impact of actions when added to past, present, and reasonably foreseeable future actions regardless of what (federal or non-federal) agency or person undertakes such actions. The analysis of cumulative effects includes reasonably foreseeable actions that have a reasonably close causal relationship to the proposed action. Cumulative effects are discussed in the impacts section for each resource area.

The discussions and analyses in this document are based on the most available and relevant information, current scientific evidence, and research methods generally accepted in the scientific community.

3.1 Idaho National Laboratory Site

The INL Site is an 890-square-mile DOE facility located on the Eastern Snake River Plain (ESRP). It is primarily located within Butte County, Idaho, but portions of the INL Site are also in Bingham, Jefferson, Bonneville, and Clark Counties. All land within the INL Site is controlled by DOE, and public access is restricted to highways, DOE-sponsored tours, special-use permits (i.e., hunting and grazing), and the EBR-I National Historic Landmark.

Public highways U.S. 20 and 26 and Idaho 22, 28, and 33 pass through the INL Site, but off-highway travel within the INL Site and access to INL Site facilities are controlled. Currently, INL employs approximately 6,200 people. No permanent residents reside within the INL Site boundary. Population centers in the region include large cities (more than 10,000 residents), such as Idaho Falls, Pocatello, and Blackfoot, located to the east and south, and several smaller cities (less than 10,000 residents), such as Arco and Terreton, are located near the INL Site boundary (Figure 7).

Vegetation is dominated by low shrubs, such as sagebrush and rabbitbrush, and a wide variety of grass species. The area is populated with animals that inhabit sagebrush grasslands. Animals include pronghorn, deer, elk, coyotes, badgers, rabbits and many bird species including raptors, game birds, and waterfowl; a variety of small rodents; and several reptile species. Some plants and animals that live within the boundaries of the INL Site are culturally significant to the Shoshone-Bannock Tribes.

Cultural resources are numerous on the INL Site. Resources that have been identified include:

- Pre-contact archaeological sites representing hunter-gatherer use over a span of about 13,500 years
- Historic archaeological sites representing settlement and agricultural development during the period from 1805 and the late 1920s
- Historic architectural properties associated with World War II and the development of nuclear science and technology
- Areas of cultural importance to the Shoshone-Bannock Tribes.

Many of these resources are eligible for nomination to the National Register of Historic Places (NRHP). Archaeological sites and Native American resources are generally located in undeveloped areas, while historic architectural properties are found within facility perimeters at the INL Site.

The area surrounding the INL Site is classified as a Prevention of Significant Deterioration Class II area, designated under the Clean Air Act (42 USC 7401 et seq) as an area with reasonable or moderately good air quality while still allowing moderate industrial growth. Craters of the Moon National Monument and Preserve, located about 30 miles from MFC, is classified as a Prevention of Significant Deterioration Class I area, and is the nearest area to the INL Site where additional degradation of local air quality is restricted. DOE monitors air quality using a network of air monitors. The monitors collect samples on a routine basis to measure particulate matter (PM), radioactivity, and other air pollutants.

Release of radionuclides to the environment from current INL Site operations can expose individuals near the INL Site to radiation. Types and quantities of radionuclides released from INL Site operations, including dose estimates from these releases, are listed in the NESHAP annual reports (DOE-ID, 2024) Historically, the dose to the maximally exposed individual (MEI) is less than 1% of the 10-mrem/yr federal standard.

INL Site workers receive the same dose as the general public from background radiation, but they may also receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker (involved worker) and the cumulative dose to all INL Site workers (total workers) fall within the radiological regulatory limits of 10 CFR § 835. According to the accepted risk estimator of 6.0×10^{-4} LCF per person-rem among workers, 0.05 LCF is the projected radiological risk for INL Site workers from normal operations in 2022 (DOE, 2023). Because the radiological risk is less than 0.5, no latent cancer fatalities are expected because of this exposure.

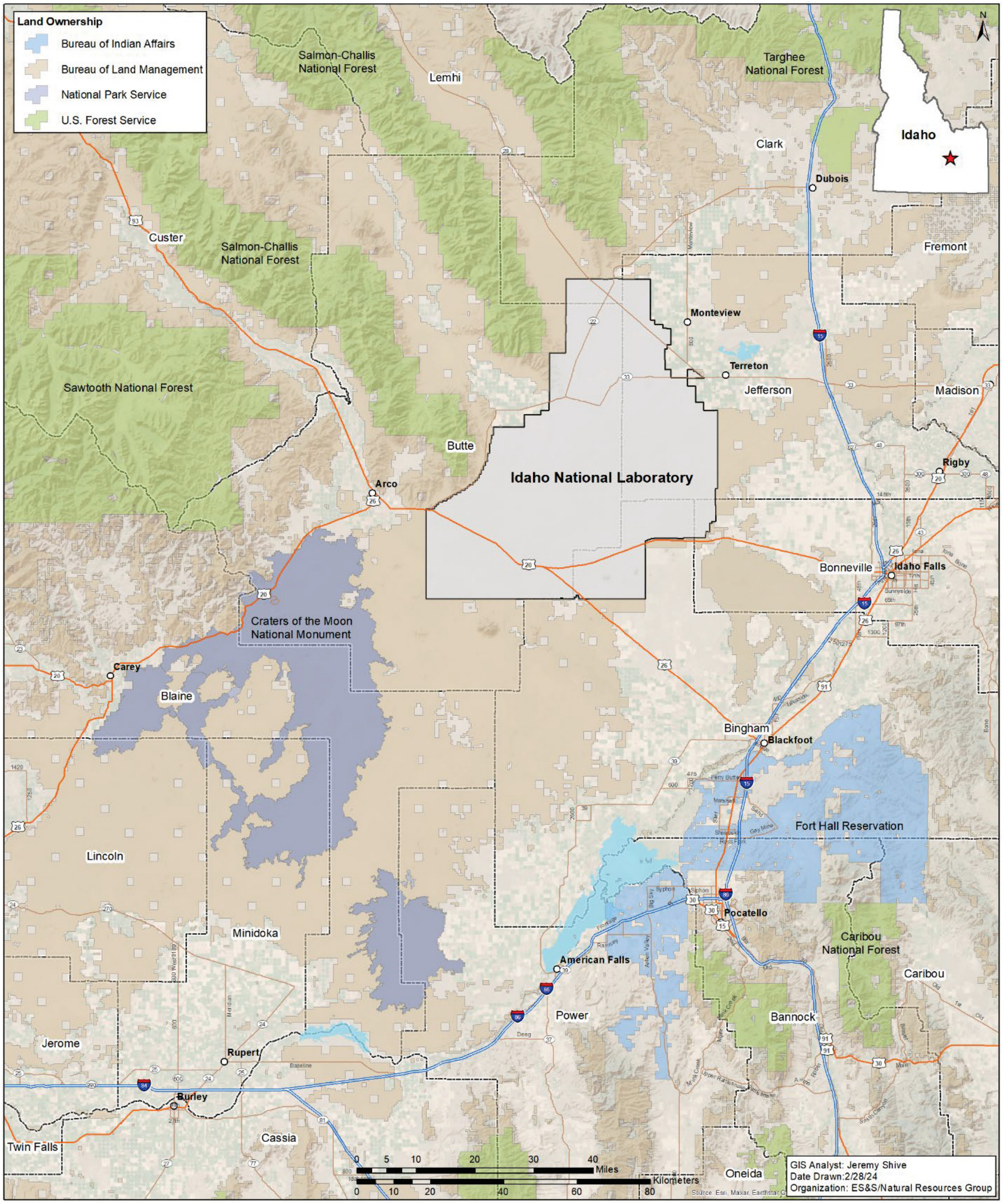

Figure 7. Regional setting of the INL Site

MFC is the most eastern INL Site facility complex (Figure 1). It is located about 38 miles west of Idaho Falls in Bingham County in the southeastern corner of the INL Site. MFC's footprint is approximately 100 acres (inside the MFC fence) and approximately 2.7 miles from the southern INL Site boundary. MFC includes a wide variety of facilities and capabilities that support DOE's nuclear research missions. Activities performed at MFC include R&D for new reactor fuels and related materials for experimentation of various nuclear energy technologies. In addition, MFC supports DOE programs for space and defense radioisotope power systems.

3.2 Resources Eliminated from Further Analysis

Scoping and preliminary analyses indicate that the proposed action would not likely impact the following resource areas; therefore, this EA does not analyze these areas further:

- Ground and Surface Water Contamination. Water consumption is addressed in Section 3.7. No perennial or permanent surface water bodies are near MFC. All facilities within the MFC fenced area are in a single local topographically closed watershed. The MFC watershed contains natural drainage channels, which can concentrate overland flow during periods of high precipitation or heavy spring runoff. The approximate elevation of MFC is 5,130 feet above sea level and more than 7 feet above the water level predicted to occur under the probable maximum flood event corresponding to repeated rainfall events over frozen ground. Therefore, the facilities described in the proposed action are not subject to flooding (Koslow & Van Haaften, 1986). The DOME test bed operations do not include activities that physically or chemically alter ground or surface water resources. Any water used for shielding or other types of activities would be treated and disposed of as appropriate. Any irradiated fuel would be stored in a manner to prevent the material from entering the environment, thereby limiting any potential impact to groundwater resources. Therefore, DOME test bed operations are not expected to result in ground or surface water contamination.
- Land Use and Visual Resources. The DOME test bed operations would not require the construction of new facilities or additional land use or ground disturbance and would occur in existing facilities designed, or modified, for this purpose. DOME test bed operations would have no impact on land use or visual resources.
- Noise. MFC is about 2.9 miles from the INL Site boundary. The closest noise-sensitive receptor is an agricultural homestead located about 5.3 miles from MFC and 2 miles from U.S. Highway 20, which is the primary noise at this location. Discernable noise from DOME test bed operations would be generated from the electrical equipment associated with the reactor operation. It is expected that discernable sound would range from about 80 to 85 A-weighted decibels (dBAs). To give context, a whisper registers at approximately 30 dBA, normal conversation approximately 50 to 60 dBA, a ringing phone 80 dBA, and a power mower 90 dBA (OSHA, 2011). Activities associated with DOME test bed operations would be in existing buildings at MFC. These buildings include numerous noise-generating sources typical of industrial activities such as industrial heating, ventilation, and air conditioning equipment, blowers, moving equipment, and vehicles. The noise generated from DOME test bed operations would be consistent with other existing industrial equipment at MFC and the potential concurrent noise would be similar to existing levels. It is anticipated that DOME test bed project would not cause a change in the noise environment at MFC or the INL Site.
- Socioeconomics. It is assumed that INL would hire no more than 45 full-time employees to support DOME test bed operations. In 2023 the total population of Bannock, Bingham, Bonneville, Butte, Clark, Jefferson, and Madison Counties was estimated at 364,465 (U.S. Census Bureau, 2024). Any potential impacts to population, housing, employment, income, community services, public transportation, and public finance from an additional 45 employees would be negligible. Potential impacts to the local socioeconomic regional landscape from DOME test bed operations would not likely be distinguishable from current INL Site operations, and the anticipated change would not noticeably alter socioeconomic conditions in the seven-county region surrounding the INL Site.

- Greenhouse Gases (GHGs). A natural greenhouse effect is the warming of the earth's atmosphere due to terrestrial radiation being absorbed or trapped by gases in the atmosphere. Scientific evidence is clear that steadily increasing atmospheric GHG concentrations have had significant impacts on Earth's climate (CEQ, 2023). These gases primarily consist of carbon dioxide and include trace amounts of nitrous oxide, methane, sulfur hexafluoride, and chlorofluorocarbons. Emissions of GHG (carbon dioxide equivalents [CO_2e]) in 2023 at INL were estimated to be 111,705.5 MT CO_2e per year (INL, 2023), which is significantly less than the total 3.343 billion MT of CO_2e produced in the U.S. in 2022 (EPA, 2024). Foreseeable GHG emissions attributed to the proposed activities occurring within the DOME test bed is expected to be no more than 1,000 MT CO_2e per year from gasoline-powered vehicles, including commuter vehicles and construction equipment and electricity usage. GHG emissions from construction activities are not evaluated as part of this analysis because no major construction activities are anticipated under the proposed action. The DOME test bed operations are not expected to significantly, directly, indirectly or cumulatively, affect the larger contribution of INL's annual GHGs. Finally, all activities occurring in the DOME test bed would adhere to INL's net-zero carbon emission initiative and goals.

3.3 Air Quality

3.3.1 Affected Environment

Sources of non-radiological air emissions at the INL Site include oil-fire boilers, diesel engines, emergency diesel generators, small gasoline, diesel, and propane combustion sources, and emissions from using chemicals and solvents. Boilers generate steam for heating facilities and are the main source of non-radiological air emissions at the INL Site. Diesel engines are mainly used to generate electricity for facility operations. Miscellaneous non-vehicle sources include small portable generators, air compressors, and welders.

Sources of non-radiological air emissions at offsite facilities include those related to the machining and manufacture of reactor components, including the generation of particulate matter (PM) and emissions from using chemicals and solvents.

Radionuclide emissions from the INL Site occur from (1) point sources, such as process stacks and vents; and (2) fugitive source such as waste ponds, buried waste, contaminated soil areas, and decontamination and decommissioning operations. In 2023, the calculated effective dose equivalent[c] to the MEI member of the public[d] from INL Site operations was 2.9×10^{-2} mrem per year, which is 0.29% of the 10 mrem per-year regulatory standard for the INL Site (DOE-ID, 2024).

Radiological air emissions from MFC occur from spent fuel treatment at the Fuel Conditioning Facility, waste characterization, and fuel R&D at the HFEF, fuel R&D at the Fuel Manufacturing Facility, and PIE at the IMCL. Exhaust streams from these facilities pass through HEPA filtration systems prior to being monitored via continuous emissions monitoring systems or emission sampling systems. The effective dose equivalent to the MEI member of the public from MFC operations in 2023 was calculated at 2.7×10^{-2} mrem per year, which is 94% of the effective dose equivalent to the MEI member of the public for the INL Site (DOE-ID, 2024). No radiological air emission would be produced from activities occurring at offsite facilities because no radiological material would be used.

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c Dose equivalent is a measure of the biological damage to living tissue as a result of radiation exposure. The dose equivalent is calculated as the product of absorbed dose in tissue multiplied by a quality factor. Effective dose equivalent is the sum of the products of the dose equivalent and the weighting factors applicable to each of the body organs or tissues that are irradiated. Refer to the "Helpful Information for the Reader" section at the beginning of this document or Nuclear Regulatory Commission publication Dose in Our Daily Lives and Measuring Radiation for more information (NRC 2021).

d A maximally exposed individual member of the public is a hypothetical individual who, because of proximity, activities, or living habits, could potentially receive the maximum possible dose of radiation or of a hazardous chemical from a given event or process.

3.3.2 Impacts to Air Quality

To determine whether environmental effects from the DOME test bed operations on air quality would be disproportionately high or cause a significant impact, DOE considered the following three factors:

1) Whether emissions would violate any air quality standard or contribute substantially to an existing or projected air quality violation
2) Whether emissions would result in a cumulative, considerable net increase in criteria air pollutants or GHGs (e.g., CO, NO_2, CO_2, PM, and SO_2), exceed the state and National Ambient Air Quality Standards, exceed the facility emissions cap sitewide permit (P-2020.0045) for non-radiological emissions, or exceed the National Emissions Standards for Hazardous Air Pollutants, Subpart H (40 CFR § 61) 10 mrem/year regulatory standard for radiological emissions
3) Whether emissions would expose sensitive receptors (including, schools, hospitals, resident care facilities, or daycare facilities) to substantial pollutant or radiological concentrations.

DOME test bed operations have the potential to generate minor amounts of toxic air pollutants and radionuclide air emissions. Impacts from installing reactors and project components into the DOME test bed are minimal and typical of activities performed at the INL Site. It is expected that these activities would have no radiological impacts on the general public as the closest potential public receptor is located about 5 miles south-southeast from MFC facilities.

Combustion equipment such as generators, portable heaters, ventilation equipment, and heavy equipment fueled with diesel fuel may be used during project activities. In general, emissions during construction type activities are exempt from Prevention of Significant Deterioration review because these requirements are primarily for major stationary sources and exempt temporary increases in emissions. Emissions from mobile generators in place for less than 1 year are exempt from permitting requirements, and emissions are regulated at the manufacturing level.

Combustion of fossil fuel in construction type equipment, trucks, and worker commuter vehicles are likely to emit non-radiological criteria air pollutants and hazardous air pollutants. Temporary emissions include reactive organic gases, carbon monoxide, nitrogen oxides, sulfur oxides, and respirable PM with an aerodynamic diameter of 10 micrometer or less (referred to as PM10). PM10 consists of PM emitted directly into the air (e.g., fugitive dust, soot, and smoke) from mobile and stationary sources and construction operations.

The mobile and intermittent operation of equipment emissions sources combined with the installation of reactors and components into the DOME test bed that occur indoors would result in dispersed concentrations of these pollutants adjacent to proposed activities. The substantial transport distance of emissions from MFC to the nearest location of the INL Site boundary (about 3 miles south) would produce further dispersion and negligible concentrations of hazardous air pollutants beyond the INL Site boundary. The use of worker commuter vehicles on public roads would result in low concentrations of pollutants. Concentrations generated by installation activities and worker transportation activities would not result in adverse conditions beyond regional emissions (Table 2). Any potential impact would be considered negligible. Sources of criteria air pollutants are temporary or mobile and would not contribute to the site wide PTC-FEC.

Table 2. Estimated pollutant concentrations from DOME test bed activities

Activity Phase	Criteria Air Pollutants or Greenhouse Gases of Concern (tons/year)[1]						
	Volatile Organic Compounds	Carbon Monoxide (CO)	Nitrogen Oxides (NOx)	Sulfur Oxides (SOx)	PM_{10}	CO_2	CH_4
Integration	0.21	4.11	8.75	0.02	0.01	191.52	0.55
Experiment	0.71	2.62	0.40	0.11	0.13	90.12	0.01
Decommissioning	0.55	3.77	2.64	0.01	0.05	1392.85	0.03
2023 Site Wide Emissions	0.92	6.36	44.4	0.68	2.56	NA	NA
PTC-FEC Limits	90	90	95	70	85	NA	NA
Region of Influence (ROI) Emissions Inventory[2, 3]	5,013	37,867	7,075	21	440	2,234,112	195

[1] Estimated pollutant concentrations are based on the types of equipment that would be used during different phases of DOME test bed operations and vehicular traffic from commuting employees.

[2] The ROI for the emissions inventory includes the seven Idaho counties immediately surrounding the INL Site (Bannock, Bingham, Bonneville, Butte, Clark, Jefferson, and Madison)

[3] Emission inventory estimates are based on the EPA's 2017 National Emissions Inventory (NEI) Data (EPA, 2017).

Fueling reactors, inside either the DOME test bed or another facility at MFC, would potentially emit a minimal amount of radiological emissions. Any radiological emissions would be managed by the facility's ventilation system. Any facility used for reactor fueling with the potential to emit more than 0.1 mrem/year would be required to have a ventilation system with an exhaust stack that has an effluent monitoring system compliant with ANSI/HPS N13.1-2021 *Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities*. The exhaust stack would be required to operate and maintain a continuous monitoring system and emissions would be regulated to less than 10 mrem/year effective dose equivalent to the MEI from all INL site sources, as per the emission standard of 40 CFR Part 61, Subpart H.

Operations within the DOME test bed would be designed to ensure minimal risk to the health and safety of the public. The DOME test bed provides the confinement (e.g., walls, floor, ceiling) necessary to prevent unintended toxic air pollutants and radiological emissions from migrating from the reactor and entering the environment. The integration of a reactor project into the test bed includes incorporating project components into the test bed's ventilation system that includes HEPA filtration and negative air pressure to prevent contaminated exhaust. Furthermore, as stated above, the TRISO fuel used for the advanced reactors is very robust and, under normal operating conditions, can retain almost all the radionuclides generated while in operation.

There would be no direct emissions from the fission process during normal operations in the DOME test bed because of the containment nature of the facility. Any indirect emission would be abated through the ventilation system. The ventilation system would vent to a stack equipped with a continuous emission monitoring system and HEPA filters or a series of HEPA filters that have a control efficiency of at least 99.97%.

The impact of unabated radioactive air emissions from an operating reactor in the DOME test bed to an offsite member of the public and co-located worker were assessed and determined to be extremely low when compared to the regulatory limits (INL, 2023a). Doses were calculated with CAP88-PC, a set of computer programs for estimation of dose and risk from radionuclide emissions to the air. CAP88-PC is both a mature and EPA-recommended model for demonstration of compliance with the applicable performance objective (40 CFR § 61, Subpart H). The potential dose to an offsite member of the public (INL Site MEI) is 1.5 x 10^{-3} mrem/year and the dose to a co-located worker is estimated to be 2.26 x 10^{-1} mrem/year. The estimated 1.5 x 10^{-3} mrem/year dose to a member of the public is significantly less than both the 10 mrem/year regulatory standard and the minor source threshold of 0.1 mrem/year. The estimated co-located worker potential dose of 2.26 x 10^{-1} mrem/year is significantly less than the 5,000 mrem/year regulatory dose standard.

The dose estimates are calculated without accounting for abatement via HEPA filtration system. Assuming that radiological emissions are abated, it is anticipated that the actual dose to a member of the public and a co-located worker would be less than estimated. Because the estimated dose would be less than the regulatory limits, the normal operation of reactors inside the DOME test bed would not result in adverse conditions above the existing baseline and any potential impact would be considered low.

During decommissioning, hazardous and radioactive materials would be removed to ensure protection of workers, the public, and the environment. Activities associated with decommissioning of a reactor project would be performed in existing INL Site facilities. The actual emissions would be determined when more definite operational conditions have been defined. Decommissioning operations would comply with all regulatory requirements of the Clean Air Act; therefore, the operations are bounded by the regulatory limits.

INL personnel would develop an air permitting and applicability determination for each applicable source of radiological air emissions associated with a project to ensure compliance with the NESHAP, Subpart H (40 CFR § 61). The air permitting and applicability determination would be used to demonstrate compliance with the facility emissions cap sitewide permit (P-2020.0045) for any non-radiological emissions. In the event a Permit to Construct is required, an application for the Permit to Construct would be submitted to the Idaho Department of Environmental Quality, pursuant to IDAPA 58.01.01, "Rules for the Control of Air Pollution in Idaho," and an Approval to Construct application would be submitted to EPA pursuant to 40 CFR § 61.96.

As described above, reactor projects sited in the DOME test bed (including project integration, operation, decommissioning, long-term storage of project components, etc.) would produce minor amounts of air emissions. Transport of these emissions would produce negligible ambient air pollutants concentrations at offsite locations (Table 2). Therefore, any minor increase in offsite air pollutant concentrations produced from DOME test bed operations, in combination with emissions from other past, present and reasonably foreseeable future actions, including future demonstration reactor projects (e.g., Project Pele, MARVEL), would result in air pollutant concentrations that would not exceed the state and National Ambient Air Quality Standards and would not substantially contribute to cumulative air quality impacts (Table 3). Similarly, any radioactive air emissions would result in negligible dose impacts to co-located workers and offsite members of the public. Any potential direct, indirect, or cumulative impacts to air quality from DOME test bed operations would be considered low.

Table 3. Projects having the potential to contribute to cumulative impacts to offsite dose

INL Site Activity	Estimated Dose to MEI (mrem/yr)	Dose as a Percentage of the Regulatory Limit
2023 INL Sitewide Operations (DOE-ID, 2024)	2.9 x 10-2	0.29
Versatile Test Reactor (DOE, 2022)	9.6 x 10-3[1]	0.096
Microreactor Applications Research, Validation and Evaluation Project (INL, 2024)	2.6 x 10-3	2.3 x 10-2
Construction and Demonstration of a Prototype Mobile Microreactor Project (DOD, 2022)	1.0 x 10-2[1]	0.0001

INL Site Activity	Estimated Dose to MEI (mrem/yr)	Dose as a Percentage of the Regulatory Limit
Molten Chloride Reactor Experiment (DOE-ID, 2023a)	2.4 x 10-3	0.024
DOME Test bed Operations (INL, 2023a)	1.5 x 10-3	0.015
Cumulative Total	5.5 x 10-2[1]	0.55
[1] The MEI location for the Versatile Test Reactor EIS (DOE, 2022) is the INL Site boundary south of MFC (approximately 3.1 miles). The MEI for the Construction and Demonstration of a Prototype Mobile Microreactor Project EIS (DOD, 2022) is the INL Site boundary south of CITRC (approximately 6.9 miles). The MEI for all other activities is the same as the MEI for the INL Site Radiological NESHAP evaluation (DOE-ID, 2024), a residence located approximately 5 miles south-southeast of MFC facilities. The cumulative total dose conservatively assumes that all MEI locations are the same as the NESHAP MEI location. The actual cumulative total at the INL Site MEI location would be less than shown.		

3.4 Ecological Resources

3.4.1 Affected Environment

Ecological resources include the plant and animal species, habitats, and ecological relationships within the area of impact, which is the area directly or indirectly affected by the DOME test bed. Consideration is given to sensitive species, which are those species protected under federal or state law, including threatened and endangered species, migratory birds, and bald and golden eagles. For the purposes of this EA, sensitive and protected ecological resources include plant and animal species that are federally or state-listed for protection.

There are several species of concern or special status species that occur within the INL Site boundary. The United States Fish and Wildlife Service (USFWS) provides spatially explicit information regarding threatened and endangered species. Based on the information provided by the USFWS, there is no critical habitat identified within the DOME test bed boundary nor within the INL Site boundary (USFWS, 2024). The USFWS identifies the North American wolverine (Threatened), the yellow-billed cuckoo (Threatened), Ute ladies' -tresses (Threatened), whitebark pine (Threatened) and monarch butterfly (Candidate) as potentially occurring within several counties partially occupied by the INL Site, including Butte, Bonneville, Jefferson, Bingham, and Clark counties, Idaho. However, the likelihood of the North American wolverine, yellow-billed cuckoo, whitebark pine or Ute ladies'-tresses occurring within the DOME test bed is small because it does not support the appropriate habitats for those species.

Although no wildlife nor plant species currently listed under the Endangered Species Act of 1973 (ESA) are known to occur on the INL Site, at least 20 special status plant species and 24 wildlife species of conservation concern are identified by the Bureau of Land Management (BLM) as special status species (Type 2) that have been documented on the INL Site (DOE-ID, 2023). Many of those plant species are rare and occur very infrequently within their optimal habitats. Others may have slightly larger population sizes but are restricted by unique habitat requirements. A few special status plants have a widespread distribution across the INL Site. Of these BLM Type 2 wildlife species, some of the most common at the INL Site include the sage thrasher, the loggerhead shrike, the ferruginous hawk, and the greater sage-grouse. Additionally, at least 20 wildlife species identified in the Idaho State Wildlife Action Plan (IDFG, 2024) by the Idaho Department of Fish and Game (IDFG) as Species of Greatest Conservation Need have been documented on the INL Site (DOE-ID, 2023). These include transitory species, such as the American white pelican and the ring-billed gull, to species that occupy the INL site during some or all their life cycles, such as the greater sage-grouse, big brown bat, and the burrowing owl. Many special status species are detected during annual survey efforts at the INL Site and monitoring efforts are directed toward understanding the abundance, distribution, and habitat use patterns of some of those species.

3.4.2 Impacts to Ecological Resources

Impacts to ecological resources are considered significant if they result in a loss of protected or sensitive species or loss of local populations from direct mortality or diminished survivorship. The facility modifications, project installation into the DOME test bed, and operations proposed as part of the DOME test bed would occur in and around existing facilities. The DOME test bed does not require additional land use that would result in the disturbance of intact native vegetation communities.

All areas used for transportation, project installation, and operation of the DOME test bed are mapped as existing facilities or other existing manmade features (Shive, et al., 2019). There are no anticipated impacts from DOME test bed operations on native vegetation communities, special status plant species, nor critical habitat designated under the ESA. Any peripheral effects on native plant communities or sensitive plant species from the DOME test bed operations would not be discernable from current INL Site operations.

There is potential for the DOME test bed activities to impact various wildlife species both directly and indirectly during transportation, installation, and operation activities. Transportation activities, including shipment of construction equipment, supplies, and employee commuter vehicles, have the potential to impact wildlife from inadvertent vehicle strikes. The loss of protected or sensitive species or loss of local populations from direct mortality of diminished survivorship is not anticipated. Additionally, the use of commuter vehicles on public roads would not be discernable from current INL Site operations. Therefore, impacts to wildlife during transportation activities would be negligible.

Installation and operations activities have the potential to impact wildlife species both directly and indirectly. Various bird species including those protected under the Migratory Bird Treaty Act have the potential to be impacted during installation and operations activities. Many bird species may use structures, equipment, and surrounding areas for nesting during installation and operations of the DOME test bed and may result in a "take" under the Department of Energy Idaho Operations Office (DOE-ID) Special Purpose-Miscellaneous Permit issued by USFWS if active migratory bird nests are disturbed during construction and operation activities. In addition to bird species, various bat species have the potential to roost in existing facilities that are proposed to be modified. These activities have the potential to result in the harm or destruction of potential roosting bat species.

Regulatory and planning controls used for installation and facility operations on the INL Site can greatly reduce any of the potential impacts to ecological resources discussed above. Conservation measures outlined in the INL Bat Protection (DOE-ID, 2018) such as searching existing structures for the presence of bats before building modifications take place, greatly reduce the likelihood of impacting bat species on the INL Site. The direct impacts of disturbance on wildlife would be limited to the period of installation and maintenance, and the level of disturbance may be reduced for some species through the implementation of such design features as conducting work outside migratory bird nesting season, pre-work surveys, and onsite monitoring, which are intended to minimize these types of effects.

The expected noise from DOME test bed activities is not likely to exceed existing industrial noise levels. Thus, the integration of those components into the DOME test bed, operation, or decommissioning would not disturb any small mammals, reptiles, bats, or migratory birds that might be present.

Radiological activities that cause direct radiation to the environment, or that discharge or otherwise release radioactive material into the environment must comply with DOE-STD-1153-2019*, A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*, to show that dose rates to representative biota populations do not exceed the dose rate criteria DOE Order 458.1 (DOE 2019). The impact of potential radioactive air emissions on terrestrial biota were assessed using the *Evaluation of Impacts from Potential Radiological Air Emissions for the Demonstration of Microreactor Experiments (DOME) Testbed Operations Environmental Assessment* (INL, 2023a). Based on this evaluation, no negative dose impacts to biota are expected. Therefore, any potential impact to ecological resources from radiological air emissions would be negligible to low.

From a cumulative impact perspective, the incremental impacts to ecological resources of the DOME test bed when added to past, present, and reasonably foreseeable actions at the INL Site are low.

3.5 Cultural and Historic Resources

3.5.1 Affected Environment

The affected environment for cultural and historic resources includes the integration, experiment, and decommissioning of a demonstration project within the DOME testbed facility and the associated yard area. Other areas of affected environment would include facilities to fuel and defuel reactors. It is anticipated that experiments would be fueled at the DOME test bed or inside an existing facility at MFC following project-specific procedures. Therefore, it is anticipated that fueling activities would occur within facilities that already conduct such operations. A specific facility for any defueling activity has not been identified nor have any procedures been developed for such activity.

The DOME testbed is housed in MFC-767 which was constructed in 1961 as the containment building for the EBR-II reactor. It served in this role until 1994 when the reactor was shut down for the last time. The subsequent decommissioning process was completed in 2001 and included defueling the reactor core and grouting the reactor vessel and ancillaries in place. MFC-767 is the centerpiece of MFC and in 1995 was given a nuclear historic landmark award by the American Nuclear Society for its singularly unique contributions to the advancement of reactor design.

MFC-767 is a historic property eligible for listing in the National Register of Historic Places (NRHP) under Criterion C (Design) (Trinomial 10BM1148). The majority of MFC-767's character defining features remain intact: its architectural design is original and unaltered which includes the irregular form dictated by the safety considerations and containment requirements for the reactor housed within the building; the construction materials used are original reinforced concrete and steel, and the primary contributing elements are intact.

3.5.2 Impacts to Cultural and Historic Resources

The integration, experimentation, and decommissioning activities discussed in Table 1. Bounding Plant Parameters for DOME Testbed Operations do not have the potential to affect historic properties. The DOME Test Bed is designed as a "plug-and-play" microreactor testing facility with the assumption that users applying to use the DOME testbed will meet the plant parameters. Modifications to accommodate specific equipment and components are limited to the test bed, and additional modification to MFC-767 is not anticipated. Therefore, there are no anticipated impacts to cultural and historic resources as a result of DOME test bed operations. Operation of the test bed would be considered standard operations of DOME and would not trigger Section 106 review.

There are no anticipated impacts to cultural and historic resources if fueling and defueling are to occur within existing buildings that currently support these types of activities. This action would be considered standard operation of such buildings and would not trigger Section 106 review.

Fueling and defueling activities within buildings that do not currently support such operations may impact cultural and historic properties. To identify such activities and determine if an experiment falls under this EA, DOE would review user applications under the established review process and evaluate if the bounding parameters analyzed in this EA are exceeded by a proposed experimentation project. If, at the conclusion of the review process DOE determines the bounding parameters analyzed in this EA are exceeded by a proposed experimentation project, then a project specific NEPA review and review under Section 106 of the NHPA per 36 CFR § 800 would be required.

3.6 Geology and Soils

3.6.1 Affected Environment

The INL Site is located on the ESRP, which is part of the Snake River Plain, a large (about 56 miles wide and 348 mile long) physiographic region with low-relief and covered by basaltic lava flows and sediment (Figure 8). The Snake River Plain extends in a broad arc across southern Idaho from the Yellowstone Plateau in Wyoming on the east, and into eastern Oregon on the west. Surface elevations on the Snake River Plain decrease gradually from about 6,562 ft near Yellowstone, to about 2,132 ft near the Idaho Oregon border.

The ESRP represents the track of buried and extinct volcanic centers associated with passage of the North American plate over the relatively stationary "Yellowstone" hotspot (Pierce & Morgan, 1992) (Pierce & Morgan, 2009) (Smith, et al., 2009). From about 6.3 to 8.4 million years ago, the crust beneath the ESRP at and near the INL Site's location was impacted by volcanism associated with the Yellowstone hotspot (McCurry, et al., 2016) (Anders, et al., 2014) (Schusler, Pearson, McCurry, Bartholomay, & Anders, 2020). Volcanism within the last 2.1 million years associated with the Yellowstone hotspot is now beneath the Yellowstone Plateau (Christiansen, et al., 2007), 99 to 143 miles northeast of the INL Site. Since about 4 million to 2,100 years ago in the ESRP at and around the INL Site, basaltic magma has continued to periodically erupt producing volcanic vents and lava flows (Kunz, et al., 1994) (Kunz, Anderson, Champion, Lanphere, & Grunwald, 2002) (Kuntz, Skipp, Champion, Gans, & Van Sistine, 2007). Surface basalt flows at the INL Site range in age from 13,000 to 1.2 million years ago (Kunz, et al., 1994). During intervening eruptive periods, sediments have been deposited by wind and surface water. Along the southern INL Site border, basaltic magma stagnated in the crust and eventually evolved in composition to erupt from 300,000 years to 1.4 million years ago as rhyolitic domes which formed five buttes with heights between 394 to 2,460 ft (McCurry, Hayden, Morse, & Mertzman, 2008).

MFC is in the eastern part of the INL Site and on thin surficial sediments of mainly eolian origin overlying basaltic lava flows. MFC is within a closed basin and outside of the Big Lost River drainage basin, thus sediments are deposited primarily by the wind and localized drainage during precipitation events. The surface sediment thickness near the DOME test bed ranges from about 6.5 ft to 26.5 ft with two nearby locations as deep as 31.5 ft and 46 ft and are composed of silty and sandy layers containing varying amounts of basalt rock fragments. The permeability of these soils is moderately rapid to rapid, and their erosion hazard is slight or moderate.

The basalt lava flows below the DOME test bed location erupted from nearby vents to the south and east of MFC, which have been dated to be less than 358,000 years to over 1.4 million years old (Champion, Hodges, Davis, & Lanphere, 2011). The closest basaltic vents are over 4.3 miles east and south of the DOME test bed location. The basaltic lava flows at MFC erupted as pahoehoe flow types and generally have rubbly zones from the top of the flow to more massive interiors at the center (Northern Testing Laboratories, 1978).

The Snake River Plain transects and sharply contrasts with the surrounding mountainous country of the Northern Basin and Range Province. Summits of mountains surrounding the Snake River reach elevations up to 12,000 ft, producing a maximum elevation contrast of 7,050 ft. North and northwest trending mountain ranges, up to about 124 miles long and 19 miles wide, are separated by intervening basins filled with terrestrial sediments and volcanic rocks. Extension of the Earth's crust over the last 16 million years formed normal faults including the three closest range-bounding faults northwest of the INL Site (northern Basin and Range) and those east and south of the ESRP in the Basin and Range.

From 1850 to 2020, 22,870 earthquakes with magnitudes greater than 2.0 compiled from the INL Site's and other nearby seismic networks show a parabolic distribution of epicenters located predominantly in the Basin and Range regions outside of the ESRP (Payne & Montaldo Falero, 2022).The two largest earthquakes, the 1959 moment magnitude 7.3 Hebgen Lake, Montana, and 1983 moment magnitude 6.9 Borah Peak, Idaho, produced normal faulting surface ruptures with maximum lengths of 22 mi ((Crone, et al., 1987) and 23 mi ((Myers & Hamilton, 1964), respectively. Three earthquakes have caused ground shaking at the INL Site, but no damage occurred due to the large distances of their epicenters from the INL Site. Infrequent small magnitude earthquakes occur within the ESRP. From 1972 to 2020, the INL Site seismic network has located 103 microearthquakes with magnitudes less than 2.4 in the ESRP ((Bockholt, Payne, & Sandru, 2022). Of these, 15 occurred within INL Site boundaries and none were located near MFC. Neither mapped faults nor volcanically induced features such as ground cracks or fractures are at or near MFC (Kunz, et al., 1994).

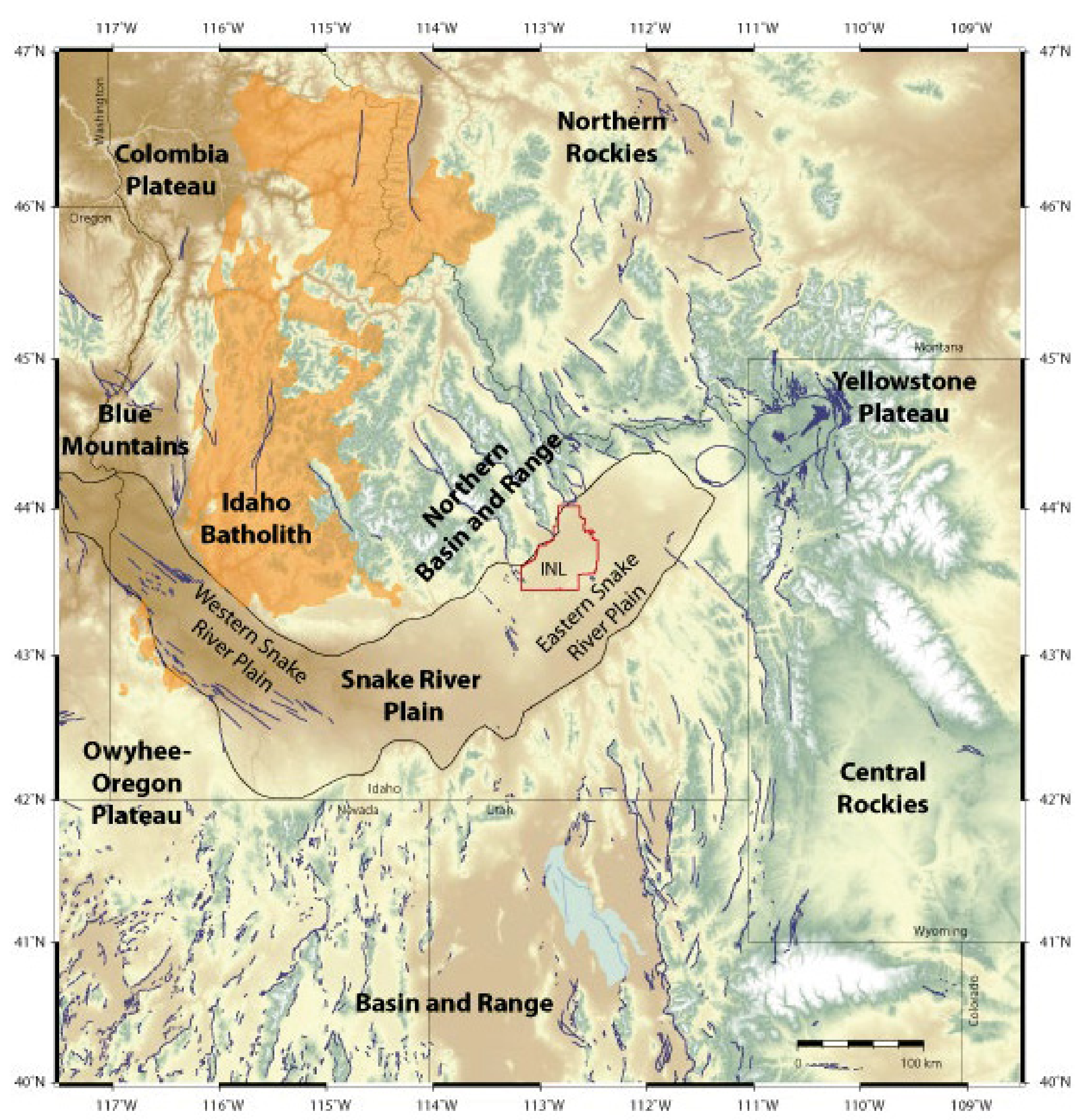

Figure 8. Location of the INL Site in relation to the Snake River Plain

3.6.2 Impacts to Geology and Soils

The DOME test bed is an existing facility. The proposed action limits ground disturbance to previously disturbed areas within the MFC fence and there would be no change to existing land use at MFC. Therefore, there are no anticipated impacts to geological or soil resources.

No environmental impacts are assessed from DOME test bed operations as a result of potential future earthquakes. The DOME test bed is classified as Seismic Design Category (SDC)-3, facility per DOE Order 420.1C, *Facility Safety*, implemented through DOE Standard, DOE-STD-1020, *Natural Phenomena Hazards Design and Evaluation Criteria*. Seismic design criteria were developed from site-specific, seismic hazard analyses of soil and rock conditions at the DOME test bed (Payne, 2007). The evaluation of the DOME test bed under seismic loads is currently being performed. Reactor projects would be designed to withstand vibratory ground motions (or ground shaking) as specified by American Society of Civil Engineers, (ASCE, 2017) Standard 47-16, *Seismic Design of Safety-Related Nuclear Structures*.

As described above, potential impacts due to seismic activity are not expected. Therefore, no cumulative impacts to geologic or soil resources from other past, present, and reasonably foreseeable future actions are expected.

3.7 Infrastructure

3.7.1 Affected Environment

INL Site infrastructure includes basic resources and services required to support planned installation and operation activities and continued operations of existing facilities. For this EA infrastructure is defined as electricity, fuel (for equipment), water, and municipal wastewater. Table 4 summarizes INL's 2023 infrastructure usage and capacity.

Table 4. 2023 INL infrastructure use and capacity

Resource	2023 INL Usage	DOME Test bed Projection	Site Capacity
Energy Consumption (megawatt-hours per year)	176,499	1	481,800[a]
Peak Load (mega-watt)	45	0.05	55
Natural Gas (mcf per year)	67,921	0[c]	Not limited[b]
Fuel Oil for Heating (gallons per year)	761,440	0[c]	Not limited[b]
Diesel Fuel (gallons per year)	210,498	7,200	Not limited[b]
Gasoline (gallons per year)	55,646	900	Not limited[b]
Propane (gallons per year)	539,000	810	Not limited[b]
Water (gallons per year)	695,000,000	6,502,400	11,400,000,000[d]
MFC Sewage Effluent (average gallons per day)	17,911	800	19,500[e]

[a] Limited by contract with the Idaho Power Company

[b] Capacity is limited only by the ability to ship resources to the INL Site

Resource	2023 INL Usage	DOME Test bed Projection	Site Capacity
[c] The DOME test bed facility is not heated by natural gas or fuel oil. [d] Water right allocation [e] MFC wastewater lagoons design capacity			

3.7.2 Impacts to Infrastructure

When determining whether environmental effects from DOME test bed operations to INL Site infrastructure would be disproportionately high or cause a significant impact, DOE considered the following factors:

1) Whether the proposed action would require or result in the construction of a new water source (i.e. well), public water system, or wastewater treatment facilities or expansion of existing facilities to meet the project's anticipated demand
2) Whether the proposed action could create a water supply demand in excess of existing entitlements and resources
3) Whether the proposed action would require or result in the construction of new transmission facilities or expansion of existing facilities to supply energy needed to support the project
4) Whether the proposed action would result in the inefficient use of fuel resources, or the use of fuel resources beyond that typically used by INL on an annual basis
5) Whether the proposed action would conflict, or create an inconsistency, with any applicable plan (i.e. Site Sustainability Plan), policy, or regulation adopted for the purpose of avoiding or mitigating environmental effects related to energy use and the emission of GHGs.

A reactor project in the DOME test bed would use an estimated 1000 kW-hours of electricity per year supplied by the INL Site power infrastructure – an anticipated increase of 0.0006% from the annual site usage. Any potential impacts to electrical energy consumption at the INL Site would not require the construction or expansion of transmission facilities and any potential impact would be low and nearly indiscernible from current consumption rates.

Water may be required depending on reactor type and shielding requirements. Although the exact quantity of water needed for a reactor operation is unknown, the max quantity would be no more than 6,502,400 gallons of water over the anticipated life of the DOME test bed, or about 325,120 gallons per year if the amount is averaged over the estimated 20-year period of operations. The estimated amount of water to be used by the DOME test bed is conservative and represents the maximum, bounding quantity that could be used. This represents about 0.009 percent of the INL Site's Federal Reserved Water Right of 11.4 billion gallons per year. This estimate includes both project reactor operations, shielding, and office use. This small increase in water consumption would not affect the ability of the system to provide an adequate supply to meet the requirements of existing personnel, process, and fire protection purposes. Any potential impacts to water consumption at the INL Site would be negligible.

DOE estimates that the proposed High Temperature Test Facility (HTTF), proposed to be located at the Central Facilities Area (CFA), would consume about 9.5 million gallons of water per year. The total cumulative amount of water estimated to be used per year for ongoing INL Site activities, the HTTF, and DOME test bed operations would amount to about 0.09 percent of the INL Site's Federal Reserved Water Right of 11.4 billion gallons per year. The cumulative impacts to water use from operating the DOME test bed would be small.

The MFC sanitary sewer system collects and treats domestic wastewater. DOE upgraded the sewage lagoons in 2012. These upgrades were designed to accommodate the existing facility population and significant future growth and was based on a value of 13 gallons per day per worker (INL, 2010). The current workforce at MFC is about 1,200 employees. Based on the current use (see Table 4) and the current number of employees, discharges to the MFC sewage lagoon average about 15 gallons per day per worker. The addition of 45 new employees would result in the addition of about 350 to 800 gallons of wastewater per day to the MFC sanitary sewer system. This additional discharge to the MFC lagoons is within the design capacity of the facility, as shown in Table 4. This estimated number of new employees is conservative and represents a bounding number of new employees. This estimate does not consider that much of the work needed for integration, operations, and decommissioning would be performed by existing employees. The small increase in effluent to the sanitary sewer system would not affect the ability of the system to perform as currently designed. Any potential impacts to the sanitary sewer system at MFC would be low.

The anticipated use of fuel (diesel, gasoline, and propane) is expected to be less than what is used annually at INL. The use of fuel resources for DOME test bed operations would be managed to reduce the inefficient, or wasteful, use of these resources. Based on the expected fuel use quantities any potential impact would be considered negligible.

DOME test bed operations would adhere to the sustainability goals and requirements established in INL's *FY 2024 Idaho National Laboratory Site Sustainability Plan* to ensure that project activities would lead to continual energy reductions (INL, 2023). The proposed activities are not likely to conflict with existing plans, policy, or regulations for the management of energy use.

It is anticipated that operations within the DOME test bed would have negligible to low impacts on current INL Site infrastructure. Direct and indirect impacts would be nearly indiscernible from current operations when combined with past, present, and reasonably foreseeable future actions. Any cumulative impacts are expected to be low.

3.8 Waste Management

3.8.1 Affected Environment

The INL WMP provides the processes and procedures for compliant management of radioactive, hazardous, mixed, and universal wastes, and hazardous recyclables at INL. The INL WMP facilitates management of containerized radioactive, hazardous, mixed, and universal waste, and hazardous recyclables from characterization through disposal so that long-term waste storage prior to disposition is minimized and exposures are below allowable levels and as low as reasonably achievable (ALARA) in compliance with DOE Order 435.1, *Radioactive Waste Management*, and the accompanying DOE Manual 435.1-1, *Radioactive Waste Management Manual*.

Construction and demolition debris that are not hazardous may be recycled or disposed of at onsite facilities or sent offsite, but would be recycled to the greatest extent possible, regardless of the facility. Non-hazardous waste, such as construction and demolition debris, is primarily disposed of at the INL CFA Landfill Complex. The CFA Landfill Complex is operated in accordance with the state of Idaho regulations. The remaining capacity of the landfill is approximately 3.4 million m^3. Non-hazardous solid waste items that cannot be disposed of at the landfill are sent offsite to commercial disposal facilities. As much as possible, such recyclable materials, as batteries, plastic, aluminum beverage containers, paper, and cardboard, are segregated from the solid waste stream and sent for recycling. From calendar year

(CY) 2021 through CY 2023, MFC generated and disposed of an average of 40.21 m^3 of recyclable[e] and industrial[f] wastes per year (Table 5).

Non-radiological hazardous[g] wastes, such as those regulated under the Resource Conservation and Recovery Act (RCRA) and Toxic Substance Control Act (TSCA), and universal[h] wastes are treated and disposed of at offsite facilities and transported by a commercial transport contractor. From CY 2021 through CY 2023, the volume of non-radiological hazardous wastes generated at MFC and disposed of at an offsite facility averaged 16.7 m^3 per year (Table 5).

Radioactive wastes generated at the INL Site are generally divided into the following categories: LLW,[i] mixed low-level waste (MLLW),[j] and TRU. The types of LLW can be either contact-handled (CH) or remote-handled (RH). Waste quantities vary with different operations, installation activities, and implementation of waste minimization activities. From CY 2021 through CY 2023, MFC generated and disposed of an average of 479.22 m^3 of LLW and MLLW per year (Table 5).

Radioactive waste is typically disposed of at on- or offsite waste disposal facilities. Most of the radioactive waste is shipped offsite to a commercial disposal facility or the Nevada National Security Site for disposal. Onsite disposal facilities are used for LLW meeting very specific criteria – the Idaho CERCLA Disposal Facility only receives waste from qualified cleanup actions and the RHLLW Disposal Facility only receives remote-handled waste (with a package dose rate greater than 200 mrem per hour) in specific types of stainless-steel packaging.

Table 5. MFC waste shipments (CYs 2021-2023) 3-year average

Waste Type	Gross Volume (m^3)	Gross Mass (kg)	Shipments
LLW & MLLW			
Contact handled low level waste (CH-LLW)	350.07	92,491.24	24.00
RH-LLW	6.78	4,789.41	3.67
CH-MLLW	121.77	37,517.35	17.33
RH-MLLW	0.60	720.62	0.33
Totals	479.22	135,518.62	45.33
Non-Radioactive Waste			
Recyclable	32.95	9,190.99	3.33
Industrial	7.26	5,717.48	3.67

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e Recyclable means material or objects that may be reclaimed and/or processed and used in the production of raw materials or products.

f Industrial waste means the solid waste generated by manufacturing and industrial and research and development processes and operations, including contaminated soil, nonhazardous oil spill cleanup waste and dry nonhazardous pesticides and chemical waste, but does not include hazardous waste regulated under Subtitle C of the Solid Waste Disposal Act (42 U.S.C. 6921 et seq.), mining or oil and gas waste.

g Hazardous waste is waste with properties that make it dangerous or capable of having a harmful effect on human health or the environment as defined by RCRA (40 CFR § 239–282).

h Universal wastes are considered hazardous wastes that are subject to the universal waste requirements of 40 CFR § 273. These wastes include, but are not limited to, batteries, pesticides, mercury-containing equipment, light bulbs or lamps, and aerosol cans.

i Low-level radioactive waste is radioactive waste that is not high-level radioactive waste, spent nuclear fuel, transuranic waste, byproduct (as defined in Section 11e. (2) of the Atomic Energy Act, as amended), or naturally occurring radioactive material.

j Mixed low-level radioactive waste contains source, special nuclear, or byproduct material subject to the Atomic Energy Act, as amended, and a hazardous component subject to RCRA.

Waste Type	Gross Volume (m³)	Gross Mass (kg)	Shipments
Universal	0.80	344.48	8.00
Hazardous	9.08	4,330.64	6.00
TSCA Only	0.02	18.75	1.00
Totals	50.11	19,602.34	22.00

3.8.2 Impacts to Waste Management

Operations within the DOME test bed would include the generation of waste from the integration of reactor projects, project operations, and decommissioning of reactor projects. When determining if the generation of waste would cause a disproportionately high or significant impact, DOE considered the following factors:

1) Whether the proposed action would comply with federal, state, and local statutes and regulations related to radioactive, hazardous, universal, and solid waste
2) Whether the proposed action would require or result in the construction of new or expanded landfills, hazardous waste disposal facilities, radioactive waste disposal facilities, or other locations that accept waste generated from project activities.

During a reactor project's integration phase, the reactor project is expected to generate a minimal quantity of installation waste from small tools and packaging material used to transport and assemble the reactor components. This waste would consist of industrial, recyclable, and hazardous wastes (e.g., lead, brass, and circuit boards). Much of the construction waste resulting from project installation would be recycled to the greatest extent possible. About 43.5 m³ of LLW would be generated per project annually from fuel loading activities during the integration phase (Table 6). LLW generated during an integration phase would include personal protective equipment, scrap metal, filters, wipes, rags, and radiological control supplies. It is expected that the majority of LLW would be designated as contact handled (CH)-LLW.

Table 6. Waste generation and shipment projections for the DOME test bed

Phase	Waste Type	Average Annual - Transport		Average Annual - Generation	
		Containers	Shipments	Gross Volume (m³)	Gross Weight (kg)
Integration	Non-Radiological Waste				
	Recyclable	2	1	0.53	346
	Industrial	2	1	0.21	220
	Low-Level Waste (*from fuel loading*)				
	CH-LLW	16	2	42.3	46,900
	RH-LLW	1	1	0.46	451
	Totals	21	5	43.5	47,917
Experiment	Non-Radiological Waste				
	Recyclable	2	1	0.27	173
	Industrial	2	1	0.11	110
	Low-Level Waste				
	CH-LLW	16	2	42.3	46,900

Phase	Waste Type	Average Annual - Transport		Average Annual - Generation	
		Containers	Shipments	Gross Volume (m^3)	Gross Weight (kg)
	RH-LLW	1	1	0.46	451
	Totals	21	5	43.1	47,634
Decommissioning	Non-Radiological Waste				
	Industrial/Recyclable	5	2	10.6	37,736
	Low-Level Waste				
	LLW	24	3	61.7	109,826
	Totals	29	5	72.3	147,562

Most radioactive waste generated from project operations is anticipated to be LLW. Project operations are expected to include sampling activities, personal protective equipment, scrap metal, filters, wipes, rags, and radiological control supplies. It is expected that these wastes would be designated as contact handled low level waste (CH-LLW). The projected radioactive waste generated per project annually during project operations is approximately 43.1 m^3 (Table 6). Water used for shielding would be treated prior to use 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. It is anticipated that no more than 25,000 gallons of shield water would be used for one reactor project. Following operations, shield water would be sampled for waste analysis. Shielding water would be shipped offsite for disposal. Shielding water would not be discharged to a wastewater treatment facility, surface water, groundwater, or the ground at the INL Site.

Waste generated during decommissioning of reactor projects in the DOME test bed would include the reactor and all ancillary equipment. Based on an evaluation of the equipment inside and outside the radiation shield, DOE anticipates LLW would be generated. Approximately 61.7 m^3 would be disposed of as LLW (Table 6). Decommissioned LLW waste would include the reactor and project components that came in contact with radiological material, personal protective equipment, scrap metal, and radiological control supplies. The reactor and other project components after removal from the test bed may be stored at a MFC facility for a period to allow for radiation levels to lower to meet an offsite facility’s WAC. The temporary storage facility would be able to accept the reactor and project components without any modifications and materials would be inspected regularly to prepare for offsite shipment.

Based on the projected radioactive waste quantities from projects sited in the DOME test bed, most of the radioactive waste would be generated during the decommissioning phase of the project. The annual generation rate would be an about 35.2 percent increase over the baseline average for the generation of waste at MFC. Radioactive waste generated during other project phases would be indiscernible from annual radioactive waste generated at MFC. An increase of radioactive waste shipments during the integration and operational phases would cause a 12.7 percent increase over the baseline average for waste shipments from MFC. The small increase would be minor in nature and any potential impact associated with this increase would be small.

During the decommissioning phase, radioactive and non-radiological waste shipments would be more than 50 percent over the baseline average. It is expected that this increase would only occur six times over the 20-year operational lifespan of the DOME test bed. Considering the temporary nature of the increase in shipments, it is expected that any potential impact would be moderate. However, all shipments would be completed in compliance with federal, state, and local statues and regulations to ensure hazards to the public or the environment are minimized to the greatest extent possible. Therefore, the potential impacts would be low.

The projected amount of waste to be generated would be within the current capacities of either onsite or offsite waste storage facilities. All waste generated during DOME test bed operations is expected to have a clear and accepted disposition pathway with little uncertainty, and the additional amounts contributed from integration, operations, and decommissioning would have a negligible direct or indirect impact on onsite or offsite storage facilities. All waste management activities would comply with federal, state, and local statutes and regulations. Therefore, any potential impacts would be temporary in nature from current operations and low when combined with past, present, and reasonably foreseeable future actions.

3.9 Irradiated Fuel

3.9.1 Affected Environment

As discussed above, DOME reactors would need to be defueled and deconstructed to facilitate disposal of project components. The irradiated fuel, which will remain under DOE's ownership following reactor experimentation, will have significant value for future advanced reactor fuel or advanced fuel cycle R&D material. As such, it is proposed that these materials be managed and stored for future programmatic use at an appropriate INL storage facility. If the material should be determined to no longer have programmatic value (either as TRISO fuel or advanced fuel cycle R&D material), then the DOE waste determination process would be invoked, and the material would be managed accordingly and stored in a compliant manner while awaiting final disposition.

An initial plan for the management of post-irradiated fuel from the DOME experimental reactors has been developed and identifies that the reactors and fuel will be removed from DOME, stored temporarily at RSWF, defueled, identified post irradiation examinations (PIE) performed, returned to temporary storage, have a fuel determination, and disposed of as SNF if it is determined as SNF.

If PIE were to be performed on the 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 reactor experiment fuel and potentially other reactor experiment components. The determination of the components that could be of interest for PIE would not be made until after the experiment testing has progressed for some time and possibly been completed.

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). The samples may be cut, ground, and/or polished to facilitate examination. These activities may use current capabilities housed in the HFEF, including the following:

- 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
- Bench measurements.

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

The management of any material designated as SNF includes the processes necessary to support the safe and secure storage of the SNF in a configuration that is ready for shipping to an independent spent fuel storage installation or permanent repository. This includes: (1) the interim storage for the dissipation of heat and reduction of radiation dose immediately after discharge, (2) treatment of reactive materials and damaged fuel, (3) DOE standard packaging for extended dry storage or transport to a repository, (4) extended dry storage while awaiting packaging or transport to a repository, and (5) transport to a repository.

SNF is generated, managed, and stored at the INL Site in compliance with applicable regulations, requirements, and other agreements. The current SNF inventory at the INL Site includes over 250 different types of fuel. The INL Site SNF inventory contains a total of about 325 metric tons of heavy metal (U.S. Nuclear Waste Technical Review Board, 2020) and is comprised of a broad range of fuels that were used during commercial, research, testing, and navel reactor operations. The diversity of fuel types at the INL Site leads to a wide variety of storage configurations. SNF is managed and stored at the INL Site pending off-site shipment to an approved independent spent fuel storage installation or permanent repository.

DOE stores SNF at the INL Site in nine facilities at three locations: INTEC, the Naval Reactors Facility (NRF), and MFC. The SNF storage facilities include a variety of storage configurations, including wet pool storage, indoor dry vaults, outdoor below-grade vaults, and SNF cask storage on concrete pads. Additional details about the storage facilities, stored SNF, and DOE efforts to manage SNF while it awaits disposal are described in *Management and Disposal of U.S. Department of Energy Spent Nuclear Fuel* (U.S. Nuclear Waste Technical Review Board, 2017).

3.9.2 Impacts from Irradiated Fuel

During decommissioning, each reactor project would be disassembled and removed from the DOME test bed and managed as described above. Irradiated materials reserved for PIE 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 Statemen*t (DOE, 1995a), Record of Decision (DOE, 1995b), supplemental analyses, and the Amended Record of Decision (DOE, 1996). 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.

DOE manages SNF in accordance with 10 CFR 72, DOE orders and guidance, and the numerous DOE Records of Decision and EISs on SNF management, including the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE, 1995a). SNF would be securely stored at existing INL Site facilities awaiting transfer to a final disposal facility.

As described above, the 1995 Idaho Settlement Agreement (DOE/Navy/ID 1995) put into place milestones for the management of radioactive waste and SNF at the INL Site. The operational life of the proposed DOME test bed, and as a result, its potential production of SNF, will extend beyond January 1, 2035. Prior to declaring any of the irradiated fuel as SNF, DOE would explore potential approaches with the State of Idaho to clarify and, as appropriate, address potential issues concerning the management of DOME SNF beyond January 1, 2035.

The specific quantity of nuclear fuel needed for an individual reactor project is unknown. However, based on the nuclear fuel needs for similar advanced nuclear technology projects, DOE anticipates about 0.52 metric tons of fuel would be needed for an individual project sited in the DOME test bed with a total of 10.4 metric tons over the 20-year lifetime of operations within the DOME test bed. Even if this entire amount was designated as SNF, this would be about 3.2 percent of the total current SNF inventory, and the impacts are anticipated to be negligible.

3.10 Traffic and Transportation

3.10.1 Affected Environment

Truck shipments and commuters from Bannock, Bingham, Bonneville, Butte, Clark, Jefferson, and Madison Counties access the INL Site on U.S. Highway 20, U.S. Highway 26, or Idaho State Highway 33 (Figure 7). U.S. Highway 20 is the closest public road, and the only access, to MFC. The closest interstate highway to the INL Site is Interstate 15 (I-15), east of the INL Site and is the major transportation route from the local area to places beyond eastern Idaho. Truck shipments to and from the INL Site primarily enter the region on I-15 and reach the site along either U.S. Highway 26 from Blackfoot, Idaho, or U.S. Highway 20 from Idaho Falls, Idaho.

Table 7 shows the average daily traffic in the vicinity of the INL Site (ITD, 2024). The number of INL Site employees (including BEA, Idaho Environmental Coalition, and NRF) exceeds 9,750 employees. During a typical workweek, most employees assigned to INL Site facilities take buses, covering about 70 bus routes, to and from work. About 1,200 private vehicles travel to and from the INL Site daily.

Table 7. Annual average daily traffic on routes in the vicinity of the INL Site

Route	Number of Vehicles Daily (weighted average)
U.S. Highway 20 – Idaho Falls to the INL Site	3000
U.S. Highway 26 – Blackfoot to the INL Site	2000
State Route 33 – West from Mud Lake	1200
U.S. Highway 20/26 – East from Arco to the INL Site	2700

Typical transport of materials at INL, both deliveries and outgoing shipments, averages 40 trucks per week.

3.10.2 Impacts to Traffic and Transportation

Operations within the DOME test bed would include the addition of traffic from and to the INL Site. When determining whether additional traffic would cause a disproportionately high or significant impact, DOE considered the following factors:

1. Whether the proposed action causes a substantial increase in traffic in relation to the existing roadway capacity to and from the INL Site
2. Whether the proposed action creates a significant hazard to the public or the environment through the routine transport of hazardous materials.

Reactor projects using the DOME test bed would involve non-radiological shipments from offsite manufacturing facilities. These shipments would consist of project equipment, including the reactor and other material necessary for the successful integration of the project in the test bed. Transport would likely be tractor-trailers, but other types of transportation (e.g., delivery vans) could also be used. Reactor projects would require the shipment of unirradiated fuel from the manufacturing facility to the INL. Unirradiated fuel would be transported in standard-sized shipping containers by truck to the INL site. These shipments would adhere to all NRC, DOE, and DOT regulatory requirements for the transport of unirradiated material. DOE anticipates one transport of unirradiated fuel per reactor project.

DOE further estimates that the DOME test bed operations would require 50 shipments of LLW from MFC per year. The transportation of other types of hazardous waste from the INL Site is also expected to be minimal. Shipments of LLW and other hazardous waste from the INL Site are a regular occurrence and are described in the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE, 1997). The packaging and transportation of hazardous waste is strictly regulated and is conducted in accordance with the U.S. Department of Transportation regulation (49 CFR § 100–185) and DOE Order 460.1D, *Hazardous Materials Packaging and Transportation Safety.* It is anticipated that the normal transport of LLW and other hazardous waste from the INL Site would not adversely affect the public and any potential impact would be low.

Onsite shipments containing radiological materials undergo an extensive safety analysis and review process to ensure proper safety plans are developed and implemented. Accidents are not likely to occur more than once in every 100,000 miles on public roadways (NRC, 2012). The total number of miles traveled on the INL Site per year is expected to be less than 1,000. In 2022 Idaho's fatality rate per 100 million vehicle miles traveled was 1.12 and the rate for accidents resulting in an injury was 63.46 per 100 million vehicle miles traveled (ITD, 2022). The fatality rate per 1 million miles for the proposed action would be $1.2E^{-9}$ and the number of accidents would be about $7.68E^{-8}$. Minor accidents are even less likely to occur on the INL Site because of the low transport speeds and because access along the INL Site transportation route would be restricted. Based on mileage alone, the likelihood of traffic or transportation impacts is low.

The estimated increase in worker commuter traffic is not anticipated to adversely affect the existing level of service for the roadways that service the INL Site. The addition of about 45 new staff members to support DOME test bed operations, assuming that they commuted daily to the site in private vehicles, would not cause a major increase in traffic, and traffic would generally flow at the posted speed limits to and from the INL Site. The resulting impact would be indiscernible to traffic at the INL Site or on public roads.

DOME test bed operations would have a negligible to low impact on the transportation network serving the INL Site. These impacts would be nearly indiscernible from current operations when combined with past, present, and reasonably foreseeable future actions. Cumulative impacts would be low.

3.11 Human Health and Safety

3.11.1 Radiation Exposure and Risk

3.11.1.1 Affected Environment

DOE monitors radiation in the environment and exposure of workers and calculates radiation doses to members of the offsite general public and onsite workers from operations at the INL Site. Historically, the dose to the MEI has been in the range of hundredths of a mrem each year and less than 1% of the 10-mrem/yr federal standard (40 CFR § 61 Subpart H) for radionuclide emissions from DOE facilities. For CY 2023, the dose to the public MEI from INL Site operations was 2.91×10^{-2} mrem/yr. The risk of developing an LCF from this dose is less than 1 in 1 million.

The annual dose to an individual from INL Site operations is several orders of magnitude less than the average dose of 381 mrem/yr from exposure to natural background radiation of someone living on the Snake River Plain. Potential impacts from radiological air emissions are discussed in Section 3.3.2.

To protect workers from impacts of radiological exposure, 10 CFR § 835 imposes an individual dose limit of 5,000 mrem per year. In addition, worker doses must be monitored and controlled below the regulatory limit to ensure that individual doses are less than a DOE administrative limit of 2,000 mrem per year as detailed in DOE-STD-1098-2017, *Radiological Control*, and maintained ALARA. The M&O contractor also implements a 700 mrem/yr administrative limit for worker dose.

To protect the public against undue risk from radiation associated with radiological activities conducted under the control of DOE, DOE Order 458.1, *Radiation Protection of the Public and the Environment*, establishes the public dose limit at a total effective dose (TED) not to exceed 100 mrem/yr above background radiation levels.

3.11.1.2 Impacts to Radiation Exposure and Risk

Operations within the DOME test bed may result in hazards to the workers and the public health through radiological emissions and exposure to radiological material. When determining whether any potential impact would cause a disproportionately high or significant impact, DOE considered the following factors:

1. Whether the proposed action complies with federal, state, and local statutes and regulations, DOE orders, standards, and guidance related to radiation protection of the public and the environment
2. Whether the proposed action would create a significant hazard to the public or workers through the use of radiological materials
3. The consequence of radiological emissions to the public and onsite workers
4. The consequences of a radiological dose to onsite workers.

As described in Section 3.3, the potential dose to an offsite member of the public from emissions associated with operations within the DOME test bed is estimated to be approximately 1.5×10^{-3} mrem/yr. This is less than 6 percent of the 2023 dose to the public MEI from all INL Site operations, and significantly less than the 10 mrem/yr regulatory standard for all sources. When compared to projected doses from past, present, and reasonably foreseeable activities occurring at that INL Site, it is expected that the DOME test bed dose contribution to the cumulative offsite dose would be low (Table 3).

INL Site workers receive the same dose as the general public from background radiation. Some workers may receive an additional dose from working in facilities with nuclear materials. DOME test bed operations would require about 45 additional workers who could receive a measurable dose over the life of the project. DOME test bed operation workers would be expected to receive a TED of approximately 65 mrem per year, each. During all operations, DOE would implement measures—including the use of shielding, personal protective equipment, and training mock-ups—to minimize worker exposures and maintain doses ALARA and improve the efficiency of operations and reduce exposure times.

For comparison, the average collective TED for INL employees from 2018 to 2022 was 84.7 person-rem as shown in Table 8 (DOE, 2023). Operations within the DOME test bed is anticipated to add approximately 2.925 person-rem to the INL Site's average worker occupational exposure (collective TED).

Table 8. Annual radiation doses to INL workers during operations 2018-2022

Year	**Collective TED (person-rem)**	**Number with Measurable Dose**	**Ave. Measured TED (rem)**	**Radiological Risk[a]**
2018	82.66	1368	0.060	0 (0.05)
2019	76.511	1203	0.064	0 (0.04)
2020	80.614	1,667	0.048	0(0.05)
2021	113.108	1,816	0.062	0 (0.07)
2022	84.569	1,602	0.053	0 (0.05)
AVERAGE	84.70	1311.5	0.065	0 (0.05)
[a] Represents the probability of the occurrence of an LCF 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. Calculated				

Year	Collective TED (person-rem)	Number with Measurable Dose	Ave. Measured TED (rem)	Radiological Risk[a]
using a dose conversion factor of 6×10^{-4} LCF per rem (6×10^{-7} per mrem). Values in parentheses are calculated values. A value of less than 0.5 is considered to result in no LCFs.				

Activities associated with decommissioning reactor projects in the DOME test bed would be performed in existing INL Site facilities. DOE would monitor worker dose and take appropriate action to limit individual worker dose below the 700 mrem annual administrative control level. DOE-STD-1089-2017 identifies an effective ALARA process as including implementation of both engineering and administrative controls to control worker dose. All equipment and operations would be designed and implemented following this principle. Further worker protection would be incorporated into the final decommissioning process to ensure worker doses are ALARA. The dose received by workers would be monitored and limited for decommissioning activities at any facility in accordance with regulatory limits.

The average dose to the individual worker (involved worker) and the cumulative dose to all INL Site workers (total workers) would be below the radiological regulatory limits of 10 CFR § 835. Potential impacts to workers and public health and safety from direct radiation and radiological emissions are expected to be low.

3.11.2 Nonradiological Health and Safety

3.11.2.1 Affected Environment

Nonradiological exposures are controlled through programs intended to protect workers from normal industrial hazards. Activities at the INL Site are controlled by the safety and health regulations for DOE contractor workers governed by 10 CFR § 851, which established 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.

Project activities occurring at offsite facilities would be subject to Occupational Safety and Health Administration (OSHA) standards for those specific industries. Considering that these activities would occur in facilities that operate under these industry-specific standards, workers are expected to have a safe work environment and be protected against occupational injuries and illnesses, accidents, and hazardous chemicals. Furthermore, considering these facilities are established in their respective areas, it is also anticipated that there would be controls in place to prevent accidents or injuries to the public at large.

3.11.2.2 Impacts to Nonradiological Health and Safety

Operations within the DOME test bed may result in hazards to the workers through contact with hazardous materials and performing hazardous operations. When determining whether any potential impact would cause a disproportionately high or significant impact, DOE considered the following factors:

1. Whether the proposed action complies with federal, state, and local statutes and regulations, DOE orders, standards, and guidance related to worker protection
2. Whether the proposed action creates a significant hazard to the public or workers through the use of hazardous materials.

Potential impacts from noise, exposure to chemicals, and occupational injuries are and would continue to be regulated to be protective of human health. Per 10 CFR § 851, employee exposures to hazardous agents are maintained below the American Conference of Governmental Industrial Hygienists threshold limit values, the OSHA permissible exposure limits, and other applicable standards as defined by DOE. When exposure limits defined by the various agencies conflict, DOE policy is to comply with the most stringent limit.

Hazardous materials (radiological and chemical) at the INL Site are minimized to those necessary to accomplish the mission. DOME test bed operations would follow sitewide and project-specific plans and procedures for handling and storing hazardous materials.

Standard industrial hazards are hazards that are routinely encountered in general industry and construction; for these hazards, national consensus codes and standards, such as OSHA standards and DOE-prescribed occupational safety and health standards, guide safe design and operation of reactor projects in the DOME test bed. In accordance with the guidelines in DOE-STD-1027-2018, *Hazard Categorization of DOE Nuclear Facilities*, and DOE-STD-3009-2014, *Preparation of Nonreactor Nuclear Facility Documented Safety Analysis*, no special analysis is required for these occupational hazards unless they are possible initiators of an uncontrolled release of radioactive or hazardous material.

The level of exposure to nonradiological hazards, the regulatory requirements for managing those hazards, and existing exposures are not anticipated to change. Therefore, the potential impacts from exposure to normal industrial hazards at the INL Site would be low.

Due to the distance between the DOME test bed and the nearest public receptor, potential impacts to the public from the use of hazardous materials or operations are not expected. Potential impacts would be negligible.

3.11.3 Facility Accidents

A safety basis describes the nuclear facility hazards and the risks to the workers, the public, and the environment and defines the safety-related equipment, procedures, and practices relied on to adequately control those hazards. To support the development of a DSA for operations in the DOME test bed, hypothetical events are identified and are evaluated to determine the potential accident consequences and identify appropriate safety SSCs necessary to ensure prevention and mitigating functions. Furthermore, per the recommendations from *Recommendations for Analyzing Accidents under the National Environmental Policy Act* (DOE 2002) the collective impact to a population is determined. The development of the DSA for the DOME test bed is ongoing and would include a set of safety SSCs for reactor projects and their associated required safety functions to avoid unacceptable consequences. The safety SSCs for reactor projects are assigned a safety classification based on whether they perform a required safety function, provide environmental conditions for the performance of safety functions, or provide significant DID protection.

Reactor projects sited in the DOME test bed would range from 1 to 20 MWth with a range of technologies, including variations in neutron energy spectrum (fast or thermal), primary and secondary coolant choices. They would use TRISO fuel. Reactor projects would be designed to survive a wide variety of off normal, upset, or accident conditions. Typical safety response for these reactors is to shut down.

The primary hazard for the DOME test bed during reactor project operations is a fuel failure event coupled with a reactor boundary breach. In the event of a fuel failure event, the DOME test bed would perform the confinement function for non-gaseous fission products, and the facility's ventilation system would contain a portion of the gaseous fission products.

A theoretical possibility is that a severe accident could occur that challenges the plant design basis. In preparation for operations within the DOME test bed, a facility accident analysis is prepared to determine the hypothetical consequences if a severe accident would occur. For this EA, it is assumed that a reasonably foreseeable accident using a reactor operating at 20 MWth releases 100% of the radionuclide inventory instantly. In this unlikely hypothetical event, it is assumed all fission products and fuel activation products are in the fuel at the time of release, there is no decay time for the fuel, and there are no containment barriers.

If this type of event were to occur, a plume of fission products would disperse from the test bed. Under this scenario, some hypothetical receptors would be unaware of the accident and no emergency actions would be taken for protection. These receptors would be susceptible to the entire potential dose. By way of the calculated TED, the evaluation estimates the collective impact to the population of co-located workers and a member of the public at the nearest INL Site boundary (INL, 2024a) (Table 9).

Table 9.Summary of dose impacts for the highest postulated accident consequences for operations within the DOME test bed

Receptor (distance)	Dose (TED) rem	LCF Risk[a]
Co-located worker (100 m)	3.64×10^{-1}	2.18×10^{-4}
Nearest Site Boundary (4700 m)	9.45×10^{-4}	2.02×10^{-10}
[a] Calculated using a dose conversion factor of 6×10^{-4} LCF per rem.		

The estimated dose consequence of a hypothetical reasonably foreseeable accident is calculated for a 20 MWth high temperature gas reactor operating to the end of life of the reactor. At the end of life, a hypothetical reactor accident would breach the reactor confinement and release radionuclides into the DOME atmosphere. The hypothetical accident would also result in a breach of the DOME confinement and radionuclides would be released outside of DOME.

Adverse consequences from significant releases of radioactive or hazardous materials are limited by the size of a reactor, fuel type, and fission product inventory. However, DOE requirements for emergency planning as described in DOE Order 151.D, *Comprehensive Emergency Management System*, state that distances to site boundaries on DOE facilities and additional safety management programs, including a reactor project DID strategy, are used to mitigate consequences from extremely low probability events. In all cases, the release of fission products during a hypothetical accident, as described here, is within guidelines for public exposure under severe accident conditions (see Section 3.3). Existing low-population exposures to humans from radiation resulting from a hypothetical accident, when considering the containment structure and reactor vessel retention within the DOME test bed, would be low.

3.11.4 Emergency Preparedness

DOE Order 151.D, *Comprehensive Emergency Management System*, describes detailed requirements for emergency management DOE must implement. 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 (e.g., radioactive materials or certain chemicals that do not fall under the purview of fundamental worker safety programs) establishes and maintains an emergency management hazardous material 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 an emergency occur onsite.

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. DOE maintains the necessary apparatus, equipment, and state-of-the-art Emergency Operations Center in Idaho Falls to respond to emergencies, not only at the INL Site but through the local communities.

A readiness assessment would be completed prior to the integration of a reactor project into the DOME test bed and subsequent operations to demonstrate that there is reasonable assurance that operations are performed safely and give adequate protection to workers, the public, and the environment. The readiness 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 conform and periodically reconfirm the condition and operability of all safety and support systems; procedures; emergency management; and conduct of operation processes.

3.12 Environmental Justice

3.12.1 Affected Environment

Environmental justice (EJ) is 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 population bears a disproportionate share of negative environmental consequences resulting from industrial, municipal, and commercial operations or from the execution of federal, state, and local laws, regulations and policies.

Consideration of EJ in NEPA analysis is driven by Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, and is further supported by EO 14008, *Tackling the Climate Crisis at Home and Abroad*, and EO 14096 *Revitalizing our Nation's Commitment to Environmental Justice for All* as well as accompanying guidance (CEQ, 1997) (IWG, 2016).

The EOs direct federal agencies to identify disproportionately high and adverse human health or environmental effects of federal programs, policies, and activities on communities of EJ concern and to take action to address such impacts. The definitions used for communities of EJ concern and other EJ terminology in this document are consistent with the definitions within the most recent EOs and federal guidance.

The total population residing within the 50-mile Region of Influence (ROI) is about 326,003 of which roughly 87% identify as white (Table 10) (U.S. Census Bureau, 2024a). American Indian and Alaska Native populations comprise about 2% of the population within the 50-mile ROI because the Fort Hall Reservation lies largely within it (Table 11) and almost 13% are of Hispanic or Latino descent.

About 8.0% of the population residing within the ROI are identified as living below the U.S. poverty rate and several census tracts meet or exceed the Climate and Economic Justice Screening Tool (CEJST) threshold for low income.

Table 10. Estimated population and demographics within a 50-mile radius of MFC

	Population	Percent of Population
Race and Ethnicity		
Total	326,003	100%
Black or African American	993	0.3%
American Indian or Alaskan Native	6,616	2%
Asian	3,083	0.9%
Hawaiian or Pacific Islander	351	0.1%
Two or More Races	12,555	3.9
White	286,711	87%
Hispanic or Latino	41,423	12.7%

	Population	Percent of Population
Race and Ethnicity		
Age		
Under 5 Years	26,156	8%
5-17 Years	70,546	21.6%
18-64 Years	186,208	57.1%
Over 64 Years	43,093	13.2%
Source (U.S. Census Bureau, 2024a)		

Table 11. Tracts within 50-mile radius of MFC that meet or exceed a CEJST burden category

Tract ID #	County	Water	Workforce	Climate	Energy	Transportation	Housing	Pollution	Health	Disadvantaged?
3	Jefferson	No	No	Yes	Yes	No	Yes	No	No	Yes
6	Clark	No	Yes	Yes	Yes	No	No	No	No	Yes
7	Lemhi	No	No	Yes	Yes	Yes	No	No	Yes	Yes
8	Power	No	No	Yes	No	No	No	Yes	Yes	Yes
11	Butte	No	No	Yes	No	No	No	Yes	No	Yes
17	Madison	No	Yes	No	No	No	No	No	No	Yes
23	Bannock	No	No	Yes	No	No	No	No	No	Yes
25	Bannock	No	No	Yes	No	No	No	No	No	Yes
28	Bannock	No	Yes	Yes	No	No	Yes	No	No	Yes
30	Bonneville	No	No	No	No	No	Yes	No	No	Yes
33	Bonneville	No	Yes	No	No	No	No	No	Yes	Yes
37	Bonneville	No	No	No	No	No	Yes	No	No	Yes
40	Bannock	No	No	Yes	No	No	No	Yes	No	Yes
41	Bannock	No	No	Yes	No	No	No	Yes	No	Yes
42	Bannock	No	No	Yes	No	No	No	No	No	Yes
46	Bingham	No	No	No	No	No	No	Yes	No	Yes
50	Bingham	No	No	Yes	No	No	Yes	No	No	Yes
58	Bonneville	No	No	Yes	No	No	No	No	No	Yes
61	Bannock	No	Yes	Yes	No	No	No	No	No	Yes
63	Bingham	No	Yes	No	No	No	No	No	Yes	Yes
64	Custer	No	No	Yes	No	No	No	No	No	Yes

DOE uses CEQ CEJST methodology to aid in the identification of communities of EJ concern (CEQ, 2024a). CEJST identifies U.S. Census tracts as "disadvantaged" based on meeting or exceeding environmental and socioeconomic burden thresholds. Disadvantaged communities are those that meet both an environmental and a socioeconomic burden threshold. All disadvantaged communities are considered communities of EJ concern. Figure 9 displays communities identified as “disadvantaged” by CEJST. These communities are of EJ concern. Of the 65 tracts within the ROI, 21 are identified as disadvantaged. Every CEJST burden category is met within the ROI other than the burden category for water and wastewater.

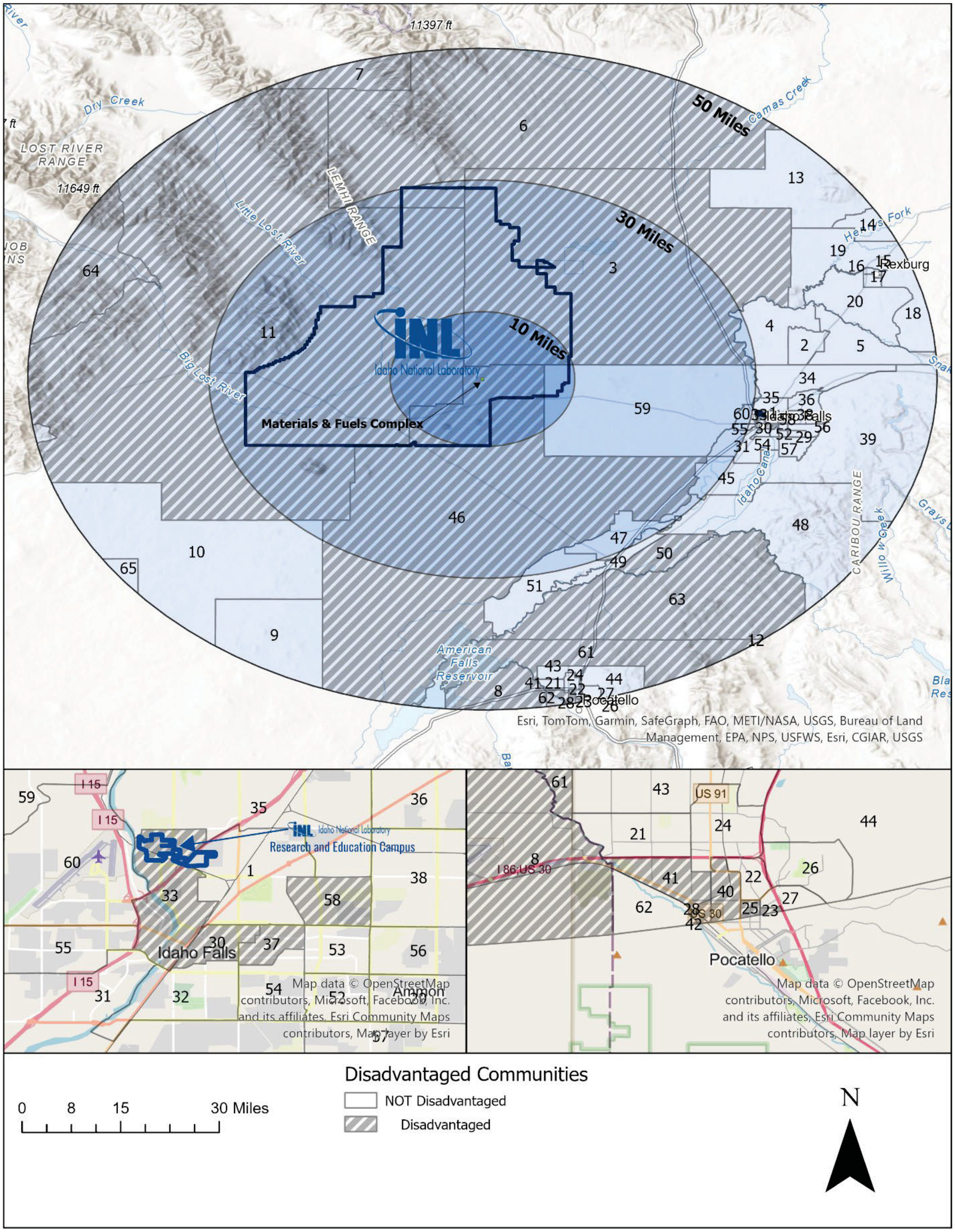

Figure 9. Location of communities of EJ concern identified as "disadvantaged" by CEQ's CEJST methodology

3.12.2 Impacts to Environmental Justice

When determining whether environmental effects from the proposed DOME test bed on communities of EJ concern are disproportionately high and adverse, DOE considered the following factors:

- Does the physical location of the proposed activity and/or the ROI reside within or encroach upon a community considered disadvantaged as defined by the CEQ CEJST Methodology?
- What CEJST burden thresholds do the census tracts collocated with the ROI meet?
- Are there additional potential effects that need to be considered to appropriately analyze the potential impacts to EJ?
- Do anticipated impacts as analyzed have the potential to exacerbate or otherwise negatively impact EJ conditions for the census tracts collocated with the ROI when compared to baseline conditions?
- Whether direct or cumulative effects are anticipated to be significant (as defined by 40 CFR § 1500–1508) or have a reasonable potential to have disproportionately or adverse impacts in communities of EJ concern in relation to the general public.

Currently, all but one census tract comprising and immediately surrounding the INL site are considered disadvantaged under CEQ's CEJST methodology (CEQ, 2024). All communities identified as disadvantaged are considered communities of EJ concern. Table 11 shows the burden thresholds met by the communities that intersect or immediately surround a 50-mile buffer of the location of the proposed activity as described in the preferred alternative. Tracts exceeding a category and considered disadvantaged according to CEJST methodology are considered communities of EJ concern.

The impacts from installation and operation of the proposed reactor test bed in DOME at MFC are anticipated to be minimal. Although the project is located within and surrounded by census tracts identified as communities of EJ concern, the activities described in the preferred alternative are unlikely to negatively affect the baseline EJ conditions in surrounding communities. Additionally, analyses provided for other resource areas in this EA suggest any effects to be minimal. It is not anticipated that effects in communities of EJ concern or disadvantaged communities will be disproportionately high or adverse relative to the public at large within the greater INL Site ROI.

The proposed activities would have minimal impacts on environmental or socioeconomic burdens present in the collocated and surrounding communities. None of the analyses provided in this document suggest that activities could have a direct or cumulative impact on any CEJST-identified environmental or socioeconomic burden category.

There would be minimal impacts to these resource areas that might affect off-site populations (including Native American populations) or subsistence resources. Land disturbance at the INL Site from the proposed activities would be negligible because the project would occur primarily in an existing facility at MFC. Therefore, any potential impact to communities that rely on subsistence consumption (including Native American populations) would be negligible.

DOME test bed operations would not limit access to sacred and traditional-use areas of the Shoshone-Bannock tribes, natural landscapes, water, or ecological resources on or near the INL Site.

3.13 Intentional Destructive Acts

DOE routinely uses a variety of measures to mitigate the likelihood and consequences of intentional destructive acts. DOE maintains a highly trained and equipped Protective Force intended to prevent attacks against and entry into facilities and to mitigate the potential for an act of sabotage to occur onsite.

The potential for an intentional destructive act to occur —including its exact nature, location, and consequential magnitude—is inherently uncertain. However, DOME test bed operations would be performed within a protected area, under a high level of security at MFC. If an intentional destructive act involving the DOME test bed occurred, the potential consequences would be dependent on the amount of fissile material in those facilities at the time of the event and would be similar to the maximum reasonably foreseeable accident as described Section 3.11.3.

3.14 Irreversible and Irretrievable Commitment of Resources

Irreversible commitment of resource refers to the loss of future options for resource development or management, especially of nonrenewable resources like as cultural resources. Operations in the DOME test bed would not require the disturbance of soil, conversion of current land uses, or disturbance of habitat. All activities as they relate to reactor projects would occur in existing facilities designed to support these projects. DOME test bed operations would require the irretrievable commitment of non-recyclable materials that would support reactor projects, fuel consumed by equipment and vehicles, and the energy consumed by the project.

3.15 Relationship between Short-Term Use of Resources and Long-Term Productivity

The proposed action would not result in substantial change to the existing condition. Therefore, there would be no impact from the short-term use versus long-term productivity. The results of operations within the DOME test bed would contribute to the advancement of nuclear technology and be beneficial in the long-term productivity of non-carbon sources of energy production.

3.16 Conclusion

The selection of any alternative would not result in the exceedance of a regulatory limit or standard (e.g., air emissions), capacity of a specific resource (e.g., ecological resources), or infrastructure and utilities' ability to provide services (e.g. water treatment) for DOME test bed operations. Based on the impact analysis associated with the proposed action, no potential adverse impacts were identified that would require additional mitigation measures beyond those required by regulations, permits, and agreements or achieved through design features and best management practices. Any adverse impact would be small and would not destabilize important attributes of resources or the environment. Potential impacts, in conjunction with other past, present, and reasonably foreseeable future actions, would not result in long-term cumulative impacts. Finally, the proposed action would not significantly affect the quality of the human environment.

Table 12 summarizes the anticipated environmental impacts from the DOME test bed as described in this EA. Implementing the proposed action would result in small adverse impacts to the environment. However, these impacts, in conjunction with other past, present, and reasonably foreseeable future actions, would not result in discernible cumulative impacts.

Table 12. Summary of environmental impacts from the DOME test bed

Resource	Impacts from the DOME Test Bed
Air Quality	Reactor projects sited in the DOME test bed would produce minor amounts of air emissions. Transport of these emissions would produce negligible ambient air pollutants concentrations at offsite locations. Therefore, any minor increase in offsite air pollutant concentrations produced from DOME test bed operations, in combination with emissions from other past, present and reasonably foreseeable future actions, including future demonstration reactor projects would result in air pollutant concentrations that would not exceed the state and National Ambient Air Quality Standards and would not substantially contribute to cumulative air

Resource	Impacts from the DOME Test Bed
	quality impacts. Radioactive air emissions would result in negligible dose impacts to collocated workers and offsite members of the public. Any potential direct, indirect, or cumulative impacts to air quality from DOME test bed operations would be considered low.
Ecological Resources	There is potential for the DOME test bed activities to impact various wildlife species both directly and indirectly during transportation, installation, and operation activities. The loss of protected or sensitive species or loss of local populations from direct mortality or diminished survivorship is not anticipated. Regulatory and planning controls used for installation and facility operations on the INL Site can greatly reduce any of the potential impacts to ecological resources discussed in Section 3.4. No negative dose impacts to biota are expected. Therefore, any potential impact to ecological resources from radiological air emissions would be negligible to low. Cumulative impacts to ecological resources of the DOME test bed when added to past, present, and reasonably foreseeable actions at the INL Site would be low.
Cultural and Historic Resources	At this time, Section 106 review cannot be completed until an application is received for a reactor experiment in the DOME test bed. When user applications are received, DOE would evaluate how the proposed experiment activities fall within the parameters of this EA, and a concurrent Section 106 review would be conducted. The outcome of the Section 106 review would help inform the evaluation. Although there are historic properties within the affected environment for these activities, it is anticipated that a majority, if not all, of these actions would result in no historic properties affected determination.
Geology and Soils	The DOME test bed is an existing facility. No ground disturbance or change to existing land use at MFC is expected; therefore, there are no anticipated impacts to geological or soil resources. Potential impacts due to seismic activity are not expected. Therefore, no cumulative impacts to geologic or soil resources from other past, present, and reasonably foreseeable future actions are expected.
Infrastructure	Reactor operations, shielding, and office use would result in a small increase in water consumption, but would not affect the ability of the system to provide an adequate supply to meet the requirements of existing personnel, process, and fire protection purposes. Any potential impacts to water consumption at the INL Site would be small. When combined with the total amount of water estimated to be used per year for DOME test bed operations, in combination with ongoing INL Site activities and proposed construction of the HTTF, cumulative water use would amount to about 0.09 percent of the INL Site's Federal Reserved Water Right of 11.4 billion gallons per year. The cumulative impacts to water use from operating the DOME test bed would be small. The small increase in effluent to the sanitary sewer system from new employees would not affect the ability of the system to perform as currently designed. Any potential impacts to the sanitary sewer system at MFC would be low. Based on the expected fuel use quantities any potential impact would be considered negligible.

Resource	Impacts from the DOME Test Bed
	It is anticipated that operations within the DOME test bed would have negligible to low impacts on current INL Site infrastructure. Direct and indirect impacts would be nearly indiscernible from current operations when combined with past, present, and reasonably foreseeable future actions. Any cumulative impacts are expected to be low.
Waste Management	The projected amount of waste to be generated would be within the current capacities of either onsite or offsite waste storage facilities. All waste generated during DOME test bed operations is expected to have a clear and accepted disposition pathway with little uncertainty, and the additional amounts contributed from integration, operations, and decommissioning would have a negligible direct or indirect impact on onsite or offsite storage facilities. All waste management activities would comply with federal, state, and local statutes and regulations. Therefore, any potential impacts would be temporary in nature from current operations and low when combined with past, present, and reasonably foreseeable future actions. The proposed action would not generated TRU or high-level waste.
Irradiated Fuel	DOME reactors would need to be defueled and deconstructed to facilitate disposal of project components. The irradiated fuel, which will remain under DOE's ownership following reactor experimentation, will have significant value for future advanced reactor fuel or advanced fuel cycle R&D material. As such, it is proposed that these materials be managed and stored for future programmatic use at an appropriate INL storage facility. If the material should be determined to no longer have programmatic value (either as TRISO fuel or advanced fuel cycle R&D material), then the DOE waste determination process would be invoked, and the material would be managed accordingly and stored in a compliant manner while awaiting final disposition. An initial plan for the management of post-irradiated fuel from the DOME experimental reactors has been developed and identifies that the reactors and fuel will be removed from DOME, stored temporarily at RSWF, defueled, identified post irradiation examinations (PIE) performed, returned to temporary storage, have a fuel determination, and disposed of as SNF if it is determined as SNF. Irradiated materials reserved for PIE 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 Statemen*t (DOE, 1995a), Record of Decision (DOE, 1995b), supplemental analyses, and the Amended Record of Decision (DOE, 1996). 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. The specific quantity of nuclear fuel needed for an individual reactor project is unknown. However, based on the nuclear fuel needs for similar advanced nuclear technology projects, DOE anticipates about 0.47 metric tons of fuel would be needed for an individual project sited in the DOME test bed with a total of 2.84 metric tons over the 20-year lifetime of operations within the

Resource	Impacts from the DOME Test Bed
	DOME test bed. Even if this entire amount was designated as SNF, this would be about 0.87 percent of the total current SNF inventory, and the impacts are anticipated to be negligible.
Health and Safety	The average dose to the individual worker (involved worker) and the cumulative dose to all INL Site workers (total workers) would be below the radiological regulatory limits of 10 CFR § 835. Potential impacts to workers and public health and safety from direct radiation and radiological emissions are expected to be low. Due to the distance between the DOME test bed and the nearest public receptor, potential impacts to the public from the use of hazardous materials or operations is not expected. Potential impacts would be negligible. Existing low-population exposures to humans from radiation resulting from a hypothetical accident, when considering the containment structure and reactor vessel retention within the DOME test bed, would be low.
Environmental Justice	The impacts from the installation and operation of the proposed reactor test bed in DOME at MFC are anticipated to be minimal. Although the project is located within and surrounded by census tracts identified as communities of EJ concern, the activities described in the preferred alternative are unlikely to negatively affect the baseline EJ conditions in surrounding communities. Additionally, analyses provided for other resource areas in this EA suggest any effects to be minimal. It is not anticipated that effects in communities of EJ concern or disadvantaged communities will be disproportionately high or adverse compared to the public at large within the greater INL Site ROI.
Intentional Destructive Acts	The potential for an intentional destructive act to occur —including its exact nature, location, and consequential magnitude—is inherently uncertain. However, DOME test bed operations would be performed within a protected area, under a high level of security at MFC. If an intentional destructive act involving the DOME test bed occurred, the potential consequences would be dependent on the amount of fissile material in those facilities at the time of the event and would be similar to the maximum reasonably foreseeable accident as described Section 3.11.3.

4. COORDINATION AND CONSULTATION

4.1 Shoshone-Bannock Tribes

DOE briefed staff from the Shoshone-Bannock Tribal staff and Fort Hall Business Council on the DOME test bed's operations on September 25, 2024.

4.2 State of Idaho

DOE briefed staff from the Idaho Office of Energy and Mineral Resources on the DOME test bed's operations on September 30, 2024.

4.3 Congressional

4.4 Idaho Department of Environmental Quality

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