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Revision 0

Engineering Evaluation/Cost Analysis for the Naval Reactors Facility S5G Final End State Including Disposition of Reactor Vessel

October 2024

U.S. Department of Energy
Idaho Operations Office

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

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ABSTRACT

Under this engineering evaluation/cost analysis (EE/CA), four alternatives were developed for the final end-state determination and associated reactor vessel disposition for the Submarine 5th Generation General Electric (S5G) Prototype Facility at the Naval Reactors Facility. As a result of this EE/CA, the U.S. Department of Energy (DOE) recommends Alternative 4, Complete Prototype Removal. Under Alternative 4, the S5G Prototype Facility would be removed, with disposal of low-level radioactive waste at a low-level waste disposal facility such as the Idaho CERCLA Disposal Facility that is authorized by the U.S. Environmental Protection Agency (EPA) to accept Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) waste. This EE/CA was developed in accordance with EPA guidance for conducting an EE/CA under CERCLA.

The S5G Prototype Facility will be removed in accordance with CERCLA, the "National Oil and Hazardous Substances Pollution Contingency Plan," and the DOE and EPA *Policy on Decommissioning of Department of Energy Facilities Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).* This 1995 policy established CERCLA non-time-critical removal actions as the preferred method to decommission and demolish DOE facilities. DOE prepared this EE/CA to review the nature and extent of contamination, describe removal action alternatives, provide a framework for selecting a preferred alternative, and satisfy Administrative Record requirements.

The DOE Idaho Operations Office briefed the Shoshone-Bannock Tribal DOE director on August 26, 2024. DOE also offered formal government-to-government consultation and comment on the S5G EE/CA in accordance with Executive Order 13175, "Consultation and Coordination with Indian Tribal Governments." This EE/CA and the recommended alternative will be made available for a 30-day public comment period. After considering Tribal and public comments, DOE will issue, with the concurrence of the EPA and the Idaho Department of Environmental Quality, an action memorandum documenting the selected alternative.

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EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) proposes to mitigate potential future risks associated with the Submarine 5th Generation General Electric (S5G) Prototype Facility at the Naval Reactors Facility (NRF) on the Idaho National Laboratory Site (INL) by implementing a non-time-critical removal action (NTCRA) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This engineering evaluation/cost analysis (EE/CA) presents the basis for DOE's recommendation to completely remove and dispose of the prototype and its defueled reactor vessel.

As the lead agency, the DOE Idaho Operations Office (DOE-ID) is conducting this NTCRA pursuant to CERCLA, Section 104(a), "Response Authorities," and Executive Order 12580, "Superfund Implementation," as recognized by Section 5.3 of the INL Federal Facility Agreement and Consent Order. DOE-ID and the Naval Nuclear Propulsion Program (NNPP) collaborated to develop this EE/CA in consultation with Idaho Department of Environmental Quality (DEQ) and U.S. Environmental Protection Agency (EPA). After considering Shoshone-Bannock Tribal and public comments, DOE-ID, in coordination with NNPP and with concurrence from DEQ and EPA, will issue an action memorandum to document the selected alternative for decommissioning the S5G Prototype Facility and to specify requirements that the NTCRA must satisfy. DOE-ID will implement the selected alternative as a NTCRA to be performed under CERCLA as part of the Idaho Cleanup Project.

The S5G Prototype Facility is designated as NRF-633P, consisting of the S5G Prototype and its defueled reactor vessel, the subgrade hull basin housing the prototype, and nine subgrade cells on the north side of the hull basin within the S5G Test Plant Building NRF-633A. To facilitate ongoing warehouse operations within the building, NRF-633A itself is specifically excluded. This EE/CA develops and evaluates the following four alternatives for decommissioning NRF-633P, the S5G Prototype Facility:

- Alternative 1, No Action—No action would leave the prototype to degrade and collapse in place, releasing hazardous substances into the environment. This alternative is not protective; however, it serves as a base case for comparison with other alternatives.
- Alternative 2, Continued Surveillance and Maintenance—Continued surveillance and maintenance affords interim protection but only delays the inevitable need for facility demolition. It offers no long-term protection and is not a viable option.
- Alternative 3, In Situ Decommissioning—In situ decommissioning involves targeted removal and disposal of radiological and other hazardous substances at approved disposal facilities followed by in situ grouting of the prototype and its hull basin. Risk assessments conclude that Alternative 3 would provide long-term protection of human health and the environment. Sources of risk are significantly reduced by removal. In situ grouting would stabilize the site, minimize voids, and immobilize residual hazardous substances. An engineered floor over the site would provide further isolation from hazardous substances that may remain. Because contamination would remain, long-term management and controls likely would be required to ensure the remedy remains protective in the future. Alternative 3 would cost approximately $73.5M.
- Alternative 4, Complete Prototype Removal (recommended)—Dismantling and removing the entire prototype would be a complete solution that would protect human health and the environment and comply with environmental regulations. Waste would be segregated and transported to approved disposal facilities. The emptied basin would be backfilled, and the building would be restored by constructing an engineered floor to facilitate ongoing warehouse operations. Because significant contamination would not remain, long-term management and controls likely would not be required to ensure the remedy remains protective in the future; however, institutional

controls would apply if concentrations of residual hazardous substances (e.g., polychlorinated biphenyls) preclude unrestricted land use. Alternative 4 would cost approximately $70.1M.

The two viable options—Alternatives 3 and 4—were evaluated based on short- and long-term aspects of three broad criteria: effectiveness (e.g., protectiveness, compliance with applicable or relevant and appropriate requirements, and ability to achieve removal action objectives [RAOs]), implementability (e.g., technical and administrative feasibility and availability of resources), and cost. Analysis shows that both alternatives are expected to be effective and implementable, and they have similar cost. Significant advantages of Alternative 3 include shorter duration and less transport of waste over public roads. Alternative 4 reduces occupational hazards during the removal action, offers more potential for recycling, and is a complete and permanent solution that is consistent with DOE objectives.

DOE recommends Alternative 4, Complete Prototype Removal, because it is a complete and permanent solution. It meets proposed RAOs for human health and environmental protectiveness and complies with applicable or relevant and appropriate requirements. Though Alternative 3, In Situ Decommissioning, would generate less waste for transport and take less time, it would leave contaminated materials behind that would necessitate long-term management and institutional controls. Under Alternative 4, the S5G Prototype and associated materials would be completely removed. Decommissioning and demolition wastes, including the prototype, its defueled reactor vessel, and associated lead shielding, would be removed and transported to a low-level waste disposal facility authorized by EPA to accept CERCLA waste, such as the Idaho CERCLA Disposal Facility on the INL Site. Mixed waste, such as radioactive lead solids that no longer serve as shielding, would be removed and shipped to a mixed waste facility authorized by EPA to accept CERCLA waste outside of the INL Site. Following removal, an EPA- and DEQ-approved sampling plan would be used to validate that RAOs have been met. The hull basin and subgrade cells would be backfilled and covered with a floor sufficient to support warehouse operations.

Complete Prototype Removal also satisfies the DOE goal of reducing the “risk footprint,” where practicable, in consideration of (a) the principles of keeping exposures of decommissioning personnel to radiological hazards as low as reasonably achievable, (b) safe engineering standards, (c) applicable disposal facility waste acceptance criteria, and (d) a desired CERCLA site end state (i.e., a functioning warehouse without characteristics that once caused Building NRF-633A to be categorized as a “major facility”). Implementation of the recommended alternative for the S5G Prototype Facility is not expected to have any significant impact on potential future remedial actions that may become necessary at NRF.

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FIGURES

TABLES

ACRONYMS

A1W	Aircraft Carrier 1st Generation Westinghouse
ALARA	as low as reasonably achievable
amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CRUD	radioactive corrosion particles
D&D	decommissioning and demolition
DEQ	Department of Environmental Quality (Idaho)
DOE	U.S. Department of Energy
DOE-EM	U.S. Department of Energy Office of Environmental Management
DOE-ID	U.S. Department of Energy Idaho Operations Office
EDF	engineering design file
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
F&WS	U.S. Fish and Wildlife Service
HWMA	Hazardous Waste Management Act
ICDF	Idaho CERCLA Disposal Facility
ICDWL	INTEC CERCLA Debris Waste Landfill
ICP	Idaho Cleanup Project
INEEL	Idaho National Engineering and Environmental Laboratory (now INL)
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
IPaC	Information for Planning and Consultation
MAR	material at risk
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NNPP	Naval Nuclear Propulsion Program

NRF	Naval Reactors Facility
NSI	new site identification
NTCRA	non-time-critical removal action
OU	operable unit
PCB	polychlorinated biphenyl
PRG	preliminary remediation goal
RCRA	Resource Conservation and Recovery Act
RAO	removal action objective
ROD	record of decision
RSL	regional screening level
S1W	Submarine 1st Generation Westinghouse
S5G	Submarine 5th Generation General Electric
SGCN	Species of Greatest Conservation Need
WAC	waste acceptance criteria
WAG	waste area group

Engineering Evaluation/Cost Analysis for the Naval Reactors Facility S5G Final End State Including Disposition of Reactor Vessel

1. INTRODUCTION

The U.S. Department of Energy (DOE) proposes to mitigate potential future risks associated with the Naval Reactors Facility (NRF) Submarine 5th Generation General Electric (S5G) Prototype Facility (designated as NRF-633P) on the Idaho National Laboratory (INL) Site by implementing a non-time-critical removal action (NTCRA) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; 42 USC 9601 et seq.). The S5G Prototype Facility provided a mock submarine used to train U.S. Navy personnel in naval nuclear propulsion plant operations and for research and development related to the Naval Nuclear Propulsion Program (NNPP). This engineering evaluation/cost analysis (EE/CA) presents the basis for DOE's recommendation to completely remove and dispose of the prototype and its defueled reactor vessel.

1.1 Purpose

DOE prepared this EE/CA to review the nature and extent of contamination, describe removal action alternatives, provide a framework for selecting a preferred alternative, and satisfy Administrative Record requirements. This EE/CA was developed in accordance with CERCLA as amended by the "Superfund Amendments and Reauthorization Act of 1986 (SARA)" (Public Law 99-499) and in accordance with 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan" (NCP).

1.2 Authority

The DOE Idaho Operations Office (DOE-ID), Idaho Department of Environmental Quality (DEQ), and U.S. Environmental Protection Agency (EPA) are the CERCLA Agencies at the INL Site. As the lead agency, DOE-ID is conducting this NTCRA pursuant to CERCLA, Section 104(a), "Response Authorities," (42 USC 9604) and Executive Order 12580, "Superfund Implementation," as recognized by Section 5.3 of the Federal Facility Agreement and Consent Order (DOE-ID 1991). DOE-ID and NNPP collaborated to develop this EE/CA in consultation with DEQ and EPA.

In accordance with 40 CFR 300.415, "Removal action," of the NCP, the use of removal action authority is appropriate because of the levels of hazardous substances present, as discussed in this EE/CA, and the potential threat of future releases of those substances. NTCRAs are consistent with the joint DOE and EPA *Policy on Decommissioning of Department of Energy Facilities Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)* (DOE and EPA 1995), which established the CERCLA NTCRA process as the preferred approach for decommissioning surplus DOE facilities. Under this policy, a NTCRA may be executed if DOE determines that the action "…will prevent, minimize, stabilize, or eliminate a risk to human health or the environment." When DOE determines that criteria for executing a CERCLA NTCRA have been met, DOE is thereby authorized to evaluate, select, and implement the removal action that DOE determines is most appropriate to address the potential risk posed by the release or threat of release.

On August 26, 2024, DOE-ID briefed the Shoshone-Bannock Tribal DOE director and provided a tour of the S5G Prototype Facility. DOE also supplied the Tribes with a draft of the S5G EE/CA and offered formal government-to-government consultation and comment in accordance with Executive Order 13175, "Consultation and Coordination with Indian Tribal Governments."

After considering Tribal and public comments, DOE-ID, in coordination with NNPP and with concurrence from DEQ and EPA, will issue an action memorandum to document the selected alternative for decommissioning the S5G Prototype Facility and to specify requirements that the NTCRA must satisfy. DOE will implement the selected alternative as a NTCRA to be performed under CERCLA as part of the Idaho Cleanup Project (ICP).

1.3 Scope and Schedule

This EE/CA evaluates four alternatives addressing the S5G Prototype Facility, designated as NRF-633P, and culminates with DOE's recommended alternative. NRF-633P is defined as the S5G Prototype and its defueled reactor vessel, the subgrade hull basin housing the prototype, and nine subgrade cells on the north side of the hull basin within S5G Test Plant Building NRF-633A. Some modifications to Building NRF-633A may be required to allow removal of large pieces of the S5G Prototype and to construct a new warehouse floor, but the building itself is specifically excluded from this action. Warehouse operations in Building NRF-633A will continue upon completion of the S5G Prototype NTCRA. Though office Building NRF-633B and warehouse Building NRF-634 are attached to the S5G Test Plant Building NRF-633A, they are not part of this major NTCRA either, and are not expected to be impacted by or interfere with decommissioning and demolition (D&D) of the S5G Prototype Facility.

Actions preparatory to decommissioning of the S5G Prototype Facility (e.g., removal of the S5G cooling-water circulation system on the south side of the basin on the main floor of the building) may begin prior to completion of the S5G-specific action memorandum, as provided for by the ICP General Action Memorandum (DOE-ID 2021a). Decommissioning actions that would influence the end state for primary reactor components (e.g., the reactor vessel) will not be undertaken until the required action memorandum has been signed. Decommissioning work is currently underway at NRF on two other prototype facilities[a] and on additional support facilities.[b] The S5G removal action is tentatively planned to begin when D&D resources become available. D&D of the S5G Prototype Facility is expected to take approximately 2 to 3 years.

1.4 Anticipated End State

Performance of the recommended removal action—Complete Prototype Removal (discussed as Alternative 4)—would protect human health and the environment by removing and disposing of the S5G Prototype and its associated reactor vessel. In addition, complete removal would clear Building NRF-633A of significant S5G-related contamination and leave the building in useable condition. Institutional controls are not anticipated following Complete Prototype Removal; however, the removal action report will provide the basis for completion of the Operable Unit (OU) 10-08 CERCLA new site identification (NSI) process, if necessary, which would determine institutional control requirements. As the lead agency, DOE-ID determined that implementing this CERCLA removal action in accordance with 40 CFR 300.415 is the appropriate means to accomplish the desired final end state. DEQ and EPA concur

a. Removal actions involving prototypes currently in progress are in accordance with *Action Memorandum for the Naval Reactors Facility S1W and A1W Final End States Including Disposition of Reactor Vessel* (DOE-ID 2023).

b. Removal actions currently in progress for support facilities are in accordance with *Action Memorandum for General Decommissioning Activities under the Idaho Cleanup Project* (DOE-ID 2021a).

that a NTCRA is warranted to place the S5G Prototype Facility and reactor vessel in final configurations that are protective of human health and the environment.

1.5 Public Participation

DOE-ID will publish a notice of availability and a brief description of this EE/CA in the local newspaper (*Post Register*, Idaho Falls, Idaho) announcing a 30-day public comment period to meet requirements of 40 CFR 300.415(n), "Community relations in removal actions." The public may contact Dana Kirkham of the INL Site Community Relations Office (phone 208-533-0538 or email eeca_comments@icp.doe.gov). In accordance with the *INL Site Community Involvement Plan* (DOE-ID 2015) and CERCLA administrative record requirements, this EE/CA is part of the ICP CERCLA Administrative Record at https://idaho-environmental.com/ARIR/. Documentation supporting this EE/CA, such as associated engineering design files (EDFs) evaluating risk, also will be included.

1.6 Document Organization

Subsequent sections of this EE/CA are organized as follows:

- Section 2, Site Characterization, describes the INL Site, NRF, and the S5G Prototype; provides background information about the prototype, systems, and reactor; and summarizes other closure and cleanup activities underway at NRF.
- Section 3, Identification of Removal Action Objectives, identifies removal action objectives (RAOs) and goals for activities associated with the NTCRA.
- Section 4, Identification of Removal Action Alternatives for the S5G Prototype, presents four NTCRA alternatives, and describes each in detail.
- Section 5, Risk Assessments, describes radiological and nonradiological source term inventories associated with the S5G Prototype Facility and summarizes conclusions from three supporting risk assessments based on those inventories.
- Section 6, Alternative Analysis, evaluates each of the NTCRA alternatives for effectiveness, implementability, and cost in accordance with EPA guidance (EPA 1993) and compares the relative performance of two viable alternatives.
- Section 7, Recommended Removal Action Alternative, presents applicable or relevant and appropriate requirements (ARARs) to which the removal action must conform, expands on approaches to compliance with specific ARARs, and summarizes the basis of DOE's recommendation.
- Section 8, References, lists references cited in this document.
- Appendix A, U.S. Fish and Wildlife Service Website Identification of Threatened and Endangered Species, provides the basis for determination that endangered species consultations with the U.S. Fish and Wildlife Service (F&WS) is not required.

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2. SITE CHARACTERIZATION

This section describes the INL Site and the Naval Reactors Program, summarizes the potential for release that justifies decommissioning the S5G Prototype Facility as a CERCLA NTCRA, and discusses remediation activities completed, underway, or planned at NRF.

2.1 Site Description and Background

The INL Site is an 890 mi^2 property in southeast Idaho managed by DOE. NRF occupies 7 mi^2 within the INL Site. Historically, NNPP oversaw both the operations and cleanup mission at NRF, while DOE-ID, under the U.S. Department of Energy Office of Environmental Management (DOE-EM), oversaw the cleanup mission at the rest of the INL Site. NNPP established an agreement with DOE-EM to cleanup/D&D facilities at NRF. NNPP maintains responsibility for meeting CERCLA requirements, including monitoring and cleanup, for all locations on the NRF. At the INL Site, DOE-ID will perform cleanup at NRF in collaboration with NNPP. Subsections that follow provide additional background information relating to the INL Site, NNPP and NRF, and the S5G Prototype Facility. Figure 2-1 illustrates the NRF and S5G Prototype Facility locations within INL Site boundaries.

2.1.1 Idaho National Laboratory Site

The INL Site, managed by DOE, occupies 890 mi^2 of the northeastern portion of the Eastern Snake River Plain 32 mi west of Idaho Falls, Idaho. In 1949, the U.S. Atomic Energy Commission established the INL Site, then called the National Reactor Testing Station, for the purpose of conducting nuclear energy research and related activities. The INL was renamed the Idaho National Engineering Laboratory in 1974 and then the Idaho National Engineering and Environmental Laboratory (INEEL) in 1997. In 2003, the INEEL was restructured into two separate business units: one for laboratory research-and-development missions (i.e., INEEL) and one for environmental cleanup activities (i.e., Idaho Completion Project). In 2004, the INEEL was officially named the Idaho National Laboratory to reflect the laboratory's mission being expanded to many other projects. In February 2005, the two business units came under the management of two separate contractors, Battelle Energy Alliance, LLC, for the laboratory mission, and CH2M-WG Idaho, LLC, for environmental remediation. Subsequently, the laboratory was designated as the lead DOE laboratory for U.S. nuclear energy research and was renamed the Idaho National Laboratory in keeping with its mission realignment and multiple uses. The Idaho Completion Project was renamed the Idaho Cleanup Project (ICP), and its mission continues to focus on environmental remediation and addressing historical contamination, including decommissioning of contaminated surplus facilities at the INL Site. DOE-ID is the responsible party and lead agency for environmental cleanup under CERCLA at INL. In 2021, DOE selected the Idaho Environmental Coalition, LLC, to continue the environmental cleanup mission at the INL Site under the ICP contract.

The DOE controls access to all land within the INL Site. Public access is limited to public highways, sponsored tours, special-use permits, and the Experimental Breeder Reactor I National Historic Landmark. In addition, the DOE-ID provides Shoshone-Bannock Tribal members access to INL Site areas, including sacred sites, for ceremonial or other cultural purposes. The INL Site is located primarily in Butte County; however, it also occupies portions of Bingham, Bonneville, Clark, and Jefferson counties. The 2020 census indicated the following populations for cities in the region: Idaho Falls – 64,818; Pocatello – 56,320; Rexburg – 39,409; Ammon – 17,694; Chubbuck – 15,570; Blackfoot – 12,346; Arco – 879; Mud Lake – 321; Butte City – 78; and Atomic City – 41.

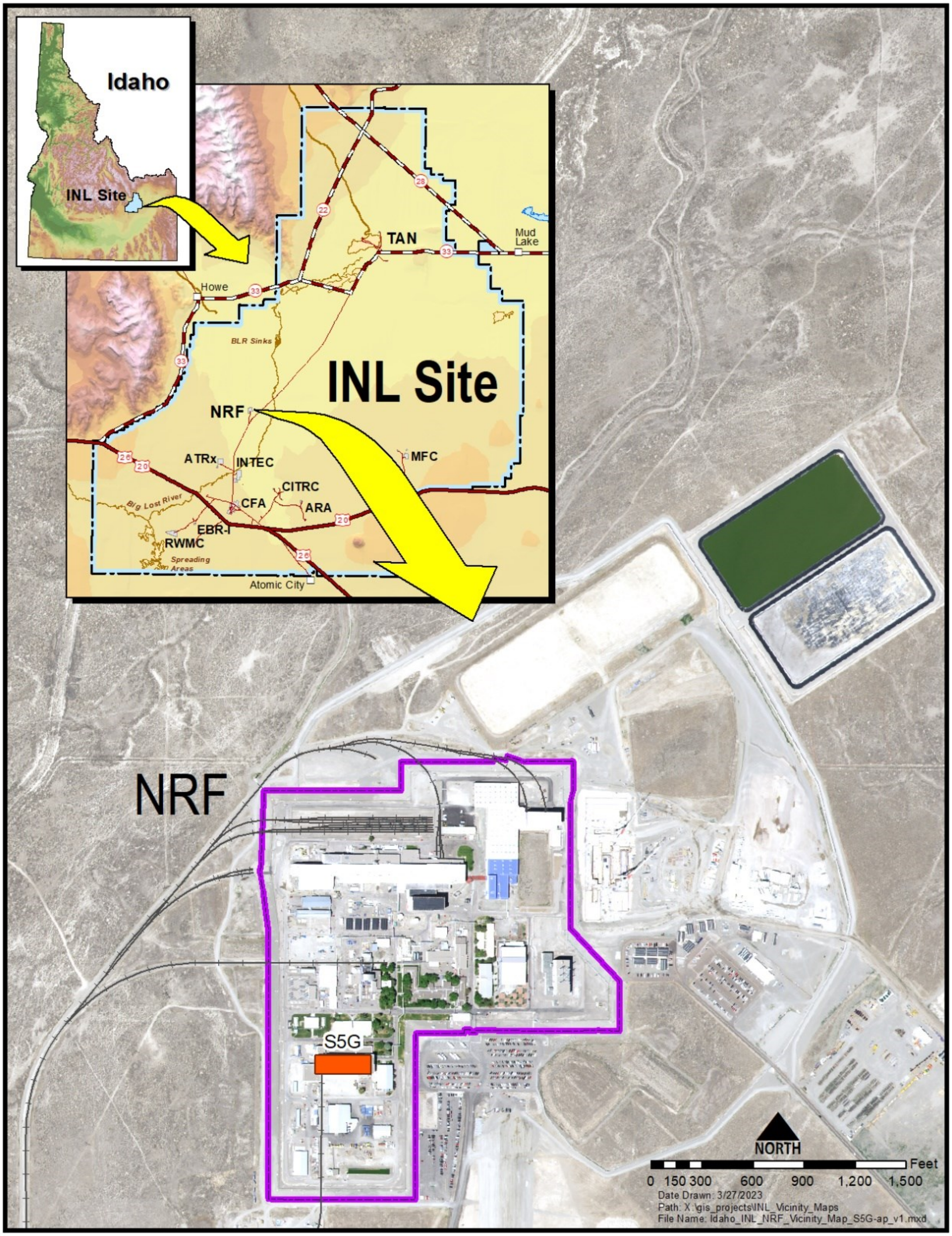

Figure 2-1. Location of the Naval Reactors Facility and S5G Prototype Facility within the Idaho National Laboratory Site boundaries.

Surface water flowing onto the INL Site consists mainly of three streams draining intermountain valleys from northwest and north of the INL Site: (1) the Big Lost River, (2) the Little Lost River, and (3) Birch Creek. The channels terminate on the INL Site. Flows from Birch Creek and the Little Lost River seldom reach the INL Site because of irrigation withdrawals upstream. The Big Lost River, and less seldom Birch Creek, may flow onto the INL Site before the irrigation season or during high-water years, but the terminal reaches are usually dry. In those few wetter years when the Big Lost River carries water to the end of its channel, the water sinks into the ground north of NRF.

NRF occupies 7 mi^2 in the central portion of the INL Site (Figure 2-1). The land surface at NRF is relatively flat, with elevations ranging from 4,835 to 4,870 ft above mean sea level. The Snake River Plain Aquifer occurs approximately 375 ft below NRF. The vegetation cover class at NRF is primarily shrub-steppe flats, with sagebrush being the dominant species and providing most of the habitat. No threatened, endangered, or otherwise regulated flora is known to be present in the NRF area, nor are there any fish or wildlife species of concern. The developed area of NRF and portions of the undeveloped area have been surveyed for archeological and cultural resources. Though some archeological remnants have been found around NRF, areas within the developed area of NRF, including areas where S5G D&D will occur, do not contain any known archeological or cultural artifacts. The three defueled NRF prototype facilities are eligible for the National Register of Historic Places. NRF has completed, or is in the process of completing, actions to preserve the history of the S5G Prototype in accordance with the National Historic Preservation Act (16 USC 470 et seq.; see Subsection 7.1.5). The OU 8-08 Record of Decision (ROD) (DOE-NR 1998) describes physical characteristics, flora and fauna, and cultural resources of the INL Site and NRF in more detail.

2.1.2 Naval Nuclear Propulsion Program and the Naval Reactors Facility

NNPP is a joint U.S. Navy and DOE organization that encompasses all the government, contractor, and Navy entities that support naval reactors and is responsible for all matters pertaining to naval nuclear propulsion from design through disposal (cradle-to-grave). NNPP's mission is to provide militarily effective nuclear propulsion plants and ensure their safe, reliable, and long-lived operation. This mission requires a combination of fully trained U.S. Navy personnel with ships that excel in endurance, stealth, speed, and independence from logistics supply chains. 50 USC 2406, "Deputy Administrator for Naval Reactors," and 50 USC 2511, "Naval Nuclear Propulsion Program," codifying Executive Order 12344, "Naval Nuclear Propulsion Program," set forth the total responsibility of NNPP for all aspects of the U.S. Navy's nuclear propulsion, including research, design, construction, testing, operation, maintenance, and ultimate disposition of naval nuclear propulsion plants. Responsibilities include related facilities; radiological controls; environmental safety and health; and selection, training, and assignment of personnel. The mission is accomplished via a network of dedicated research laboratories, nuclear-capable shipyards, equipment contractors and suppliers, and training facilities. The director of NNPP also serves as a deputy administrator in the National Nuclear Security Administration.

In 1950, NNPP established NRF at the INL Site to support construction of a land-based naval nuclear submarine prototype. NRF covers 7 mi^2, of which 100 acres is developed. NRF consists of three inactivated naval nuclear reactor prototype plants, the Expended Core Facility, and miscellaneous support buildings. The three prototypes were used to train U.S. Navy personnel for the nuclear navy and for research-and-development purposes. The Expended Core Facility, which receives, inspects, and conducts research on naval nuclear fuel, was initially constructed in 1958 and remains in operation. NRF also prepares spent naval nuclear fuel for dry storage.

NRF was the site of the first nuclear submarine prototype, the Submarine 1st Generation Westinghouse (S1W) Prototype. Construction of the S1W Prototype began in 1951. The prototype completed operation in 1989. The Aircraft Carrier 1st Generation Westinghouse (A1W) Prototype was constructed in 1958 and completed operation in January 1994. As the Navy's need for more advanced systems increased, the S5G Prototype was built at NRF to test new technology and continue nuclear operator training. The S5G Prototype served as a training facility from 1965 until it was shut down in 1995.

With the shutdown of the prototypes, the main mission of NRF shifted to storage of naval spent nuclear fuel and examination of core and irradiation test specimens. Since 1957, the NNPP has transported spent nuclear fuel removed from nuclear-powered naval vessels and prototypes to the Expended Core Facility at NRF. The Expended Core Facility provides the infrastructure to unload shipping containers and transfer, examine, prepare, temporarily store, and package naval spent nuclear fuel for transfer to an interim storage facility or geologic repository.

2.1.3 S5G Prototype Facility Background Information and Current Status

The S5G Prototype was used to train U.S. Navy personnel in naval nuclear propulsion plant operations and for research and development for the NNPP. The S5G Prototype was operated for almost 30 years from September 1965 to May 1995. Nearly 12,000 nuclear plant operators qualified at the S5G Prototype Facility, including 9,667 enlisted personnel, 1,992 officers, and 185 civilians. Defueling and systems layup were completed in 1999.

The overall S5G Complex encompassed three buildings: NRF-633A, -633B, and -634. The hull basin within Building NRF-633A houses the actual prototype submarine, including the defueled S5G reactor vessel and associated components of NRF-633P. The three buildings themselves will continue in use following D&D of NRF-633P and are excluded from this NTCRA. Figures 2-2 and 2-3 show the S5G Test Plant Building NRF-633A high bay facility that houses NRF-633P. Figure 2-4 shows a plan view of Building NRF-633A and the hull basin within the high bay. Figure 2-4 also shows the adjacent office space in Building NRF-633B and the warehouse in Building NRF-634.

Figure 2-2. The S5G Test Plant Building NRF-633A high bay houses the S5G Prototype Facility, designated as NRF-633P.

Figure 2-3. Building NRF-633A high bay (in background) houses NRF-633P, the S5G Prototype Facility, while the shorter two-story Building NRF-633B in the foreground is used primarily for office space.

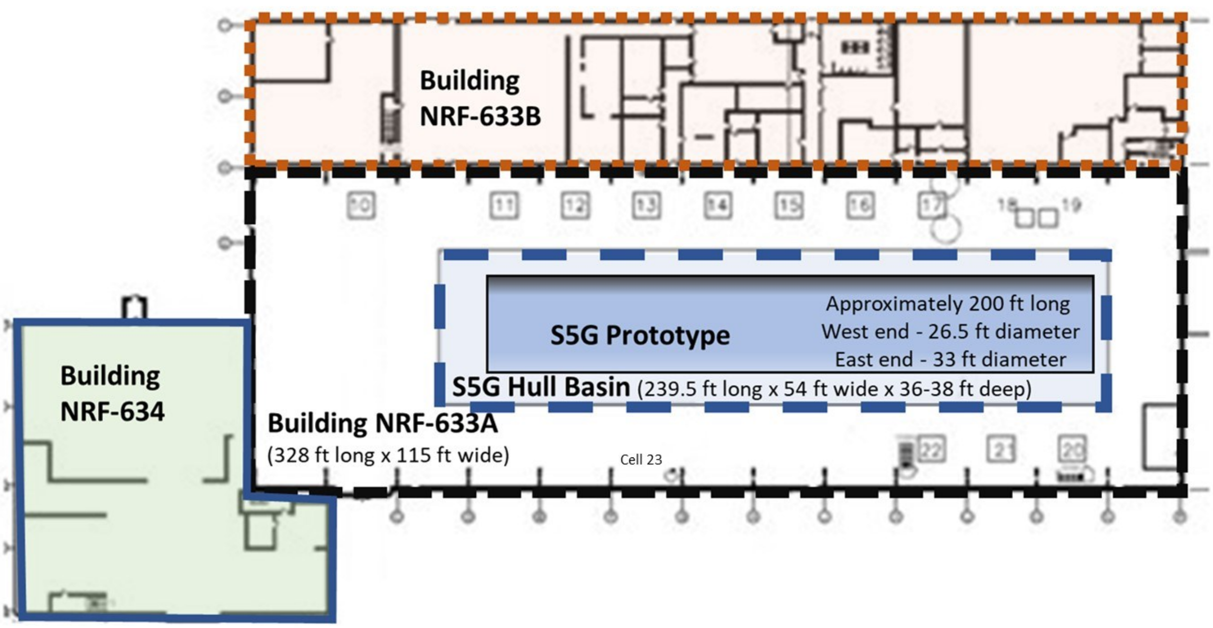

Figure 2-4. The S5G Prototype is located within the hull basin inside of the Building NRF-633A high bay area.

2.1.3.1 Facility Construction. Construction of S5G buildings (NRF-633A, -633B, and -634) and the S5G Prototype began in September 1961 and was completed in 1963. Construction began by excavating the location for the hull basin (Figure 2-5). Building NRF-633A, the S5G Test Plant Building, is a large high bay facility with a rectangular subgrade basin that contains the S5G Prototype. The hull basin is constructed of poured concrete (unlined) and measures approximately 54 ft wide × 239.5 ft long; it is positioned on an east/west axis, lengthwise to the building. The lowest point in the building is the bottom of the hull basin, 36 to 38 ft below grade (4,816 to 4,814 ft above mean sea level [amsl]) from the west end to the east end of the basin (Figure 2-6).

Building NRF-633A is made with steel framing and metal siding. Grade level is 4,852 ft amsl, and the top of the high bay building is approximately 64 ft high (4,916 ft amsl). Two rail cranes with 100-ton working load limits are operational in the Building NRF-633A high bay. These cranes likely will be used in the decommissioning of the S5G Prototype. Ancillary S5G plant equipment is located on the main floor level of the building.

Building NRF-633A also has subgrade floor cells numbered 10 through 23 on the north and south sides of the basin. Nine of the cells on the north side of the basin are included in the designation of components of NRF-633P. A typical cell has approximate dimensions of 22 ft 9 in. × 27 ft 8 in. These cells were used for support purposes and contained various operational equipment, including water-filtration tanks, high-efficiency particulate air filters, an oil/water separator, mixing tanks, an air compressor, and other miscellaneous equipment. The base of the floor cells on each side of the basin is approximately 17 ft below grade, or 4,835 ft amsl.

Figure 2-5. Construction photograph from 1961 showing excavation equipment during construction of the S5G hull basin.

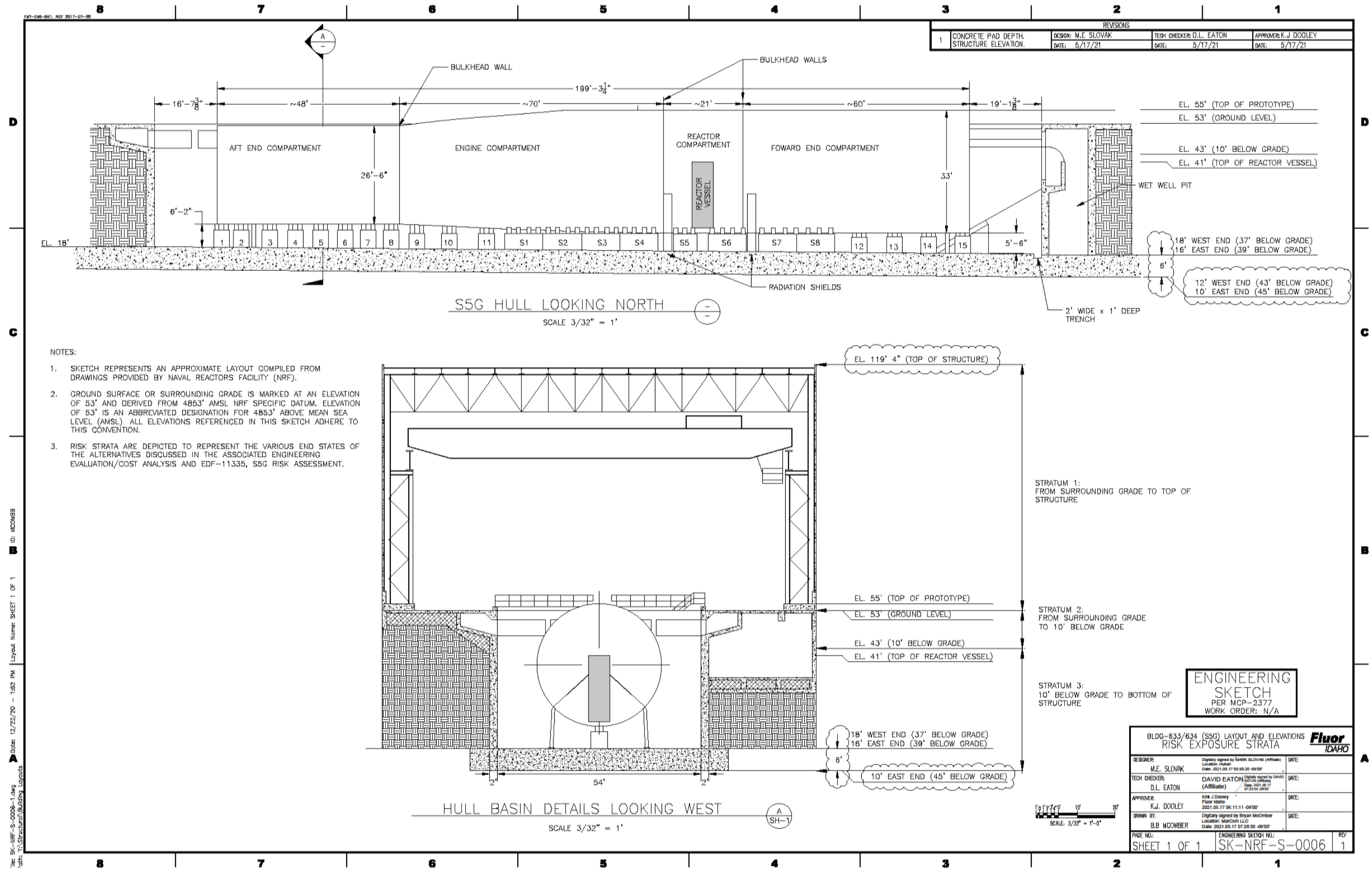

Figure 2-6. Cross sections and elevations of the S5G Prototype within the hull basin in Building NRF-633A.

2.1.3.2 *Prototype Characteristics.* The S5G Prototype was constructed within the hull basin by welding large ring-like sections together to form the submarine-like shape. The hull is a metal cylinder, approximately 33 ft in diameter and 200 ft long subdivided into four compartments (Figure 2-6). Engineering spaces include a reactor compartment and adjacent engine compartment with a control room used primarily for nuclear operations and secondarily for operator training. The reactor compartment is separated from the forward and engine compartments by bulkheads and contains the main reactor systems. Figure 2-7 illustrates a typical naval nuclear propulsion plant. The forward compartment contains mechanical equipment, primarily gyroscopes that were used to move the hull to replicate open sea conditions. The aft section contains support facilities for the prototype. Currently, a combination of concrete blocks and steel I-beams support the keel of the hull approximately 5 ft above the basin floor.

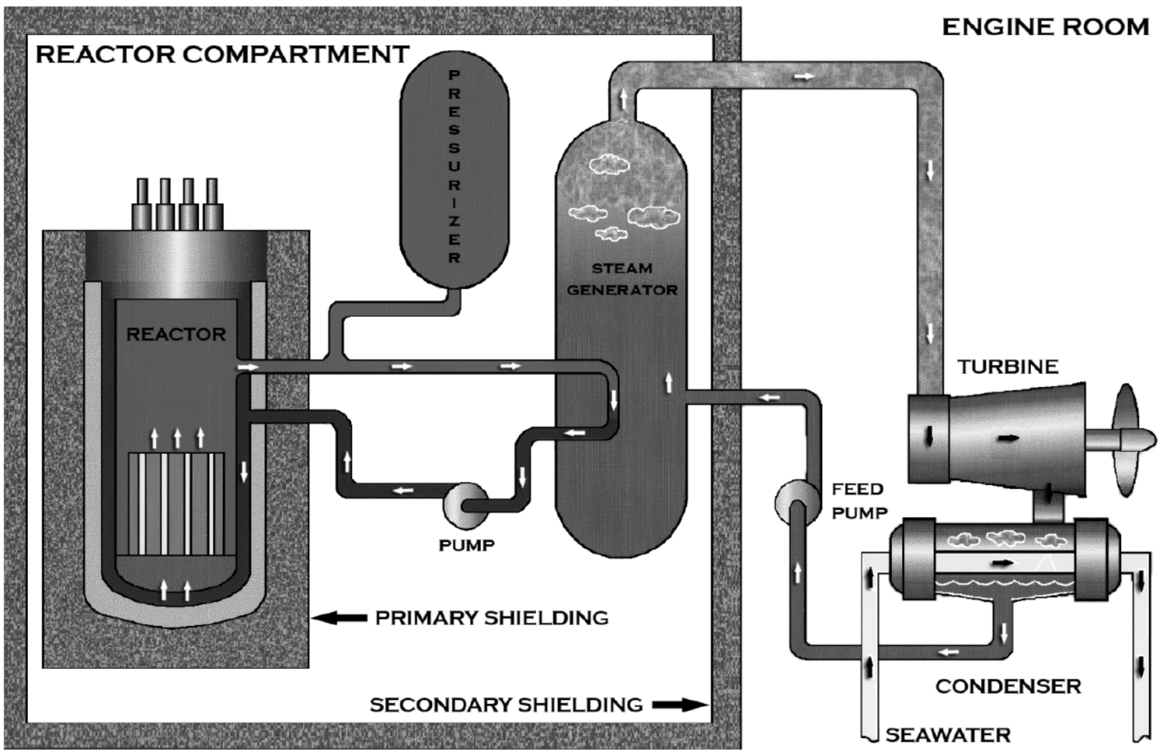

Figure 2-7. Diagram of a typical naval nuclear propulsion plant (DOE and DON 2020).

During initial operations, the prototype floated in the water-filled hull basin (Figure 2-8). Floating the prototype allowed it to be rotated along its long axis by torquing large gyroscopes to simulate at-sea conditions. At the conclusion of the proof-of-concept studies, the basin was drained of water (Figure 2-9) and the prototype was placed on keel blocks for the remainder of operations (Figure 2-10). The prototype was operated for almost 30 years until it was shut down in May 1995. Defueling and systems layup were completed in 1999.

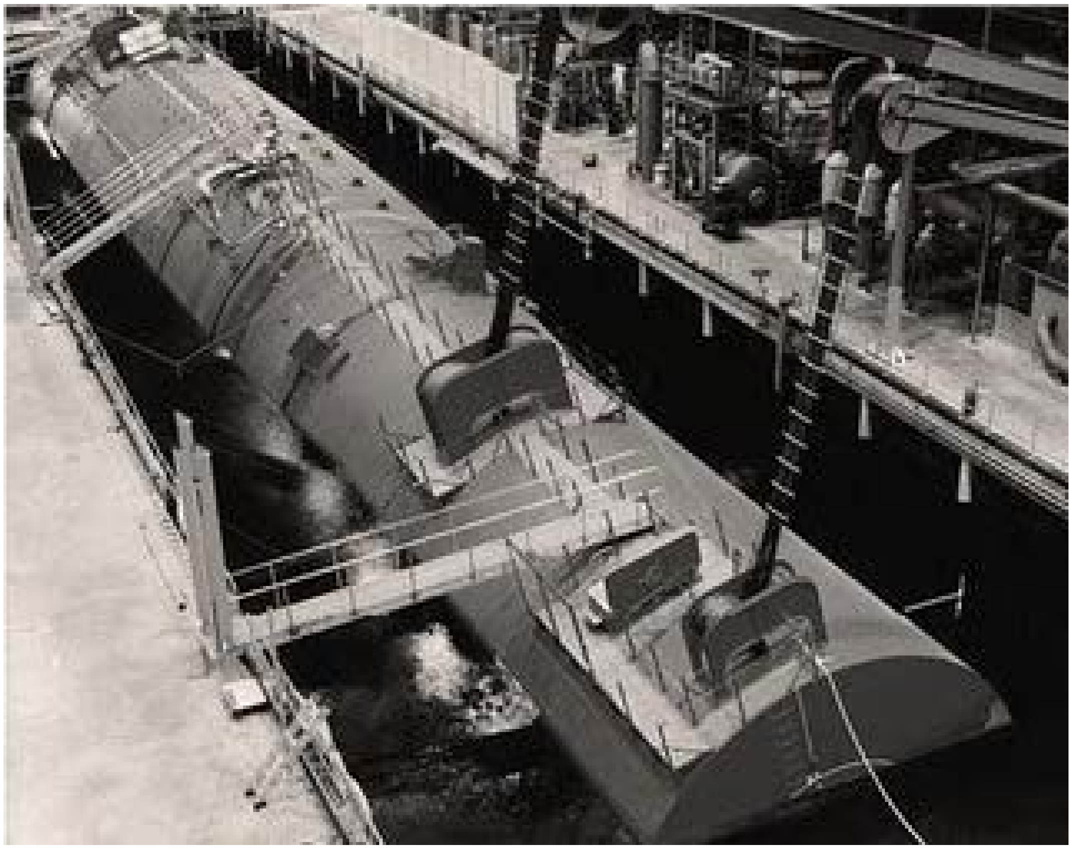

Figure 2-8. S5G Prototype in the early years viewed from the west in the Building NRF-633A high bay showing the prototype in the water-filled hull basin to simulate sea-like conditions.

Figure 2-9. S5G Prototype placed on keel blocks after the hull basin was drained.

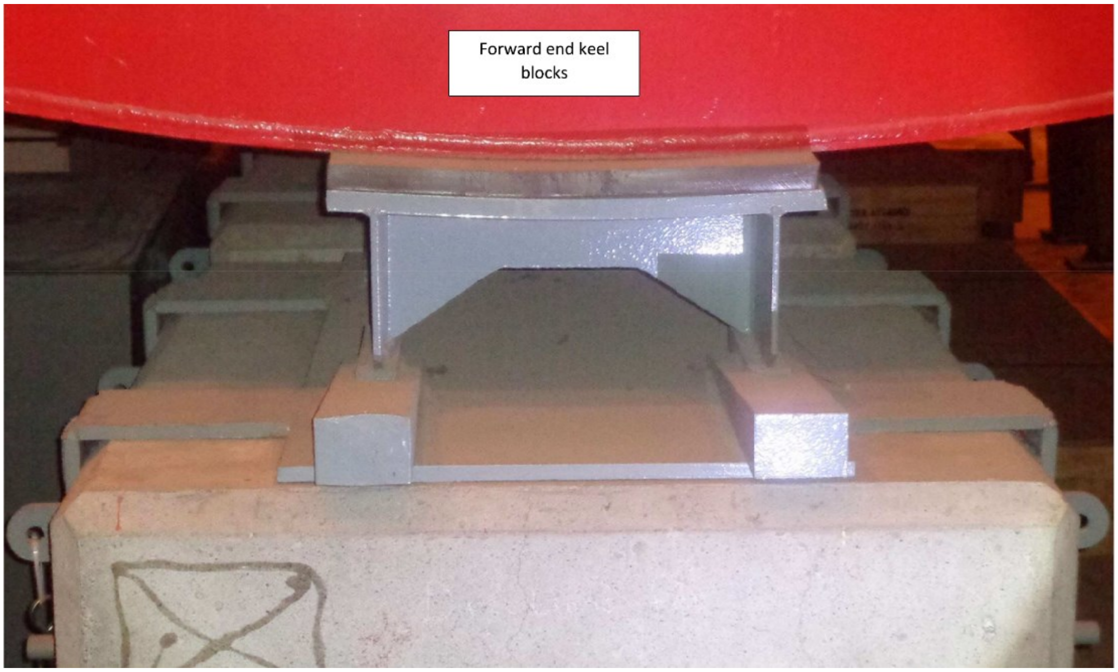

Figure 2-10. S5G Prototype forward end resting on keel blocks at the bottom of the hull basin in Building NRF-633A after water was removed from basin.

2.1.3.3 Current Status. Since inactivation and defueling of the S5G Prototype, Building NRF-633A has been repurposed to provide maintenance areas and to support general warehouse activities such as active storage of radiological equipment and material, and waste processing and shipping. In the intervening years, various systems, components, and associated materials have been partially or fully removed from the building, including items from the subgrade cells and some equipment on the ground level, to accommodate the repurposing of NRF-633A. None of the removals significantly altered the footprint of the prototype or its systems.

The defueled S5G Prototype remains within the basin inside the Building NRF-633A high bay. Radiological and hazardous substances from past operations are present in the S5G Prototype and in four of the nine cells included in this removal action. Most radiological material remains within the reactor compartment, with minor amounts found elsewhere within the S5G Prototype Facility. The defueled prototype, principally within the reactor compartment, contains residual radioactivity from past operations in the form of activated metals and radioactive corrosion particles (CRUD). CRUD is generally defined as corrosion and wear products that become radioactive over time during nuclear reactor operations. Other hazardous substances include lead radiation shielding within the reactor compartment, lead ballast bricks in the aft compartment, and brass and bronze components. In addition, given that it was constructed during the early 1960s, the S5G Prototype Facility has asbestos-containing materials (e.g., pipe and tank insulation) and paints throughout that may contain polychlorinated biphenyls (PCBs) and heavy metals.

2.2 Potential Release of Radiological or Other Hazardous Substances

NNPP maintains the S5G Prototype Facility to prevent access to, or release of, radiological or other hazardous substances. Hazardous substances in this facility include, but are not limited to, radionuclides, PCBs, metals, and asbestos. If maintenance were to cease, the site could pose a risk from a release and the associated substantial endangerment to human health and the environment. Security controls, including administrative and physical access controls, limit entry to the S5G Prototype Facility. Only authorized personnel are allowed entry into areas where hazards exist. Ongoing access control of these areas prevents direct contact with, and exposure to, radiological and other hazardous substances; however, access controls alone will not prevent deterioration of the facilities or eliminate the threat of a release of these substances to the environment. Radiological and other hazardous substances could be directly released to the environment via a breach in a pipe, containment wall, roof, or other physical component as facilities age and deteriorate. Radiological and other hazardous substances also could be released to the environment through animal or plant intrusion into contaminated structures and systems.

The potential for substantial releases of radiological and other hazardous substances increases with time as the S5G Prototype ages, and containing these materials and preventing them from being released into the environment becomes more difficult and costly. Surveillance and maintenance required to confine substances could increase the risk of potential exposure to personnel.

40 CFR 300.415 and the joint EPA and DOE policy (DOE and EPA 1995) require that "DOE will conduct a removal site evaluation as directed by the NCP to assess site conditions and determine whether a release or substantial threat of release exists at the facility." DOE documented its review of the removal site evaluation when it issued its approval to proceed with preparation of this EE/CA (Case 2020). DOE determined that the potential exposure to humans and the environment, the potential release of radiological or other hazardous substances, and the substantial risks associated with substances in the structures addressed by this EE/CA justify use of DOE's removal action authority in accordance with 40 CFR 300.415 of the NCP.

2.3 Cleanup and Closure Activities at Naval Reactors Facility

Cleanup and closure activities have taken place and will continue at NRF under several programs and regulatory authorities. The following subsections briefly describe those activities and authorities.

2.3.1 Remedial Actions at Naval Reactors Facility Under the Comprehensive Environmental Response, Compensation, and Liability Act

The Federal Facility Agreement and Consent Order (DOE-ID 1991) established Waste Area Group (WAG) 8 for NRF. Two RODs have been issued for WAG 8. The first, *Record of Decision Naval Reactors Facility Industrial Waste Ditch and Landfill Areas, Operable Units 8-07, 8-06 and 8-05, Idaho National Engineering Laboratory* (DOE-NR 1994), required remedial actions for three former landfill sites. These actions have been completed, and soil-gas and groundwater monitoring have been implemented along with institutional controls. The second, *Final Record of Decision, Naval Reactors Facility, Operable Unit 8-08 Idaho National Engineering and Environmental Laboratory* (DOE-NR 1998), identified remedial action objectives for the remainder of WAG 8, and those objectives are documented in Section 5 of the OU 8-08 ROD (DOE-NR 1998). Past release sites that required further action were identified in that document. Remedial actions for these sites have been completed, and groundwater monitoring has been implemented. As required by these two RODs and their subsequent minor changes, remedial actions at 17 sites have been completed, and institutional controls are in place at 20 sites to prevent inadvertent access to contaminants that remain in place, as described in the NRF Institutional Control Plan (Redman 2023).

The OU 8-08 ROD (DOE-NR 1998) requires groundwater monitoring. The NRF groundwater monitoring program consists of one upgradient well, six downgradient wells, and one effluent system well. In addition, several production wells and non-CERCLA wells are sampled. All wells are sampled at least annually—typically in May—or biannually in May and November.

Enclosures to Redman (2023) establish requirements for operations and maintenance, inspections, groundwater monitoring, and institutional controls for WAG 8 CERCLA sites at NRF.

2.3.2 Non-Time-Critical Removal Action Activities at Naval Reactors Facility Under the Comprehensive Environmental Response, Compensation, and Liability Act

DOE-ID, as part of DOE-EM, prepared an EE/CA in coordination and consultation with the NNPP to address the S1W and A1W prototypes (DOE-ID 2022). Similarly, DOE-ID prepared this EE/CA for the S5G Prototype Facility. An EE/CA for the Expended Core Facility is planned in the future.

The General Action Memorandum (DOE-ID 2021a) and its associated LST-1213, "Removal Actions Approved under the Action Memorandum for General Decommissioning Activities under the Idaho Cleanup Project," identify buildings, structures, and equipment that are approved for D&D as NTCRAs. The General Action Memorandum subdivides LST-1213 according to two categories: minor facility and major facility. Minor facilities can be addressed by implementing removal and disposal of buildings, structures, and building contents in accordance with the recommended action in the General Action Memorandum. Major facilities must be addressed by preparing a facility-specific EE/CA and an authorizing action memorandum. Table 2-1 lists minor and major facilities at NRF identified in LST-1213. Table 2-2 lists completed actions under the General Action Memorandum at NRF. Subsections that follow summarize prototypes designated as major facilities at NRF that require facility-specific EE/CAs and action memoranda.

Table 2-1. Major and minor facilities at the Naval Reactors Facility identified in the Idaho Cleanup Project General Action Memorandum for decommissioning and demolition.

NTCRA Identifier	Building, Structure, or Equipment Name
Major facility addressed in this EE/CA	
NRF-633P[a]	NRF-633P S5G Prototype Facility—defined as the S5G Prototype and its defueled reactor vessel, the subgrade hull basin housing the prototype, and nine associated subgrade cells on the north side of the basin within Building NRF-633A
Major facilities addressed in the *Action Memorandum for the Naval Reactors Facility S1W and A1W Final End States Including Disposition of Reactor Vessels* (DOE-ID 2023)	
NRF-601[b]	S1W Main Building and Prototype
NRF-617[b]	A1W Hull Structure Building and Prototype
Major facilities to be addressed in a future EE/CA	
NRF-618	Expended Core Facility
Minor Facilities	
NRF-616	A1W Operations Building
NRF-617A	A1W Dumping Condenser #1
NRF-617B	A1W Power Absorber Building
NRF-617C	A1W Diesel Generator Building
NRF-618x1	Expended Core Facility subgrade grouting
NRF 618x2	Evaporator Bottoms Tank Demister and piping
NRF-624	S1W Outhull Building (remaining foundation and underground piping)
NRF-626A	A1W Outhull Training Building
NRF-626B	A1W Outhull Shop Building
NRF-627[c]	Record Storage Building
NRF-631	Radioactive Component Storage Warehouse
NRF-633A[a]	S5G Test Plant Building
NRF-633B	S5G North Support Area Building
NRF-634	S5G Warehouse Building

Table 2-1. (continued).

NTCRA Identifier	Building, Structure, or Equipment Name
NRF-635	S5G Pumphouse
NRF-638[d]	Paint Storage Building
NRF-640[c]	A1W No. 2 Dumping Condenser
NRF-666	Building 14 (building foundation and underground piping)
NRF-667	Building 15 (building foundation and underground piping)
NRF-674	A1W Storage Building 22 (building foundation and underground piping)
NRF-707	A1W 100,000-gal water storage tank and enclosure
NRF-715	S5G Water Storage Tank
NRF-716	S5G Cooling Tower Basin (foundation)
NRF-726	S1W 50,000-gal water storage tank and enclosure
NRF-733	A1W Recycled Water Processing Tunnel
NRF-736	Document shredder
NRF-x2020a	NRF equipment-Brokk Excavator
NRF-x2020b	NRF equipment-Gehl Skid Steer Loader
NRF-x2020c	NRF equipment-Komatsu Excavator Operating Arm
NRF-x2022a	NRF Core Cartridge Transport Package

a. NRF-633A, the S5G Test Plant Building and Prototype, was added as a single major facility in June 2020. Subsequently, this NTCRA was split into two separate NTCRAs. NRF-633P, the S5G Prototype Facility, retains major facility status, and NRF-633A, the S5G Test Plant Building, will be addressed as a minor facility (Larsen 2024; Leake 2024; Johansen 2024; LST-1213).

b. Decommissioning and demolition are proceeding in this building (DOE-ID 2023).

c. Decommissioning and demolition under the General Action Memorandum (DOE-ID 2021a) are proceeding in these buildings. LST-1213 will be updated when associated completion reports are final.

d. Decommissioning and demolition under the General Action Memorandum (DOE-ID 2021a) are proceeding in this building. LST-1213 will be updated when the associated completion report is final.

A1W Aircraft Carrier 1st Generation Westinghouse
EE/CA engineering evaluation/cost analysis
NTCRA non-time-critical removal action
NRF Naval Reactors Facility
S1W Submarine 1st Generation Westinghouse
S5G Submarine 5th Generation General Electric

Table 2-2. Facilities where decommissioning and demolition have been completed under the General Action Memorandum at the Naval Reactors Facility.

NTCRA-ID	Building, Structure, or Equipment Name	Completion Date
NRF-18A	S1W Spray Pond #1	11/17/2009
NRF-601x1	S1W ventilation system	09/18/2018
NRF-608	S1W Battery Building	05/13/2024
NRF-613	Radiography Facility Building	10/12/2017
NRF-625	S1W Maintenance Building	11/01/2022
NRF-628A	A1W RWDS equipment building (Quench Tank A and Vault)	12/15/2020
NRF-629	Lagging Shop (building foundation and underground piping)	12/15/2020
NRF-630	A1W RWDS Control Building foundation	12/15/2020
NRF-641	Riggers Storage Building	09/30/2023
NRF-710	Radioactive Waste Disposal (Quench Tank B and Vault)	12/15/2020

A1W Aircraft Carrier 1st Generation Westinghouse
NA not applicable
NTCRA-ID non-time-critical removal action identifier
RWDS Radioactive Waste Disposal System
S1W Submarine 1st Generation Westinghouse

2.3.2.1 S1W and A1W Prototypes. The list of facilities proposed for NTCRA (LST-1213) in accordance with the General Action Memorandum (DOE-ID 2021a) identified the S1W and A1W prototypes as major facilities, which requires preparing a facility-specific EE/CA and an authorizing action memorandum. Because of their similarities, the S1W and A1W prototypes were evaluated in one EE/CA (DOE-ID 2022). Four alternatives were assessed for final end-state determinations, including disposition of the three associated reactor vessels (i.e., one S1W and two A1W). The subsequent Action Memorandum (DOE-ID 2023) selected Alternative 4, Removal of the S1W and A1W Prototype Facilities. The S1W and A1W prototype facility buildings, including the prototypes, their reactors, and ancillary components, will be completely removed to approximately 3 ft below ground surface (bgs), and the areas will be backfilled as necessary to match the surrounding grade. D&D of the S1W Prototype is well underway, while the NTCRA for portions of the A1W prototype is in the early stages.

2.3.2.2 S5G Prototype Facility. This EE/CA addresses NRF-633P, the S5G Prototype Facility, as a major facility located within Building NRF-633A. Originally, the NRF-633A S5G Test Plant Building, including the S5G Prototype, was added via addendum to the General Action Memorandum in 2020 as a major facility. Since then, it became apparent that portions of NRF-633A should remain functional to support current NRF operations; therefore, a subsequent addendum to the General Action Memorandum separates NRF-633P from NRF-633A (Larsen 2024; Leake 2024; Johansen 2024) and LST-1213 was revised. As such, this EE/CA evaluates the S5G Prototype Facility, designated as NRF-633P, as a major facility comprising the S5G Prototype and its defueled reactor vessel, the subgrade hull basin housing the prototype, and nine associated subgrade cells on the north side of the hull basin within the S5G Test Plant Building NRF-633A. This major facility EE/CA excludes decommissioning of the NRF-633A building itself. LST-1213 identifies Building NRF-633A as a minor facility under the General Action Memorandum.

Activities preparatory to D&D for a major facility like the S5G Prototype can proceed in accordance with the provisions of the General Action Memorandum to prepare for timely D&D following completion of the facility-specific action memorandum. Initiation of full-scale D&D activities for the S5G Prototype depends on adequate funding and completion of certain aspects of ongoing D&D work at S1W and A1W prototype facilities. Completion of work at S1W and A1W will provide the trained workforce ready for work at S5G.

3. IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

RAOs for this NTCRA at NRF allow for the achievement of the final end state for the S5G Prototype Facility based on the remedial action objectives[c] of the *Operable Unit 10-08 Record of Decision for Site-Wide Groundwater, Miscellaneous Sites, and Future Sites* (OU 10-08 ROD) (DOE-ID 2009) that were designed to evaluate and provide cleanup levels for new CERCLA sites for a residential scenario in 2095. RAOs for this NTCRA also are consistent with risk-based remedial action objectives established in the *Final Record of Decision Naval Reactors Facility, Operable Unit 8-08 Idaho National Engineering and Environmental Laboratory* (OU 8-08 ROD) (DOE-NR 1998). RAOs for this NTCRA are medium-specific (i.e., soil, air, water) goals established to protect human health and the environment.

Remedial action objectives were established based on the 100-year future residential scenario. In 1995, DOE-ID issued the *Long-Term Land Use Future Scenarios for the Idaho National Engineering Laboratory* (DOE-ID 1995), which, in coordination with the EPA and DEQ, established that future risk assessments would be standardized to begin 100 years from 1995, using 2095 as the beginning of their calculations. This basis was predicated on the assumption in 1995 that the site would reasonably remain under government management and control for at least the next 100 years (until 2095). Compliance with RAOs requires that the selected alternative must be determined to be protective of human health and the environment by that time. In addition, assumptions about exposure pathways, exposure parameters, and carcinogenic risk criteria that were to be used in future risk assessments were established.

3.1 Removal Action Objectives

Cleanup levels corresponding to the OU 10-08 risk-based remedial action objectives were updated in the INL 2020 CERCLA 5-Year Review (DOE-ID 2021b). Those cleanup levels remain consistent with the OU 10-08 and OU 8-08 RODs (DOE-ID 2009; DOE-NE 1998) and were incorporated into the *Action Memorandum for the Naval Reactors Facility S1W and A1W Final End States Including Disposition of Reactor Vessels* (DOE-ID 2023). Those same cleanup levels are proposed for the S5G NTCRA as follows:

- Limit total human health excess cancer risk to 1 in 10,000 (1E-04) for future residents.
  - Pathways include external gamma radiation, soil ingestion, food ingestion, groundwater ingestion, and inhalation.
  - The cancer risk from each radionuclide is calculated as the ratio of the predicted soil concentration divided by the preliminary remediation goal (PRG) for that radionuclide for 1E-04 risk. That value is then multiplied by 1E-04 to yield the cancer risk for that radionuclide. The total cancer risk for radionuclides is obtained by summing the risk for all radionuclides.
  - The cancer risk for each nonradionuclide is calculated as the ratio of the predicted soil concentration divided by the carcinogenic regional screening level (RSL) for 1E-04 risk. That value is then multiplied by 1E-04 to yield the cancer risk for that nonradionuclide. The total cancer risk for nonradionuclides is obtained by summing the risk for all nonradionuclides.

c. *Remedial* action objectives are determined through the remedial investigation/feasibility study process under CERCLA, while *removal* action objectives (RAOs) are analogous goals for NTCRAs. RAOs must be consistent with remedial action objectives.

- Limit noncancer effects to a hazard index of 1 for future residents.[d]
    - Pathways include soil ingestion, food ingestion, groundwater ingestion, and inhalation.
    - The hazard quotient is equivalent to the ratio of the predicted concentration in soil to the noncarcinogenic RSL.
    - The hazard index is the sum of hazard quotients for each individual contaminant.
- Inhibit unacceptable exposure to populations of flora and fauna.
    - For populations of flora and fauna not listed as threatened and/or endangered, exposures to contaminated soil that result in a hazard quotient greater than or equal to 10 will be inhibited.
    - For individual flora and fauna listed as threatened and/or endangered, exposures to contaminated soil that equal or exceed a hazard quotient of 1 will be inhibited.

Generally, CERCLA risk management decisions are based on excess carcinogenic risk levels in the range of 1 chance in 1,000,000 to 1 chance in 10,000. However, at the INL Site, the CERCLA Agencies made the risk-management-based decision to use the 1 in 10,000 excess carcinogenic risk as the target risk for calculating risk-based soil concentrations based on the following:

- The conservative nature of the risk assessment assumptions, such as the assumption used to calculate corresponding soil concentrations
- The remoteness of the INL Site
- The distance to groundwater
- Governmental control over a large area anticipated for an extended period of time
- The use of 1E-04 in previous risk-management decisions at the INL Site.

In addition to RAOs, the selected alternative should incorporate the DOE goal of reducing the "risk footprint" to the extent practicable in consideration of as low as reasonably achievable (ALARA) principles governing radiological exposure to decommissioning personnel, safe engineering standards, applicable disposal facility waste acceptance criteria (WAC), and the desired CERCLA site end state.

3.2 Understanding Risk Threshold Values

The threshold value for carcinogenic risk is defined as the chance, ranging from 1E-06 to 1E-04, of developing an excess cancer. This range (from 1E-06 to 1E-04) is sometimes expressed as the decimal fraction range from 0.000001 to 0.0001 or as 1 in 1,000,000 to 1 in 10,000. CERCLA emphasizes using 1E-06 as the conservative point of departure while allowing adjustments for site-specific and remedy-specific factors, including cumulative risk and future land uses. Typical decisions at the INL Site have been based on an excess cancer risk of 1E-04 due to conservativeness built into risk assessments and the remoteness of the INL Site.

d. The noncancer screening cleanup value for lead in the OU 10-08 ROD (DOE-ID 2009), Table 12, is 400 mg/kg, which is equivalent to the 400-ppm lead EPA-recommended screening level cited in the OU 8-08 ROD (DOE-NR 1998). In 2024, EPA updated the lead RSL from 400 to 200 mg/kg (Breen 2024).

Excess cancer risk[e] is the increased risk caused by exposure to contaminants (i.e., that risk above the average background risk rate) of developing fatal or nonfatal cancer. This risk is expressed as a probability. According to the American Cancer Society (ACS 2022), the average U.S. background rate in a lifetime for developing cancer is approximately 4 out of every 10 people (i.e., roughly 4,000 out of every 10,000 people will develop cancer without any excess exposure to carcinogenic material). Remedial and removal action decisions at the INL Site that use 1E-04 excess cancer risk as a threshold are based on risk calculations that indicate there would be one additional cancer for every 10,000 people that are exposed to the residual contamination.

e. Cancer risk coefficients are based on the linear no-threshold theory, which assumes a linear dose-response relationship. No direct evidence shows that radionuclide concentrations at the 1E-04 cancer risk levels cause cancer. The linear no-threshold theory for risk assessment was adapted as part of the precautionary principle in managing radiation exposure. Likewise, slope factors for nonradionuclides also are based on a linear dose-response relationship with no threshold and represent an upper-bound estimate (i.e., 95th percentile) of the probability of response per unit intake of a chemical over a lifetime (EPA 1989).

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4. REMOVAL ACTION ALTERNATIVES FOR THE S5G PROTOTYPE

This section proposes four alternatives for NRF-633P decommissioning, vessel disposition, and final end state. Alternatives range from No Action to Complete Prototype Removal. Alternatives 1 and 2 leave contaminated media in place. Alternatives 3 and 4 remove hazardous substances with approaches based on two strata:

- Surface interval—The surface interval extends to a depth of 10 ft bgs.[f] In addition to adjacent subsurface cells and the prototype (and its contents) to a depth of 10 ft bgs, the surface interval includes the above-grade portion of the prototype and above-grade water-management components of the S5G Prototype Facility on the main floor of Building NRF-633A.
- Lower interval—The lower interval encompasses portions of the S5G Prototype Facility deeper than 10 ft bgs, which includes the bottom portions of the prototype and its reactor vessel.

4.1 S5G Alternative 1, No Action

Alternative 1 for the S5G Prototype Facility is a no-action alternative where the prototype is left to degrade and collapse, releasing hazardous substances into the environment. This alternative is used as a base case for comparison with other alternatives and is not a viable option. Because no actions are taken, waste transportation risks and disposal costs are not associated with this alternative. Therefore, this alternative is evaluated only for risk to human health and the environment. Under the No Action alternative, no D&D would be conducted for the S5G Prototype Facility and no further surveillance and maintenance would be conducted. The No Action alternative offers no reduction in toxicity, mobility, or volume of hazardous substances.

Conducted solely for risk analysis purposes, the No Action alternative is a hypothetical, conservative, baseline assumption in that the sum of all identified radiological or other hazardous substances, when not properly contained or controlled, may be released to the environment, causing unacceptable risk to potential receptors. These assumptions are for comparative purposes only and are intended to reflect a reasonable worst-case scenario. This alternative does not reflect the DOE commitment to meet RAOs and to comply with ARARs. Currently, administrative and physical controls are in place to prevent unacceptable exposures to ionizing radiation and preclude contact with other hazardous substances in the S5G Prototype Facility.

4.2 S5G Alternative 2, Continued Surveillance and Maintenance

Alternative 2 for the S5G Prototype Facility is to continue maintenance and surveillance activities, thereby delaying the inevitable need for facility demolition to some future date to avoid the release of hazardous substances to the environment. This alternative also offers no reduction in toxicity or volume of hazardous substances because it only delays final action, but it does provide more protection from mobilization of the contaminants to the environment than Alternative 1. Alternative 2 is not consistent with the DOE goal to reduce environmental liabilities.

Because the facility is monitored and maintained, there are no releases to the environment, so no risk assessment is performed for human health and the environment. There are also no associated waste transportation risks or disposal costs with this alternative, although at some point in the future, those costs would be incurred. In practical terms, the endpoint of the cost for this alternative is undefined. The cost of

f. The 10-ft bgs interval is based on risk assessment protocols for modeling a future residential land use scenario.

maintaining the facility could continue forever. The product of this evaluation is the added cost of delay until an acceptable alternative is finally chosen.

Under this alternative, the NRF-633A building housing the S5G Prototype Facility would be maintained to keep the S5G Prototype in a stable configuration to prevent the release of radiological and other hazardous substances. Maintenance includes servicing support systems that provide power and ventilation to the building. Surveillance includes periodic facility inspections to ensure building integrity and systems operability. This alternative is only assessed for the cost of maintaining the surveillance and maintenance program until 2095. At that time, it is assumed Alternative 3 or 4 would be implemented.

Figure 4-1 shows the NRF-633A building housing NRF-633P as it might appear under Alternative 2, where surveillance and maintenance continue.

Figure 4-1. Photograph depicting the Building NRF-633A (housing NRF-633P) interim end state (i.e., its current inactivated condition for the prototype) under Alternative 2, Continued Surveillance and Maintenance.

4.3 S5G Alternative 3, In Situ Decommissioning

Alternative 3 features targeted removal of hazardous substances to meet RAOs and ARARs, followed by in situ grouting to isolate and stabilize residual contamination (see Figure 4-2). This description illustrates potential approaches and is not prescriptive. The general approach to partial prototype disassembly and in situ grouting under Alternative 3 is envisioned as follows:

1. Remove the top of the prototype sufficient to facilitate construction of a new warehouse floor (see Figure 4-2)
2. Remove radiologically contaminated components and lead from the upper part of the reactor compartment within the surface interval
3. Remove Resource Conservation and Recovery Act (RCRA) (42 USC 6901 et seq.) hazardous waste from the lower interval of the reactor compartment, and grout the lower interval of the reactor compartment
4. Remove RCRA hazardous waste (mostly lead alloys and lead that is not being used as shielding) from the entire prototype, and grout the lower interval within the prototype
5. Remove hazardous substances within the prototype from the entire surface interval, as necessary to meet RAOs
6. Grout the basin and remaining prototype sections incrementally until the basin meets engineering requirements for constructing a level warehouse floor.

The portion of the prototype that requires the most removal is within the surface interval, where regulated hazardous waste and other hazardous substances would be removed along with hull sections, piping, equipment, and obstacles that prevent removal of hazardous waste. The section of hull within the surface interval in the reactor compartment contains large amounts of lead, which may necessitate removing most of the reactor compartment hull within the surface interval. Hull sections in the forward, engine, and aft compartments will not be removed except for the upper portions that interfere with construction of a new warehouse floor and as needed to facilitate targeted removal of equipment and RCRA hazardous waste[g] throughout the prototype. Strategic cuts into the surface and lower intervals of the prototype would facilitate removal of equipment. Components would be size-reduced as needed to move obstacles and extract components.

Support and auxiliary equipment located above grade on the main floor and in nearby below-grade cells would be removed to meet RAOs and ARARs and disposed of appropriately. This would involve size reducing and dismantling equipment and piping and removing them. Once RAOs and ARARs have been met, the cells and remaining equipment would be grouted.

D&D waste would be recycled to the extent practicable. Removed waste and debris, upon meeting WAC, would be shipped to appropriate facilities authorized by EPA to dispose of CERCLA waste—e.g., EnergySolutions (hazardous waste), the Idaho CERCLA Disposal Facility (ICDF) (low-level waste), and the Idaho Nuclear Technology and Engineering Center (INTEC) CERCLA Debris Waste Landfill (ICDWL) (demolition debris).

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g. Lead that continues to be used as shielding during D&D, as well as lead that is not easily removable without significant ALARA radiation exposure concerns, would remain in place as shielding.

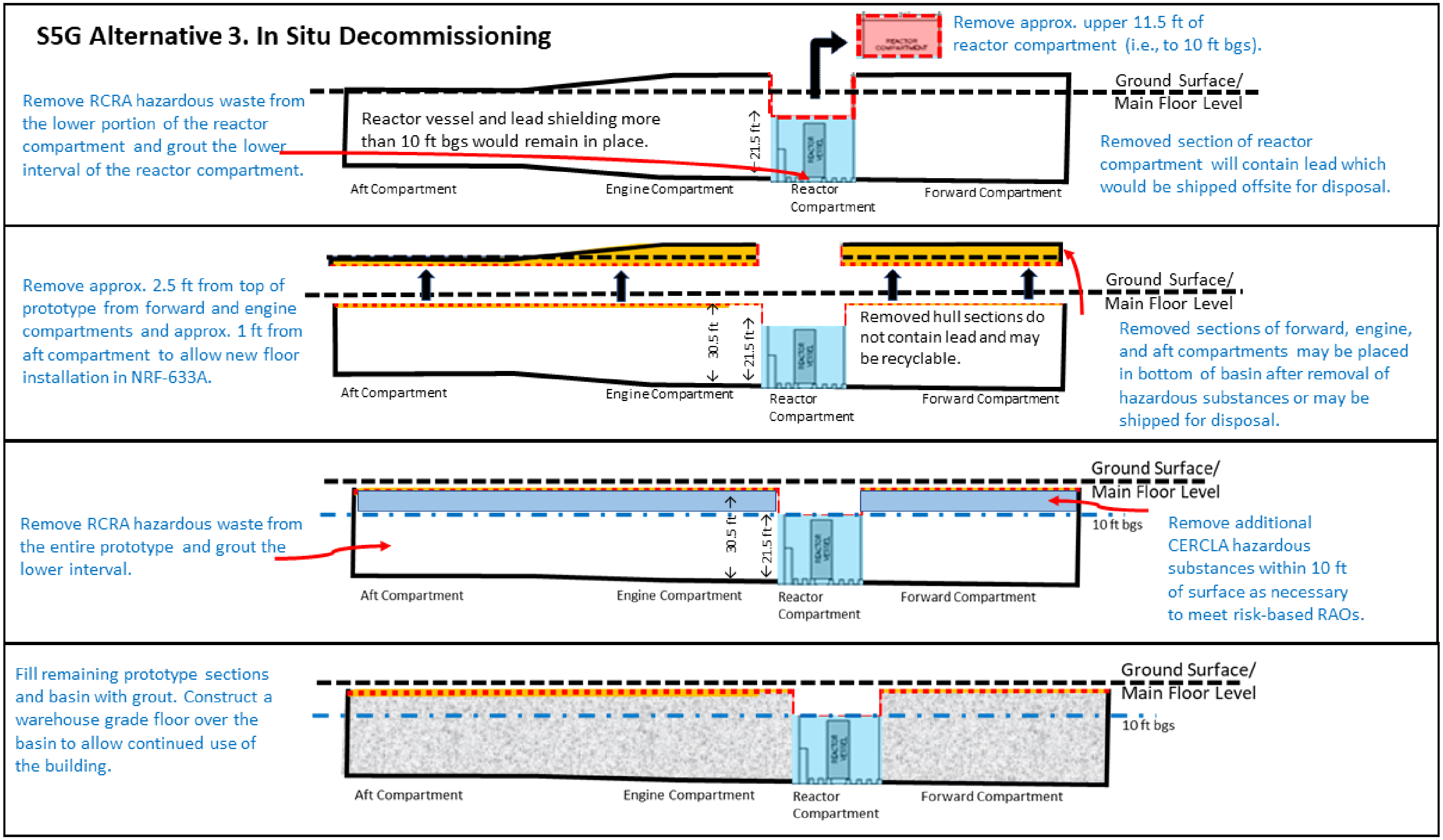

Figure 4-2. General approach to partial prototype disassembly and in situ grouting under Alternative 3.

Remaining portions of the prototype, including the reactor vessel and other radiological systems, would remain in the basin. Areas of the reactor compartment where the hull was breached would be sealed. Void spaces within the prototype would be filled with grout to stabilize and isolate residual contamination to the extent practicable. The surrounding basin would be grouted incrementally in coordination with grouting of the prototype. A level floor would be constructed over the grouted basin. Depending on engineering analysis, structural beaming may be placed to support an engineered floor capable of loads commensurate with future use of Building NRF-633A.

Four operations crews plus associated support staff working full time for approximately 64 weeks (14 months) is the estimated level of effort for completing Alternative 3. Figure 4-3 illustrates the conceptual end state.

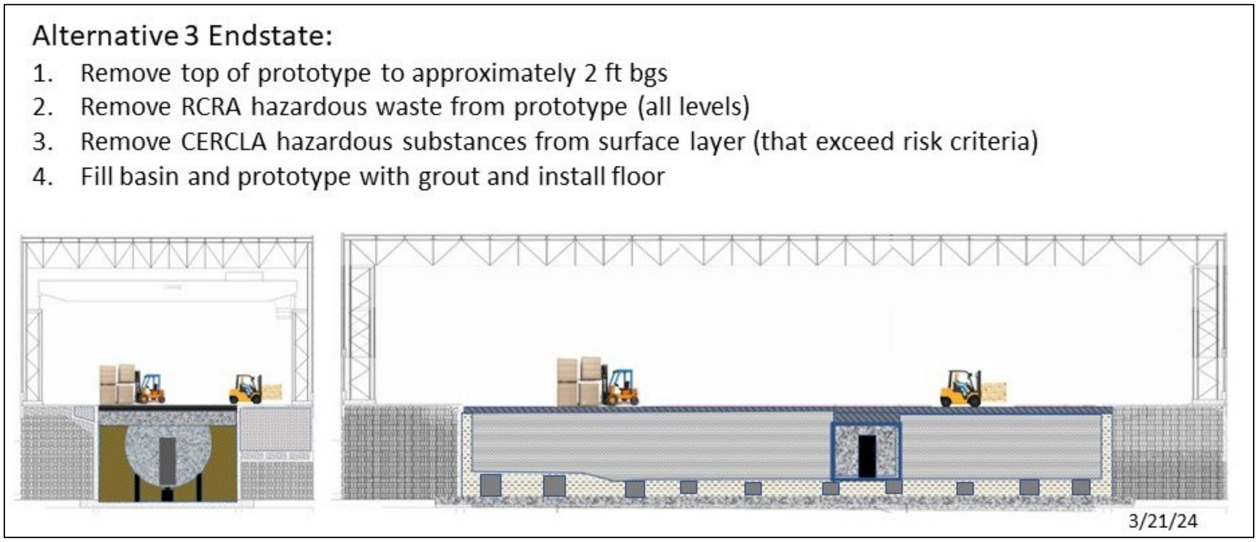

Figure 4-3. Alternative 3 conceptual end state.

Upon completion of the NTCRA, a CERCLA removal action report would be prepared for NRF-633P. This report would provide the basis for completing the OU 10-08 CERCLA NSI process. The NSI process would determine the need for creating a new CERCLA site and, if necessary, implementing institutional controls. Application of the NSI review process after implementing Alternative 3 likely would justify creating a new CERCLA site with institutional control requirements. Upon completion of the CERCLA NSI process, the S5G Prototype site would transition back to DOE-NR for future management.

4.4 Alternative 4, Complete Prototype Removal

Alternative 4 would meet RAOs and ARARs by dismantling the entire prototype to segregate RCRA hazardous waste from demolition debris and then transporting the resulting materials to approved disposal facilities. This description is illustrative of potential approaches and is not prescriptive. The general approach envisioned for Alternative 4, illustrated in Figure 4-4, is top-down prototype disassembly and removal, as follows:

1. Remove the top of the prototype, and create additional access points, as needed
2. Clear obstacles that constrain access to the reactor vessel and associated radiologically contaminated components

3. Prepare the reactor vessel and remove for disposal; remove other radiologically contaminated components, as needed to minimize radiation exposure
4. Proceed with dismantling the entire prototype from the top down, segregating materials, as needed, for compliant disposal
5. Backfill the basin with compacted clean fill to meet engineering requirements for constructing a level warehouse floor.

Alternative 4 involves removing the entire prototype from the basin. Using existing overhead cranes, detached, size-reduced components would be lifted from the basin in a top-to-bottom approach. Initial steps would focus on removing radiologically contaminated components and RCRA hazardous waste from the reactor compartment to reduce potential worker exposures as D&D proceeds. Upon meeting WAC, the defueled reactor vessel would be prepared for disposal at a low-level waste disposal facility authorized by EPA to accept CERCLA waste, such as ICDF. D&D would then continue to dismantle the entire prototype from the top down, segregating materials, as needed, for compliant disposal.

RCRA hazardous waste, particularly lead, would be segregated for disposal at an approved facility (e.g., EnergySolutions in Utah). Upon meeting WAC, lead that continues to be used as shielding[h] during removal, transport, and disposal, including lead that is not easily separable without significant radiation exposure concerns, would remain with the reactor vessel and other radiologically contaminated components through disposal as low-level waste at ICDF. Asbestos also would be removed and managed as necessary to meet RAOs. With complete removal of the prototype, only minimal quantities of CERCLA hazardous substances would remain.[i] Figure 4-5 illustrates the emptied basin.

D&D waste would be recycled to the extent practicable. Upon meeting WAC, removed waste and debris would be shipped to appropriate facilities authorized by EPA to dispose of CERCLA waste—e.g., EnergySolutions (RCRA hazardous waste), ICDF (low-level waste), and ICDWL (demolition debris that does not contain concentrations of hazardous substances that exceed risk criteria). Upon determination of compliance with RAOs and ARARs for subgrade areas, the basin would be filled with clean fill material to depth to the extent practicable and cell vaults would be grouted. The filled basin would be covered with an engineered floor constructed to specifications for continued warehouse operations within the NRF-633A building.

Four operations crews plus associated support staff working full time for approximately 78 weeks (17 months) is the estimated level of effort for completing Alternative 4. Figure 4-6 illustrates the conceptual end state.

Upon completion of the NTCRA, a CERCLA removal action report would be prepared for NRF-633P. This report would provide the basis for completion of the OU 10-08 CERCLA NSI process. The NSI process would determine the need for creation of a new CERCLA site and, if necessary, implementation of institutional controls. Application of the NSI review process after implementing Alternative 4 is expected to conclude that creating a new CERCLA site with institutional control requirements is not justified. Upon completion of the CERCLA NSI process, the S5G Prototype site would transition back to DOE-NR for future management.

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h. Lead used as shielding is not categorized as waste and is not subject to Hazardous Waste Management Act/RCRA requirements. As a best-management practice, DOE typically chooses to grout such waste before disposal.

i. A small amount of PCBs in paint on subgrade structures and asbestos materials may remain in place.

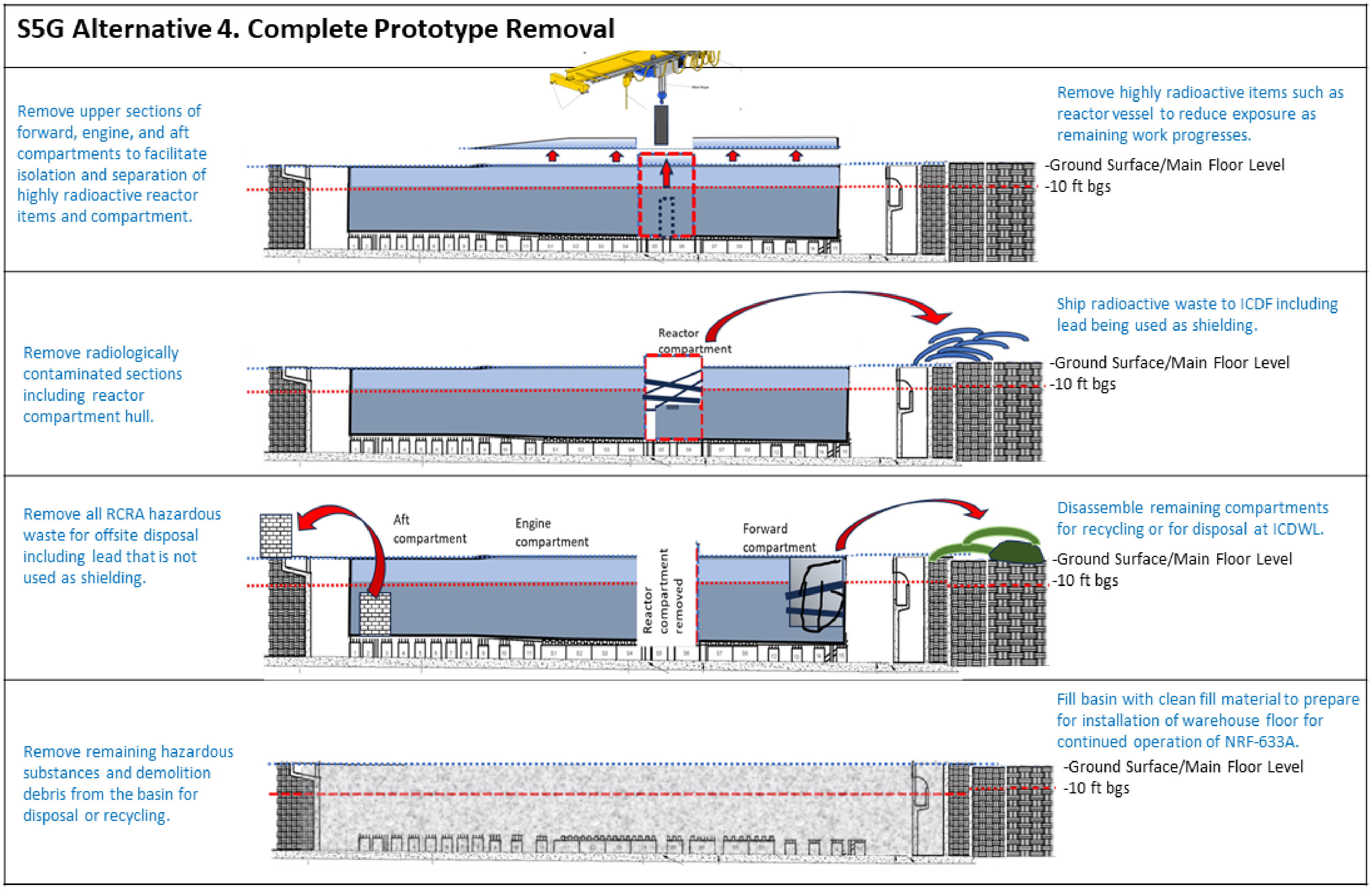

Figure 4-4. General approach to complete prototype removal under Alternative 4.

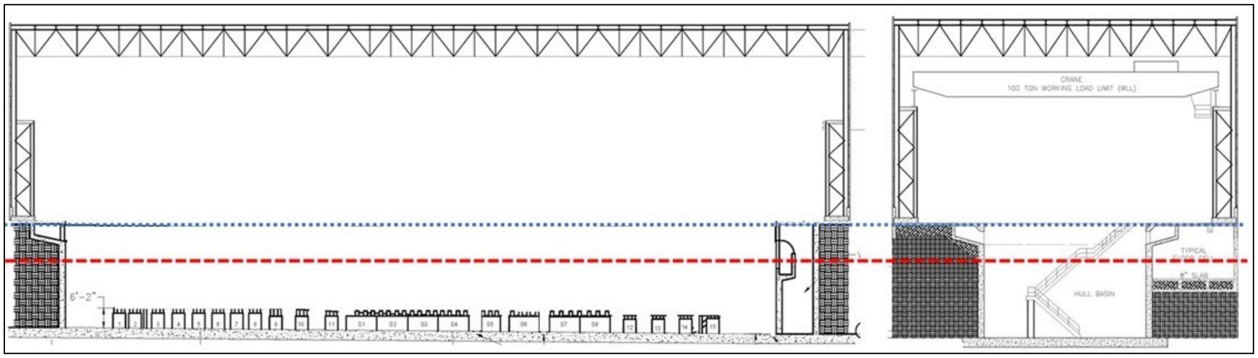

Figure 4-5. The emptied basin after removing the S5G Prototype under Alternative 4.

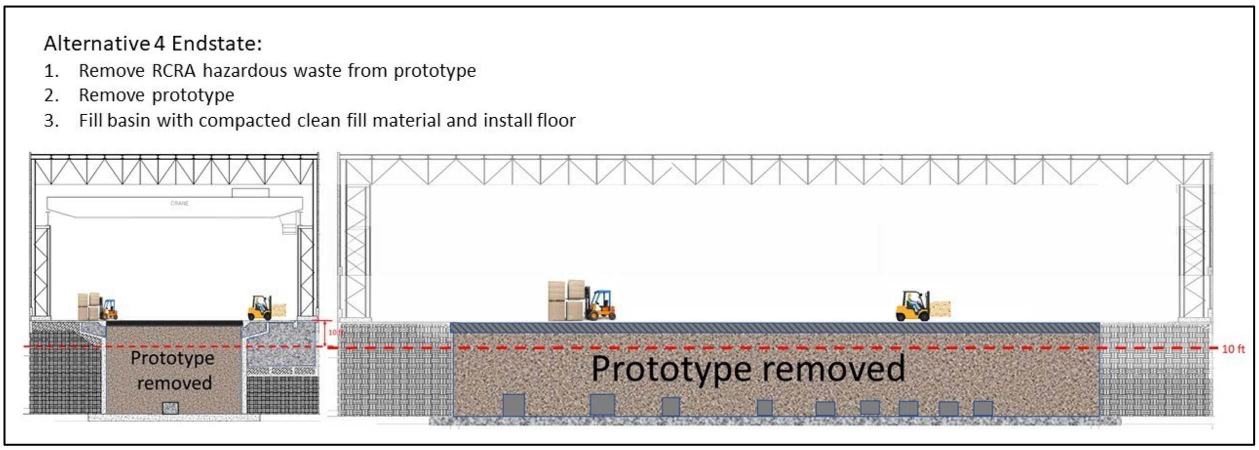

Figure 4-6. Alternative 4 conceptual end state.

5. RISK ASSESSMENTS

Three risk assessments support development of this EE/CA and the future action memorandum for the S5G Prototype Facility (i.e., NRF-633P). These risk assessments were developed using routinely applied methods for INL Site risk analyses under CERCLA and were reviewed by EPA and DEQ. Alternative 1, No Action, is recognized as not meeting RAOs and ARARs but is evaluated to establish a baseline to assess the efficacy of action alternatives (i.e., Alternative 3, In Situ Decommissioning, and Alternative 4, Complete Prototype Removal). Because Alternative 2, Continued Surveillance and Maintenance, only delays the eventual need for decommissioning, it is not evaluated in the risk assessments. The three risk documents for the NRF-633P are listed below:

- EDF-11332, "Screening Level Ecological Risk Assessment for Decommissioning of the S5G Prototype Facility"
- EDF-11335, "Radiological Human Health Risk Assessment for Decommissioning of the S5G Prototype Facility"
- EDF-11418, "Nonradiological Human Health Screening Level Risk Assessment for Decommissioning of the S5G Prototype Facility."

Inventories of hazardous substances (i.e., source term inventories) were used with various computer models to assess their impact to human health and the environment. Figure 5-1 illustrates the relationship between inventory and risk assessments. Subsections that follow summarize S5G Prototype Facility radiological and nonradiological inventories and summarize conclusions from the three risk documents.

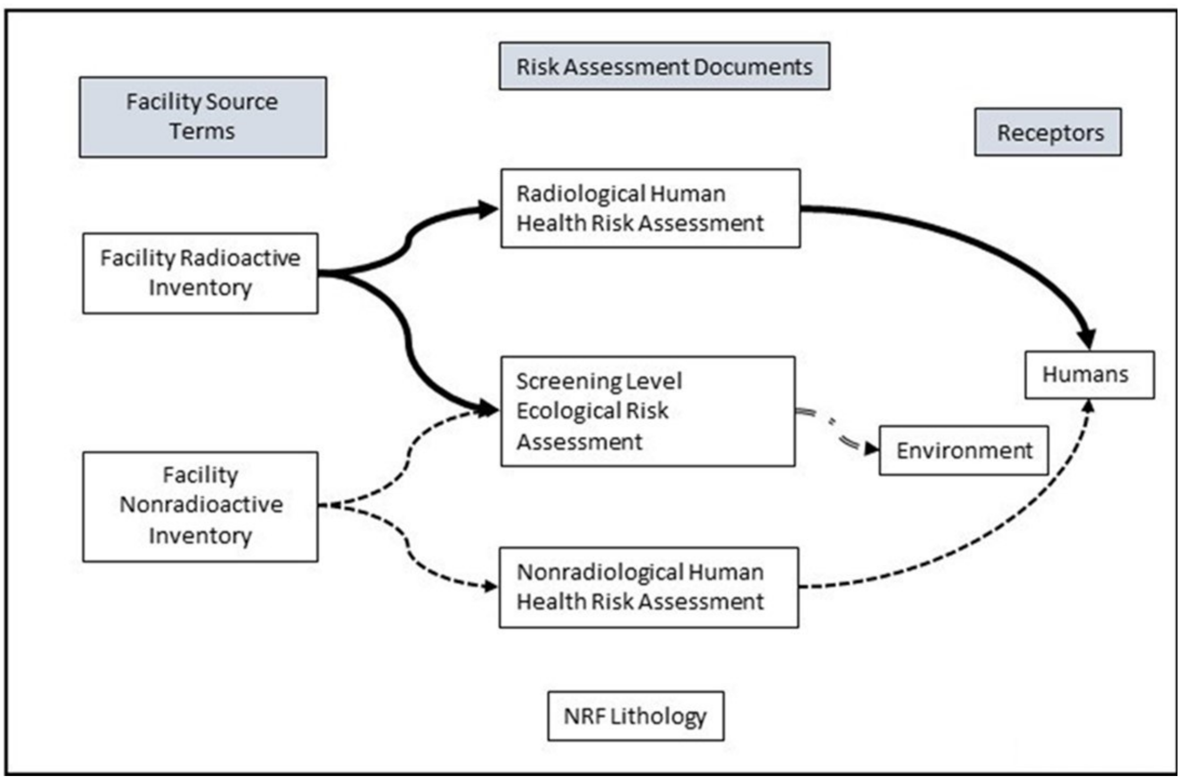

Figure 5-1. Relationship of facility source terms to risk-based documents supporting the Naval Reactors Facility S5G Prototype Facility engineering evaluation/cost analysis.

5.1 Source Term Assessments

To evaluate risk, inventories were compiled for the mass (kg) for nonradioactive hazardous substances and activity (Ci) for radioactive substances. The distribution, location, and physical state of these substances were also recorded such that the long-term risk from these substances might be quantified. Source term assessments were prepared for both radioactive and nonradioactive substances for NRF-633P.[j] The following EDFs document these inventories:

- EDF-11329, "Nonradiological Inventory of Materials, Alloys, and Substances in S5G Prototype Facility"
- EDF-11465, "S5G Non-Radiological Inventory Location and Distribution"
- TBL-616, "S5G Prototype End-of-Service Radiological Source Term."

5.1.1 Radiological Inventory

The S5G Prototype reactor vessel and primary reactor components contain approximately 1.82E+04 Ci of radionuclide activity arising from neutron activation of nickel and cobalt constituents. These constituents reside in the highly corrosion-resistant stainless-steel alloys of the reactor vessel and associated components and are contained within the reactor compartment. Activated metals represented approximately 99.96% of the total activity in the S5G Prototype Facility as of 2022. Corrosion rate constants for these metals control release in the transport model. Because corrosion release of activated metals is very slow, inventories were segregated for modeling into activated metals (non-removable) within the reactor vessel and CRUD. CRUD is generally defined as corrosion and wear products that become radioactive over time during nuclear reactor operations. CRUD inventories also include fission products (e.g., Cs-137 and Sr-90) and actinides (e.g., Pu-241). CRUD material comprises small removable particles containing radionuclides that can be released readily and dispersed in the environment. For this reason, CRUD inventories are listed as material at risk (MAR). Table 5-1 lists fission and activation product inventories used for S5G Prototype Facility human health radiological and ecological risk assessments in EDF-11335 and EDF-11332, respectively. All actinides were screened from further consideration based on calculated risk of less than 1E-06, as detailed in the risk EDFs. Risk assessment screening applied a radionuclide-specific risk of 1E-06 to ensure that cumulative risk would not exceed the excess cancer risk threshold of 1E-04 applied at the INL Site (see Subsection 3.2).

5.1.2 Nonradiological Inventory

Table 5-2 lists masses of hazardous substances assessed for nonradiological risk. Alternative 1, No Action, represents baseline inventories. Table 5-2 also provides estimates of nonradiological inventory that would remain following implementation of Alternatives 3 and 4. Inventories are subdivided by depth interval used in the risk assessments (i.e., above and below 10 ft bgs). These inventories were used for human-health nonradiological and ecological risk assessments in EDF-11418 and EDF-11332, respectively.

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j. Risk assessments and other S5G support documents did not use the term "NRF-633P," which was introduced in the "Addendum to the Action Memorandum for General Decommissioning Activities under the Idaho Cleanup Project (DOE/ID-11293, Revision 4) (CLN241500)" (Larsen 2024).

Table 5-1. Fission and activation product radionuclide inventories in the S5G Prototype Facility as of January 1, 2022.

Radionuclide[a]	Reactor Vessel Activated Metal Activity (Ci)	MAR activity (Ci)	Total (Ci)	Half-Life (years)
C-14	9.18E-01	9.77E-02	1.02E+00	5.70E+03
Co-60	2.40E+02	2.94E-01	2.40E+02	5.27E+00
Cs-137		2.12E-03	2.12E-03	3.02E+01
Fe-55	5.30E+00	2.28E-02	5.32E+00	2.74E+00
H-3	1.29E-02		1.29E-02	1.23E+01
I-129		3.92E-07	3.92E-07	1.57E+07
Mn-54	8.83E-08	3.92E-10	8.87E-08	8.55E-01
Mo-93	3.29E-02		3.29E-02	4.00E+03
Nb-93m	2.35E-02	4.67E-02	7.02E-02	1.61E+01
Nb-94	6.90E-01	1.96E-03	6.92E-01	2.03E+04
Ni-59	1.85E+02	2.94E-02	1.85E+02	1.01E+05
Ni-63	1.78E+04	2.45E+00	1.78E+04	1.00E+02
Sb-125		1.20E-04	1.20E-04	2.76E+00
Se-79		1.47E-08	1.47E-08	2.95E+05
Sn-126		4.41E-08	4.41E-08	2.30E+05
Sb-126		4.41E-08	4.41E-08	3.47E-02
Sr-90		2.06E-03	2.06E-03	2.88E+01
Tc-99	3.04E-03	9.80E-05	3.14E-03	2.11E+05
Te-125m		2.94E-05	2.94E-05	1.57E-01
Zr-93		1.96E-05	1.96E-05	1.53E+06

a. Short-lived progeny that would exist in secular equilibrium with their parent were excluded.

MAR material at risk

Table 5-2. Nonradiological hazardous substances for Alternatives 1, 3, and 4 subdivided by depth interval.

Nonradioactive Substance	CAS Number	Alternative 1		Alternative 3		Alternative 4	
		Surface to 10 ft bgs[a] (kg)	Greater than 10 ft bgs (kg)	Surface to 10 ft bgs[a] (kg)	Greater than 10 ft bgs (kg)	Surface to 10 ft bgs[a] (kg)	Greater than 10 ft bgs (kg)
Copper	7440-50-8	7.65E+04	1.10E+05	2.69E+03	1.10E+05	Removed[b]	Removed[b]
Lead	7439-92-1	2.72E+05	2.26E+05[c]	1.30E+01	1.63E+05	Removed[b]	Removed[b]
Mercury	7439-97-6	1.40E+00	0.00E+00	Removed[d]	0.00E+00	Removed[b,d]	0.00E+00
Tin	7440-31-5	1.04E+03	2.09E+02	2.02E+01	2.09E+02	Removed[b]	Removed[b]
Zinc	7440-66-6	2.36E+03	5.92E+02	1.48E+02	5.92E+02	Removed[b]	Removed[b]
PCBs	53469-21-9	3.21E+01	1.75E+01	8.40E+00	1.75E+01	8.40E+00	1.90E+00
Asbestos	1332-21-4	6.21E+03	2.48E+04	1.10E+03	2.48E+04	Removed[b]	Removed[b]

a. Surface to 10 ft bgs includes above-grade constituents in NRF-633P, the S5G Prototype Facility, on the main floor of Building NRF-633A (e.g., water-management components).

b. Alternative 4 would remove the entire prototype. Removal of the entire prototype also would remove all CERCLA hazardous substances excepting minor amounts of asbestos and PCBs in paint on subsurface structures.

c. After completion of the initial S5G Prototype Facility inventory in EDF-11329, an additional 98,000 lb (44,545 kg) of lead ballast was identified within the prototype more than 10 ft bgs, increasing the total lead that was more than 10 ft bgs from 1.81E+05 kg to 2.26E+05 kg.

d. EDF-11329 indicates that all mercury is assumed to be above grade in switches, relays, rectifiers, thermostats, lamps, and other components. Decommissioning would remove these objects.

bgs below ground surface
CAS Chemical Abstract Services
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
PCBs polychlorinated biphenyls
S5G Submarine 5th Generation General Electric

5.1.3 Exposure Concentrations

In 1995, DOE-ID, in coordination with the EPA and DEQ, issued the *Long-Term Land Use Future Scenarios for the Idaho National Engineering Laboratory* (DOE-ID 1995), which established a standardized basis for performing future risk assessments. Based on the assumption in 1995 that the INL Site would reasonably remain under government management and control for at least the next 100 years, risk assessments would use 2095 as the beginning of their calculations for potential exposure of hazardous substances to future residents. Human health risk assessments examine a postulated future residential scenario, whereby a resident constructs a home with a 10-ft-deep basement[k] and a groundwater well and spreads excavated soil on the surface. For the S5G risk assessments, that resident resides at the location of the former prototype (and its defueled reactor vessel) for 26 years and is exposed to contaminated soil and groundwater in estimated exposure concentrations that vary depending on the alternative.

The baseline alternative, Alternative 1, is that the INL takes no actions whatsoever to maintain the facility to protect human health and the environment and DOE controls have ceased to function. The hypothetical future resident would find a sagebrush-covered landscape where the remains of the S5G Prototype lay within the S5G basin now buried beneath the collapsed building and accumulated desert dust and debris. For both Alternatives 3 and 4, postulated future removal actions would eliminate all buildings at NRF. For Alternative 3, the hypothetical future resident would find a sagebrush-covered landscape with a concrete pad covering the remains of the grouted prototype and basin. For Alternative 4, the hypothetical future resident also would find a sagebrush-covered landscape with a similar concrete pad, but it would cover an emptied basin that had been backfilled with clean fill material.

Estimated radionuclide concentrations in soil and groundwater are derived from the radiological source term inventories discussed above. For soil exposure pathways, radionuclide inventories are converted to soil concentrations and compared to risk-based concentrations. EDF-11483, “Updated INL Radionuclide Preliminary Remediation Goals (PRGs) Using EPA PRG Calculator with INL Site Specific Values,” presents the inputs and calculation procedure for using the EPA PRG calculator for calculating INL Site-specific PRG values. Contaminated soil pathways are ingestion of soil, ingestion of home-grown produce, inhalation of suspended soil, and external exposure. Exposure pathways are quantitatively defined in the preliminary remediation goal calculator (EPA 2022), which also accounts for radioactive decay.

As noted above, the estimated total radiological inventory for the S5G Prototype Facility (i.e., NRF-633P) is 1.82E+04 Ci, with activated metals from within the reactor vessel accounting for approximately 99.96% of the total. This entire inventory was applied to Alternative 1, No Action. Radionuclide soil concentrations decayed to 2095 were calculated for CRUD constituents (i.e., fission products and corrosion particles that become radioactive). Table 5-3, taken from Table 5-13 in EDF-11335, presents estimated exposure concentrations. Additionally, external exposure to radionuclides from the reactor vessel was computed for Alternative 1 using the MicroShield code (Grove Software Inc. 2011). Radionuclide exposure concentrations in soil for Alternative 3 were not calculated because the entire radiological source term (i.e., the reactor vessel) is more than 10 ft bgs, making it outside of the source volume for surface exposure pathways evaluated for risk. For Alternative 3, the radiological source term is germane only for future residential groundwater use because the entire reactor vessel is more than 10 ft bgs, making it outside of the source volume for surface exposure pathways evaluated for hypothetical future residential scenario. Alternative 4 would eliminate the entire prototype, including the reactor vessel and its radiological source term.

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k. The 10-ft-deep basement is the basis for evaluating alternatives for two strata described in Section 4: the surface interval (i.e., to a depth of 10 ft bgs) and the lower interval (greater than 10 ft bgs).

Table 5-3. Radionuclide exposure concentrations for material at risk for the residential scenario from the surface exposure pathway.

Radionuclide	2022 Inventory of surface contaminated material (Ci)	Soil concentration (pCi/g)	Soil concentration decayed to 2095 (pCi/g)	Soil PRG[a] for 1E-04 risk (pCi/g)	Residential risk from surface exposure pathway
C-14	9.77E-02	1.78E+01	1.76E+01	8.12E+03	2.17E-07
Co-60	2.94E-01	5.35E+01	3.62E-03	3.30E+00	1.10E-07
Cs-137	2.12E-03	3.86E-01	7.21E-02	6.03E+00	1.20E-06
Nb-93m	4.67E-02	8.50E+00	3.69E-01	4.57E+04	8.07E-10
Nb-94	1.96E-03	3.57E-01	3.56E-01	1.60E+00	2.23E-05
Ni-59	2.94E-02	5.35E+00	5.35E+00	5.49E+04	9.74E-09
Ni-63	2.45E+00	4.46E+02	2.69E+02	3.51E+04	7.66E-07
Total residential risk from surface exposure pathway					2.45E-05

a. See EDF-11483, "Updated INL Radionuclide Preliminary Remediation Goals (PRGs) Using EPA PRG Calculator with INL Site Specific Values."

PRG preliminary remediation goal

Radionuclide groundwater concentrations were estimated using INL Site-specific groundwater transport models used for INL CERCLA risk assessments and low-level radioactive waste performance assessments, e.g., GWSCREEN (Rood 2003) and the Mixing Cell Model (Rood 2021). Groundwater screening analysis for fission and activation products showed that seven radionuclides had half-lives greater than 5 years and concentrations greater than default soil-to-groundwater preliminary remediation goals assuming a dilution-to-attenuation factor of 1.0. These seven radionuclides and their modeled groundwater concentrations were used to compute groundwater ingestion risks and for comparison to groundwater quality standards.

Estimated concentrations of nonradiological hazardous substances in soil and groundwater are derived from the source term inventories discussed above and are shown in Table 5-4. For soil exposure pathways, inventories are converted to soil concentrations and compared to risk-based concentrations. Contaminated soil pathways are ingestion of soil, inhalation of suspended soil, and dermal exposure. Exposure pathways are quantitatively defined in the EPA regional screening levels obtained from EPA's *Regional Screening Levels* website (EPA 2022). Lead is a special case in terms of regional screening levels; therefore, lead is considered separately from the other contaminants. Lead concentrations in soil and groundwater were evaluated as a ratio similar to regional screening levels for soil and tap water.[1] If lead ratios are less than 1.0, lead is considered to meet blood-lead based regional screening levels for soil and tap water.

The nonradiological groundwater assessment model used the same source configuration, lithology discretization, and parameters that were used for radiological risk assessment (EDF-11335). The Alternative 1 inventory of all nonradiological hazardous substances, including all depth layers (i.e., not

l. EPA updated the lead RSL from 400 to 200 mg/kg (Breen 2024); however, the change does not affect conclusions from EDF-11418, which retained lead for risk assessment for all alternatives and concluded that lead ratios were greater than 1 for Alternative 1 and less than 1 for Alternatives 3 and 4. For comparison to 2.0E+02 mg/kg (i.e., 200 mg/kg), the Alternative 1 exposure point concentration is 4.95E+04 mg/kg and Alternative 3 is 2.37E+00 mg/kg. For Alternative 4, lead is removed, as shown in Table 5-4.

restricted to less than 10 ft bgs as in the surface soil pathway), was used in the assessment and thereby provided the worst-case inventory. The nonradiological concentrations were used to compute groundwater ingestion risks and for comparison to groundwater quality standards (IDAPA 58.01.11).

Table 5-4. Initial S5G Prototype Facility inventories and derived concentrations of nonradiological hazardous substances in surface soils 0–10 ft below ground surface and calculated soil concentrations for Alternatives 1, 3, and 4.

Hazardous Substance	Alternative 1 Inventory (kg)	Alternative 1 Concentration[a] (mg/kg)	Alternative 3 Inventory (kg)	Alternative 3 Concentration[a] (mg/kg)	Alternative 4 Inventory (kg)	Alternative 4 Concentration[a] (mg/kg)
Copper	7.65E+04	1.39E+04	2.69E+03	4.90E+02	Removed[b]	Removed[b]
Lead	2.72E+05	4.95E+04	1.30E+01	2.37E+00	Removed[b]	Removed[b]
Mercury	1.40E+00	2.55E-01	Removed[c]	Removed[c]	Removed[c]	Removed[c]
Tin	1.04E+03	1.89E+02	2.02E+01	3.68E+00	Removed[b]	Removed[b]
Zinc	2.36E+03	4.30E+02	1.48E+02	2.70E+01	Removed[b]	Removed[b]
PCBs	3.21E+01	5.85E+00	8.40E+00	1.53E+00	8.40E+00[b]	1.53E+00[b]
Asbestos	6.21E+03	1.13E+03	1.10E+03	2.00E+02	Removed[b]	Removed[b]

a. The mixing mass was 5.49E+06 kg.

b. Removal of the entire prototype also removes all the CERCLA hazardous substances excepting minor amounts of asbestos and PCBs in paint on subsurface structures.

c. EDF-11329 indicates that all mercury is assumed to be above grade in switches, relays, rectifiers, thermostats, lamps, and other components. Decommissioning would remove these objects.

bgs below ground surface
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
PCB polychlorinated biphenyl

Potential ecological exposures are based on the same media concentrations derived from S5G source term inventories discussed above. The screening calculation assumed contaminant inventories were mixed in a soil volume equal to the footprint of the facility to a depth of 10 ft bgs and were bioavailable. For radionuclides, Alternative 1 did not present ecological risk greater than threshold values; therefore, ecological risk for Alternatives 3 and 4 were not calculated. Derived concentrations of nonradiological hazardous substances in Table 5-4 were compared to ecologically based screening levels and supported subsequent ecological risk assessment calculations (e.g., screening level quotients and hazard quotients) (see Subsection 5.4).

5.2 Radiological Human Health Risk Assessment Conclusions

Alternative 1 poses unacceptable risks for the surface soil pathway because carcinogenic morbidity risks from radiologically contaminated materials minimally exceed the target risk of 1E-04; thus, Alternative 1 is not viable. Conversely, both Alternatives 3 and 4 would reduce surface pathway risks from radiologically contaminated materials to less than 1E-04. For groundwater pathways, risk estimates are less than 1E-04 for all alternatives. In addition, groundwater quality standards for the State of Idaho (IDAPA 58.01.11) were met for all alternatives. In conclusion, carcinogenic risk from the groundwater pathway for closure of the S5G Prototype Facility is minimal and surface pathways drive the overall cancer risk. Table 5-5 summarizes the radiological human health risk assessment.

Table 5-5. Summary of radiological risk evaluation of alternatives in 2095 or greater, residential scenario.

Alternative	Groundwater Pathway[a]	Surface Pathway, Non-activated Metals[b]	Surface Pathway, Activated Metals[c]	External Exposure, Activated Metals[d]	Total[e]
1) No Action	7.8E-08	2.5E-05	1.7E-05	8.4E-05	1.3E-04
2) Continued Surveillance and Maintenance	NA	NA	NA	NA	NA
3) In Situ Decommissioning: Contaminated debris removed, reactor compartment and voids grouted, and area covered with floor	7.8E-08	0.0	0.0	5.3E-24	7.8E-08
4) Complete Prototype Removal: The entire prototype, including all reactor components removed,[f] voids filled, and area covered with floor	0.0	0.0	0.0	0.0	0

a. The maximum groundwater risks are driven by MAR (nonactivated metals) and occur in the 500- to 1,000-year time window from 2020. For Alternative 3, it is assumed the MAR radioactivity is not removed but will be greater than 10 ft below ground surface to preclude the surface exposure pathway.

b. For Alternative 3, nonactivated metal debris is covered by 10 ft of grout, which eliminates ingestion/inhalation exposure. External exposure risk would be less than 5.3E-24 based on external exposure to activated metals. For Alternative 4, nonactivated radioactive metal debris is removed.

c. The risks presented are the maximum, which occur after 10,000 years. For Alternative 3, the reactor vessel remains but is grouted, covered, and below 10 ft, which eliminates ingestion/inhalation exposure. External exposure risk would be less than 5.33E-24 based on external exposure to activated metals. For Alternative 4, nonactivated radioactive metal debris is removed.

d. Compared to Alternative 1, Alternative 3 risks are reduced substantially by grouting and covering. In Alternative 4, the prototype, including all reactor components, are removed.

e. The total risk regardless of time. For Alternative 1, risks are driven by the surface pathway for nonactivated metals and external exposure. Peak risks occur for this pathway in 2095.

f. All but trace quantities of hazardous substances (e.g., PCBs and asbestos) have been removed.

MAR material at risk (which includes corrosion and wear products on the inner surfaces of the piping and other surface contamination)
NA not applicable
PCB polychlorinated biphenyl

5.3 Nonradiological Human Health Risk Assessment Conclusions

Alternative 1 poses unacceptable risks for the surface soil pathway attributable to copper and lead. Alternative 3 reduces surface soil pathway risks to acceptable levels, while Alternative 4 achieves de minimus risk by eliminating the source. For groundwater, hazard indexes, cancer risk, and lead ratios are less than RAOs and meet groundwater quality standards for the State of Idaho for all alternatives. EDF-11418 presents details of the S5G Prototype Facility nonradiological human health risk assessment. Table 5-6 summarizes the results.

Table 5-6. Summary of nonradiological risk evaluation of alternatives for the S5G Prototype Facility.

Alternative	Surface Soil Pathway HI, Cancer Risk, and Lead Ratio for Residential Scenario	Nonradioactive Substances Exceeding Surface Soil Pathway HQs or Lead Ratio	Inventory That Will Meet HQ or Lead Ratio (kg)	Groundwater Resident Maximum HI, Cancer Risk, and Lead Ratio
1) No Action	**4.54 (HI)** 2.5E-05 (cancer risk) **124 (lead ratio)**	Copper (4.50) Lead (124)	Copper: 17,000 **Lead: 2,197**	0.35 (HI) 1.2E-07 (cancer risk) 0.004 (lead ratio)
2) Continued Surveillance and Maintenance	Not evaluated	Not evaluated	Not evaluated	Not evaluated
3) In Situ Decommissioning	0.16 (HI) 6.7E-06 (cancer risk) 0.01 (Lead ratio)	None	Meets HQs and lead ratio	Alternative 1 (No Action) met HI, cancer risk, and lead ratio for tap water
4) Complete Prototype Removal	NA (HI) 6.7E-06 (cancer risk) NA (lead ratio)	None	Meets HQs and lead ratio	Alternative 1 (No Action) met HI, cancer risk, and lead ratio for tap water

NOTE: Bold text indicates an HI or lead ratio exceeds the acceptable value of ≤1.0.

HI hazard index
HQ hazard quotient
NA not applicable; lead is removed

5.4 Screening Level Ecological Risk Assessment

The screening level ecological risk assessment for the S5G Prototype Facility NTCRA considered both radiological and nonradiological hazardous substances using methodology developed for INL Site-wide application (VanHorn, Hampton, and Morris 1995; VanHorn and Stacy 2004). EDF-11332 presents details of the S5G Prototype Facility ecological risk analysis, which concluded that hazardous substances at the facility will not present a threat to environmental populations on the INL Site. That conclusion is based on the following results:

- All radionuclides had screening level quotient values less than 1.0; thus, no further analysis was needed for radionuclides.
- For nonradiological substances, screening level quotients in Alternative 1 exceeded 1.0 for copper, lead, tin, zinc, PCBs, and asbestos. For Alternative 3, screening level quotients exceeded 1.0 for copper and PCBs. For Alternative 4, the screening level quotient was exceeded for PCBs. The screening calculation was conservative in that it assumed contaminant inventories were mixed in a soil volume equal to the footprint of the facility to a depth of 10 ft bgs and were bioavailable. Additional analysis involving the calculation of the hazard quotient for each ecological functional group was conducted for Alternatives 3 and 4 to assess hazardous substances that exceeded a screening level quotient of 1.0. Results of the analysis indicated that the maximum total hazard quotient occurred for the deer mouse functional group with a total hazard quotient of 7.4 for Alternative 3. For Alternative 4, the maximum total hazard quotient of 0.023 occurred for the deer mouse functional group. Total hazard quotients for all populations of flora and fauna were less than 10 for both Alternatives 3 and 4; therefore, exposures to contaminated soil that result in a hazard quotient greater than or equal to 10 will be inhibited and ecological RAOs are met for these alternatives.

Additional factors that suggest that these contaminants will not present a threat to environmental populations on the INL Site, include:

- The metals are not in the form of fine particles or solutions that can be readily mixed with soil. They are large solid masses that are not bioaccessible
- Corrosion calculations suggest it would take many thousands of years to degrade the solid metal objects sufficiently to a point where corrosion products from metals may enter the soil; however, it is not certain that these corrosion products would be in a bioavailable form
- Decommissioning Alternative 3 includes measures (e.g., grouting) that would inhibit biota from intrusion into contaminated media, while Alternative 4 would remove almost all contaminated media
- In addition to removing almost all contaminated media, Alternative 4 would include measures such as backfilling with compacted clean fill and covering with concrete that would inhibit intrusion by biota.

5.5 Risk Assessment Summary

Three risk assessments were developed using routinely applied methods for INL Site risk analyses under CERCLA: "Radiological Human Health Risk Assessment for Decommissioning of the S5G Prototype Facility" (EDF-11335), "Nonradiological Human Health Screening Level Risk Assessment for Decommissioning of the S5G Prototype Facility" (EDF-11418), and "Screening Level Ecological Risk Assessment for Decommissioning of the S5G Prototype Facility" (EDF-11332). Source term inventories were compiled and used to calculate concentrations in soil and to model groundwater concentrations to estimate human health and ecological risks beginning in 2095.

Three alternatives were evaluated. Alternative 1, No Action, evaluated baseline risks if no mitigation is applied. Alternative 3, In Situ Decommissioning, considered risk reduction from targeted removal of the upper portion of the prototype, hazardous waste from the entire prototype, and other hazardous substances to a depth of 10 ft bgs; grouting the remaining portions of the prototype and its hull basin; and constructing a floor over the remainder of the prototype. Alternative 4, Complete Prototype Removal, considered removing the entire prototype, along with its hazardous substances, followed by backfilling the hull basin and constructing a floor over the area.

Risk assessments showed that Alternative 1 would not meet RAOs for human health or the environment, while Alternatives 3 and 4 could achieve risk-based cleanup objectives.

6. ALTERNATIVE ANALYSIS

This section evaluates the four alternatives with respect to the CERCLA NTCRA evaluation criteria established in EPA's *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (EPA 1993). To be viable, an alternative must meet the minimum threshold criterion of being protective of human health and the environment. Because Alternative 1, No Action, and Alternative 2, Continued Surveillance and Maintenance, are hypothetical alternatives that do not meet the protectiveness criterion, they are not analyzed further. The following subsections evaluate the two viable end-state alternatives for the S5G Prototype Facility: Alternative 3, In Situ Decommissioning, and Alternative 4, Complete Prototype Removal.

6.1 Evaluation Criteria

Alternatives are evaluated against short- and long-term aspects of three broad criteria: effectiveness, implementability, and cost. Table 6-1 lists criteria and associated subcriteria for S5G Prototype Facility analysis and comparison. For clarity, headings and tables in subsections below repeat the outline numbers used in Table 6-1.

Table 6-1. Summary of evaluation criteria and associated subcriteria for comparative analysis of S5G alternatives.

CERCLA Evaluation Criteria and Subcriteria
1. Effectiveness evaluated as a combination of A. Protectiveness and B. Ability to meet RAOs.
A. Protectiveness
i. Protective of human health and community
ii. Protective of workers during implementation
iii. Protective of the environment
iv. Complies with ARARs
B. Ability to meet RAOs
2. Implementability is evaluated by evaluating A. Technical feasibility; B. Availability of equipment, personnel, services, and disposal facilities; and C. Administrative feasibility.
A. Technical feasibility
B. Availability of equipment, personnel, services, and disposal facilities
C. Administrative feasibility
3. Cost
ARAR applicable or relevant and appropriate requirement CERCLA Comprehensive Environmental Response, Compensation, and Liability Act RAO removal action objective

6.1.1 1. Effectiveness

Per guidance (EPA 1993, page 35), "The effectiveness of an alternative refers to its ability to meet the objective within the scope of the removal action. This section of the EE/CA should evaluate each alternative against the scope of the removal action and against each specific objective for final disposition of the wastes and the level of cleanup desired. These objectives should be discussed in terms of protectiveness of public health and the environment." Major subheadings are A. Protectiveness, and B. Ability to achieve RAOs. This analysis considers the following factors as aspects of protectiveness and ability to achieve RAOs:

- *1.A Protectiveness*—Describes how well each alternative provides overall protection of public health and the environment, drawing on analysis of the following:
    - *Protective of human health and community*—Evaluates short-term and long-term protection of public health and the community, considering impacts during implementation, permanence of the removal action, magnitude of residual risk, extent and effectiveness of controls to manage residual risk, and the expected adequacy and reliability of site control.
    - *Protective of workers during implementation*—Addresses potential risks to workers and ways to mitigate those risks.
    - *Protective of the environment*—Addresses potential impacts on the environment during implementation and after the removal action is complete.
    - *Complies with ARARs*—Summarizes which ARARs are "applicable" or "relevant and appropriate" and describes how each alternative meets requirements. Additional advisories, criteria, or guidance to be considered that complement the ARARs also are evaluated.
- *1.B Ability to achieve RAOs*—Assesses potential for satisfying project-specific goals to protect human health and the environment.

6.1.2 2. Implementability

Per guidance (EPA 1993, page 40), "The implementability criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation." The following factors are considered under this criterion:

- *2.A Technical feasibility*—Addresses the reliability and potential technical problems associated with the technology based on its maturity, prior use, and need for a specialized staff
- *2.B Availability of equipment, personnel, services, and disposal facilities*—Determines if sufficient treatment, storage, and disposal capacity is available and considers whether equipment, personnel, services, materials, and other resources necessary to implement an alternative will be available
- *2.C Administrative feasibility*—Evaluates aspects that require off-site permits, need right-of-way agreements, or involve concerns of other regulatory agencies (e.g., U.S. Department of Transportation).

In addition, guidance suggests assessing state (support agency) and community acceptance. For the S5G NTCRA, these aspects will be evaluated during reviews of the draft EE/CA by EPA and DEQ and by soliciting input on the EE/CA and its recommended alternative from other stakeholders (e.g., Shoshone-Bannock Tribes, ICP Citizens Advisory Board, and the community at large).

6.1.3 3. Cost

Per guidance (EPA 1993, page 43), "Each removal action alternative should be evaluated to determine its projected costs." Cost estimates for the S5G Prototype Facility include the following:

- Direct capital costs
- Indirect capital costs
- Post-removal action site control costs.

Recycling is cost-neutral. That is, costs to recycle are comparable to disposal costs; therefore, potential recycling is not specifically addressed in cost estimates. Nonetheless, recycling is desirable, and S5G is expected to generate recyclable materials. Current D&D activities at the S1W and A1W prototypes have generated a significant amount of recyclable material.

6.2 Evaluation of Alternative 3, In Situ Decommissioning

Subsections below summarize the anticipated performance of Alternative 3 against the CERCLA criteria of effectiveness, implementability, and cost.

6.2.1 Effectiveness of Alternative 3

Alternative 3, In Situ Decommissioning, would provide overall protectiveness and would meet RAOs. Risk assessments for the S5G NTCRA conclude that Alternative 3 would provide long-term protection of human health (EDF-11335; EDF-11418) and the environment (EDF-11332). Sources of risk to a depth of 10 ft bgs are significantly reduced by removal. The lower interval would be treated with in situ grouting to stabilize the site, minimize voids, and immobilize residual hazardous substances. An engineered floor over the site would provide further isolation. Because contamination would remain, long-term management and controls likely would be required to ensure the remedy remains protective in the future.

During implementation of Alternative 3, members of the public using public roads between the INL Site and a disposal facility off the INL Site would be subject to minimal risks from radiation exposure, vehicle emissions, and accidents along waste shipment routes. Because public access to the INL Site is restricted, exposure to the public from onsite shipments would be very limited. Alternative 3 would involve transporting almost 1 million kg (1,100 tons) of waste from NRF, with about 14 shipments to a facility outside of the INL Site (e.g., EnergySolutions in Utah, a round trip of 600 mi for each shipment) and about 260 shipments to a disposal facility within the INL Site (e.g., ICDF and ICDWL, a round trip of 12 mi for each shipment) (Figures 6-1 and 6-2). Transport drivers would incur associated risks (e.g., radiation exposure, vehicle emissions, and accidents). Other sources of public risk from D&D are negligible because of the remote location of NRF and general access restrictions within the INL Site.

Workers would experience risks common to D&D operations within the INL Site, with potential exposures to radionuclides, chemicals, and mechanical injuries. Removal will entail working in cramped, sometimes elevated conditions (as much as 20-ft free fall). While DOE's control of operations and use of ALARA principles for protection from radiation exposure will ensure that workers are protected during implementation, radiation exposure cannot be eliminated completely, particularly during work conducted within the reactor compartment and during cutting of grout ports and vents in radioactive systems. Engineered protections (e.g., fixatives, temporary shielding, and fall harnesses), ICP work control processes (e.g., safety analysis and radiological work permit), and personal protective equipment (e.g., gloves and respirators) would be applied to further reduce risks to workers and to meet DOE limits.

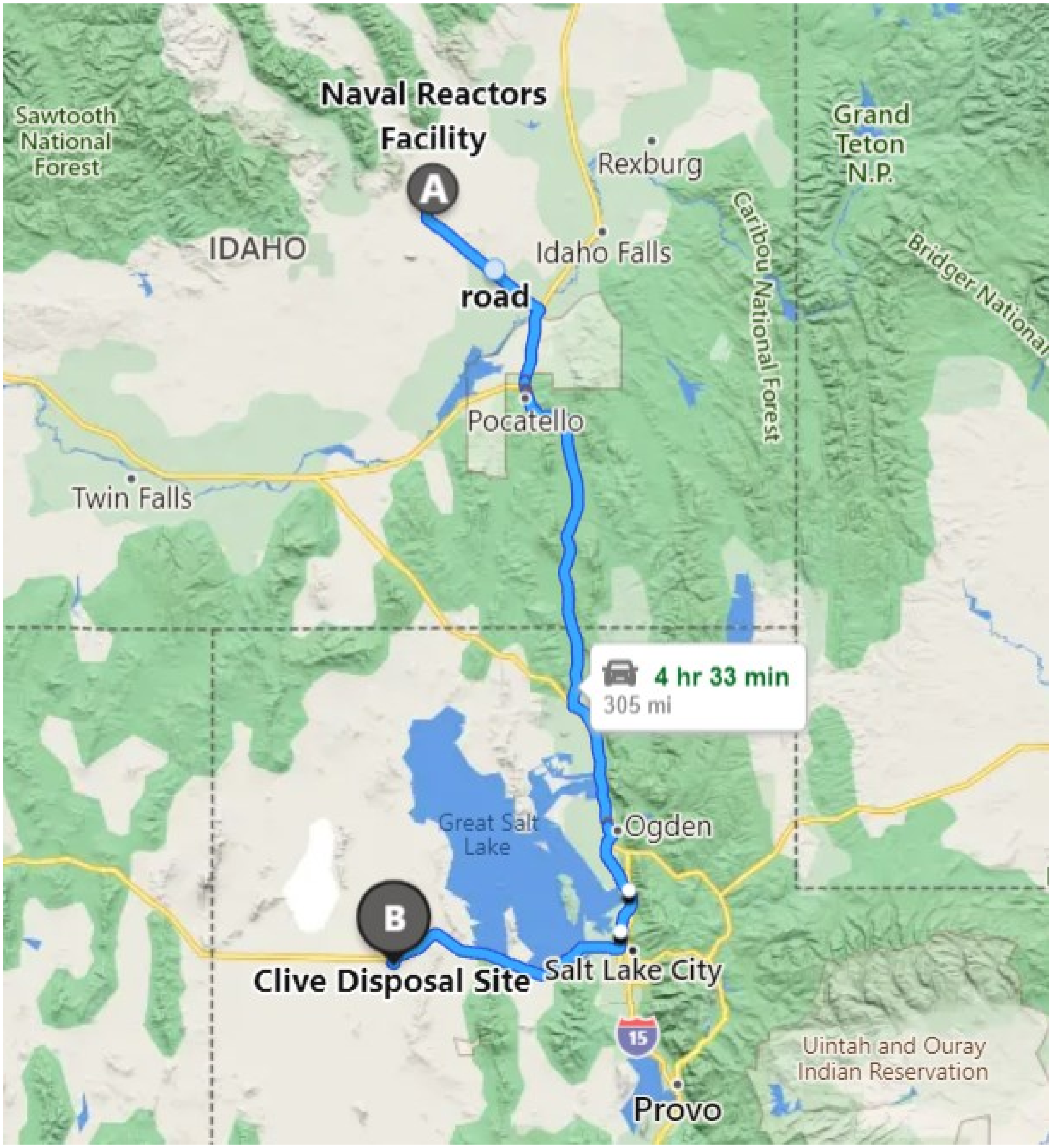

Figure 6-1. Waste transportation route from the Naval Reactors Facility to the EnergySolutions Clive facility, used as an example facility for disposal of Resource Conservation and Recovery Act hazardous waste outside of the Idaho National Laboratory Site.

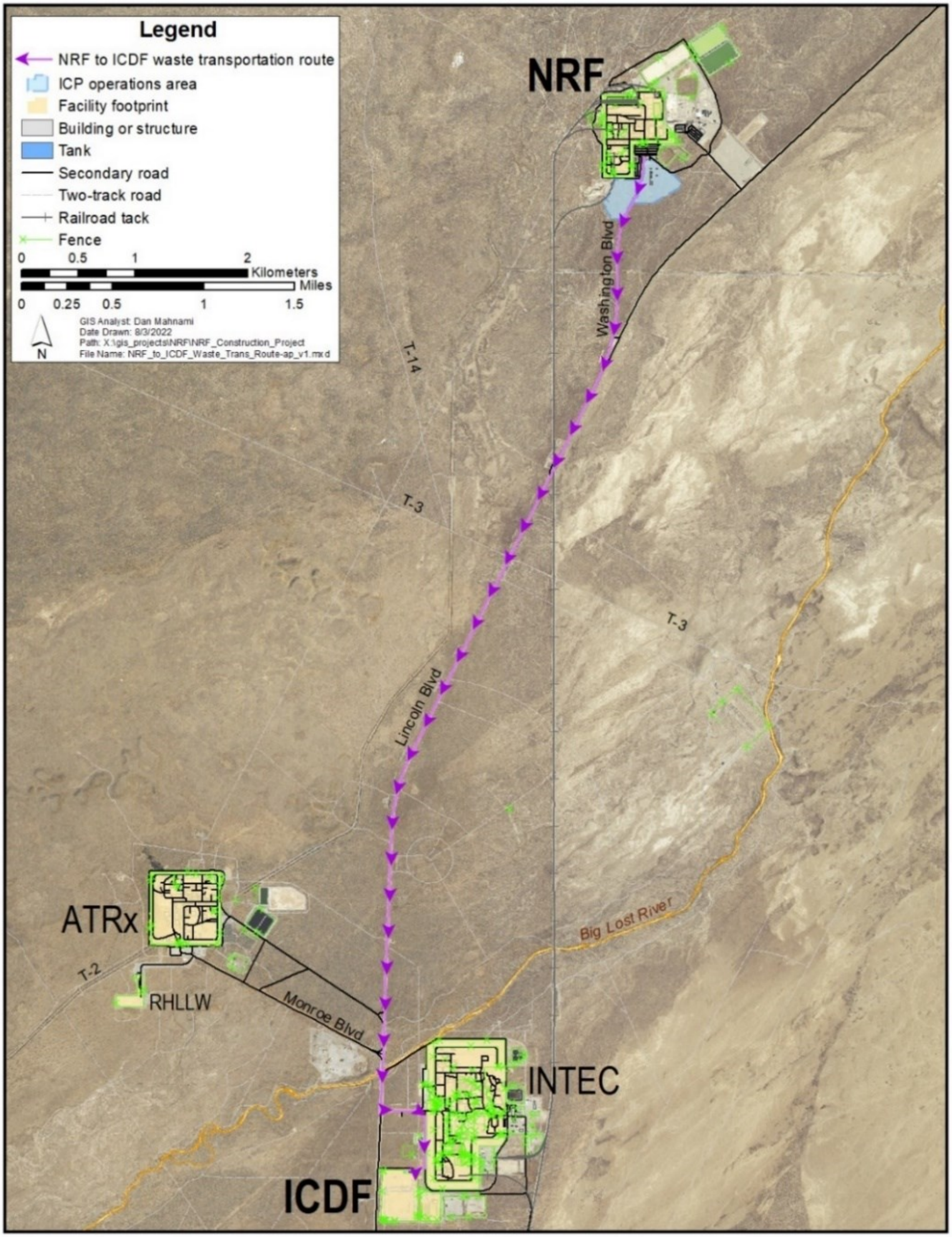

Figure 6-2. Waste transportation route from the Naval Reactors Facility to the Idaho CERCLA Disposal Facility or INTEC CERCLA Demolition Waste Landfill.

6.2.2 Implementability of Alternative 3

All aspects of the described strategy for in situ D&D are technically mature and implementable. Potential technical complications can be managed through engineering analysis, careful planning, and skilled execution. D&D personnel who have extensive experience working with materials that are contaminated with radionuclides and other hazardous substances are available. Routine D&D techniques using standard industrial machinery (e.g., cranes, cement mixers, excavators, loaders, and trucks equipped with roll-on/roll-off shipping containers) would be applied. Equipment, personnel, services, and disposal capacity necessary to complete Alternative 3 are expected to be readily available. Administrative concerns, such as coordination between entities and the potential need for long-term controls, are not significant barriers, as demonstrated by the ongoing cooperation between DOE programs and the successes at the INL Site in managing long-term stewardship functions.

6.2.3 Cost of Alternative 3

The estimated cost for Alternative 3 is $73.5M, as determined with input from subcontractors, ICDF personnel, subject-matter experts, and previous D&D projects. Costs shown in Table 6-2 include the following:

- Disposal costs for RCRA hazardous waste and other hazardous substances removed during demolition activities, including $99K for disposal of an estimated 24 m^3 or 273,600 kg (302 tons) of lead at an approved facility such as EnergySolutions in Utah, $18K for disposal of low-level waste at ICDF, and $271K for disposal of demolition debris at ICDWL
- Delivery and pumping of 23,000 yd^3 of grout to fill remaining prototype sections, portions of the basin, cells, and other subgrade areas
- Labor, infrastructure, and support costs
- Design and installation of an engineered floor for future building use
- CERCLA institutional control inspection and maintenance costs until 2095.

Table 6-2. Estimated costs for Alternative 3, In Situ Decommissioning.

Alternative 3 Cost Summary	
Category	Cost[a]
Waste disposal	$388,000
Grouting (hull basin and cells)	$13,900,000
Labor, infrastructure, and support costs	$40,200,000
Miscellaneous costs (engineering and constructing a warehouse floor over the remaining prototype, CERCLA record-keeping)	$2,030,000
Subtotal	$56,500,000
30% adder	$17,000,000
Total[b]	$73,500,000

a. Rounding may introduce slight discrepancies.

b. A 30% adder to the total cost accounts for items and activities that are not specified in this estimate.

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6.3 Alternative 4, Complete Prototype Removal

Subsections below summarize the anticipated performance of Alternative 4 against CERCLA criteria of effectiveness, implementability, and cost.

6.3.1 Effectiveness of Alternative 4

Alternative 4, Complete Prototype Removal, would provide overall protectiveness and would meet RAOs. Risk assessments for the S5G NTCRA conclude that Alternative 4 would provide long-term protection of human health (EDF-11335; EDF-11418) and the environment (EDF-11332). Sources of risk would be removed. Because significant contamination from hazardous substances would not remain, long-term management and controls likely would not be required to ensure the remedy remains protective in the future; however, institutional controls would be developed for any risk-based residual contamination that remained.

During implementation of Alternative 4, members of the public using public roads between the INL Site and a disposal facility off the INL Site would be subject to minimal risks from radiation exposure, vehicle emissions, and accidents along waste shipment routes. Because public access to the INL Site is restricted, exposure from onsite shipments would be very limited. Alternative 4 would involve transporting more than 5.5 million kg (6,100 tons) of waste from NRF, with about 26 shipments to a facility outside of the INL Site (e.g., EnergySolutions in Utah, a round trip of 600 mi for each shipment) and more than 1,800 shipments to an approved disposal facility within the INL Site (e.g., ICDF and ICDWL, a round trip of 12 mi for each shipment). Transport drivers would incur associated risks (e.g., radiation exposure, vehicle emissions, and accidents). Other sources of public risk from D&D are negligible because of the remote location of NRF and general access restrictions within the INL Site.

Workers would experience risks common to D&D operations within the INL Site, with potential exposures to radionuclides, other hazardous substances, and mechanical injuries. The top-down approach is expected to minimize working in cramped conditions and reduce fall risks. While DOE's control of operations and use of ALARA principles for protection from radiation exposure will ensure that workers are protected during implementation, radiation exposure cannot be eliminated completely, particularly during work to prepare the reactor vessel and ancillary equipment and to lift the intact vessel from the basin. Engineered protections (e.g., fixatives and temporary shielding), ICP work control processes (e.g., safety analysis and radiological work permit), and personal protective equipment (e.g., gloves and respirators) would be applied to further reduce risks to workers and meet DOE exposure limits.

6.3.2 Implementability of Alternative 4

All aspects of the described strategy for D&D are technically mature and implementable, though preparing and lifting the reactor vessel pose foreseeable technical challenges. Experience gained at the S1W and A1W prototypes will facilitate engineering analysis, careful planning, and safe execution. D&D personnel who have extensive experience working with materials that are contaminated with radionuclides and other hazardous substances are available. Routine D&D techniques using standard industrial machinery (e.g., cranes, cement mixers, excavators, loaders, and trucks equipped with roll-on/roll-off shipping containers) would be applied. Equipment, personnel, services, and disposal capacity necessary to complete Alternative 4 are expected to be readily available. Administrative concerns, such as coordination between entities, are not significant barriers, as demonstrated by the ongoing cooperation between DOE programs.

6.3.3 Cost of Alternative 4

The estimated cost for Alternative 4 is $70.1M, as determined with input from subcontractors, ICDF personnel, subject-matter experts, and previous D&D projects. Costs shown in Table 6-3 include the following:

- Complete removal and disposal of the S5G Prototype Facility
- Disposal costs for RCRA hazardous waste and other hazardous substances removed during demolition activities, including $181K for disposal of an estimated 44 m^3 or 498,000 kg (550 tons) of lead at an approved facility such as EnergySolutions in Utah, $58K for disposal of low-level waste at ICDF, and $482K for disposal of demolition debris at ICDWL
- Delivery and pumping of 5,600 yd^3 of grout to fill the subsurface cells
- Delivery and compaction of an estimated 17,600 yd^3 of clean fill to fill the basin
- Labor, infrastructure, and support costs
- Design and installation of an engineered floor for future building use.

Table 6-3. Estimated costs for Alternative 4, Complete Prototype Removal.

Alternative 4 Cost Summary	
Category	Cost[a]
Waste disposal	$721,000
Grouting (subgrade cells)	$3,340,000
Labor, infrastructure, and support costs	$49,000,000
Miscellaneous costs (backfilling hull basin, constructing a warehouse floor over the backfilled basin, CERCLA record-keeping)	$883,000
Subtotal	$53,900,000
30% adder	$16,200,000
Total[b]	$70,100,000

a. Rounding may introduce slight discrepancies.

b. A 30% adder to the total cost accounts for items and activities that are not specified in this estimate.

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6.4 Comparative Analysis

Preceding sections describe and assess alternatives independently, demonstrating that that both Alternatives 3 and 4 are viable options for D&D of NRF-633P. The comparative analysis that follows evaluates the relative performance of alternatives in relation to each of the criteria by contrasting advantages and disadvantages to highlight key tradeoffs that influence remedy selection. Tables 6-4 and 6-5 provide abbreviated and expanded comparisons of Alternative 3 to Alternative 4. The two alternatives have nearly equivalent cost estimates (Table 6-6). Cost is not a likely discriminator between alternatives for the S5G Prototype.

Table 6-4. Summary evaluation of removal action alternatives.

CERCLA Evaluation Criteria	Alternative 3, In Situ Decommissioning	Alternative 4, Complete Prototype Removal
1. Effectiveness		
A. Protectiveness		
i. Protective of human health and community	Yes	Yes
ii. Protective of workers during implementation	Yes	Yes
iii. Protective of the environment	Yes	Yes
iv. Complies with ARARs	Yes	Yes
B. Ability to meet RAOs	Yes	Yes
2. Implementability		
A. Technical feasibility	Yes	Yes
B. Availability of equipment, personnel, services, and disposal facilities	Yes	Yes
C. Administrative Feasibility	Yes	Yes
3. Cost	Yes	Yes

ARAR applicable or relevant and appropriate requirement
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
RAO removal action objective

Table 6-5. Expanded comparative analysis of alternatives for NRF-633P, the S5G Prototype Facility.

CERCLA Evaluation Criteria	Alternative 3, In Situ Decommissioning	Alternative 4, Complete Prototype Removal
1. Effectiveness is evaluated as a combination of protectiveness and ability to achieve RAOs.		
1A. Protectiveness is evaluated by considering protectiveness of human health and the community, protectiveness of workers during implementation, protectiveness of the environment, and compliance with ARARs.		
1Ai. Protective of human health and the community	Yes. Alternative 3 would permanently remove all RCRA hazardous waste plus radionuclides and other hazardous substances to a depth of 10 ft below ground surface. The reactor vessel and other contaminated media below 10 ft would be left in place, stabilized with grout, and covered with an engineered floor, precluding incidental access to contaminated media. Long-term management (e.g., ICs and O&M) likely would be required to ensure long-term protectiveness. In the short term, roughly 1 million kg (1,100 tons) of materials would be removed, loaded for disposal, and transported over public roads. Approximately 14 loads would be shipped for disposal outside of the INL Site (see Figure 6-1), and more than 260 loads would be transported to disposal facilities at INTEC (i.e., ICDF or ICDWL) (see Figure 6-2). DOE and DOT requirements would be met to ensure transportation is protective of human health and the environment. Truck drivers and members of the community using public roads would be subject to minimal risks from radiation exposure, vehicle emissions, and accidents along waste shipment routes.	Yes. Alternative 4 permanently removes nearly all radionuclides and other hazardous substances, including the reactor vessel, leaving only trace quantities of these substances behind in concentrations that would not pose risks to human health. In the short term, roughly 5.5 million kg (6,100 tons) of materials would be removed, loaded for disposal, and transported over public roads. Approximately 26 loads would be shipped for disposal outside of the INL Site (e.g., to Utah), and more than 1,800 loads would be transported to disposal facilities at INTEC (i.e., ICDF or ICDWL). DOE and DOT requirements would be met to ensure transportation is protective of human health and the environment. Truck drivers and members of the community using public roads would be subject to minimal risks from radiation exposure, vehicle emissions, and accidents along waste shipment routes.

Table 6-5. (continued).

CERCLA Evaluation Criteria	Alternative 3, In Situ Decommissioning	Alternative 4, Complete Prototype Removal
1Aii. Protective of workers during implementation	Yes. Workers would experience risks common to D&D operations at the INL Site, with potential exposures to radiation, other hazardous substances, and mechanical injuries. DOE control of operations and use of ALARA principles would ensure workers are protected during implementation. Comparatively, operations personnel would experience risks for a shorter duration (e.g., ~64 weeks) and would handle far less material (i.e., less than 1 million kg [1,100 tons]) but would incur increased hazards associated with potential exposures, confined spaces, fall risks, and manual D&D techniques (e.g., less use of the overhead crane and heavy equipment). Workers would shift, remove, or work around obstacles to segregate and extract RCRA hazardous waste from throughout the prototype and other hazardous substances from the surface zone.	Yes. Workers would experience risks common to D&D operations at the INL Site, with potential exposures to radiation, other hazardous substances, and mechanical injuries. DOE control of operations and use of ALARA principles would ensure workers are protected during implementation. Comparatively, operations personnel would experience risks for a longer duration (e.g., ~78 weeks) and would handle substantially more material (i.e., ~5.5 million kg [6,100 tons]), but the top-down D&D approach would reduce risks associated with potential exposures by early removal of radioactive systems and by minimizing work in cramped conditions. Much of the work would involve use of the overhead crane and heavy equipment with less need for manual techniques. Most of the materials could be removed as bulk waste that would qualify as either low-level waste or demolition debris. Workers would not have to segregate as much waste as in Alternative 3.
1Aiii. Protective of the environment	Yes. Alternative 3 would permanently remove all RCRA hazardous waste plus radionuclides and other hazardous substances to a depth of 10 ft below ground surface. The reactor vessel and other contaminated media below 10 ft would be left in place, and the entire prototype and its basin would be stabilized with grout and covered with an engineered floor, precluding intrusion by plants and animals.	Yes. Alternative 4 would permanently remove nearly all hazardous and radioactive materials from the prototype, including the reactor vessel. Only trace quantities of contaminants would be left behind in concentrations that would not pose risks to the environment (e.g., PCBs in paint on remaining structural components).

Table 6-5. (continued).

CERCLA Evaluation Criteria	Alternative 3, In Situ Decommissioning	Alternative 4, Complete Prototype Removal
1Aiv. Complies with ARARs	Yes. Both alternatives would comply with ARARs. Ability to meet ARARs is not a likely discriminator between alternatives for the S5G Prototype.	
1B. Ability to achieve RAOs	Yes. Targeted removal of RCRA hazardous waste followed by grouting to immobilize and isolate residual contamination and fill voids would achieve RAOs. Long-term ICs would ensure continued isolation of contaminated media through site maintenance and access controls.	Yes. Removal of the complete prototype is a permanent solution that would not leave appreciable contamination behind. Long-term ICs would provide required site tracking but would not be necessary to preclude potential exposures.
2. Implementability is evaluated by assessing technical feasibility; availability of equipment, personnel, services, and disposal facility; and administrative feasibility.		
2A. Technical feasibility	Yes. All aspects of Alternative 3 are technically mature and implementable. Potential technical complications (e.g., access constraints, venting, and filling voids) can be managed through engineering analysis, careful planning, and skilled execution. The most significant technical challenges for Alternative 3 involve grouting (e.g., accessing and venting voids to ensure adequate treatment) and construction of the floor.	Yes. All aspects of Alternative 4 are technically mature and implementable. The top-down approach for dismantling the prototype simplifies the entire process. Once the RCRA hazardous waste is removed, the rest of the prototype can be disassembled. Removal of the entire prototype would greatly reduce the complexity to engineer and construct a load-bearing floor by eliminating difficult-to-access void spaces. The most significant challenges for Alternative 4 are removing the reactor vessel and the lead-bearing hull sections. Experience gained at S1W and A1W prototypes will facilitate engineering analysis, careful planning, and safe execution.
2B. Availability of equipment, personnel, services, and disposal facility	Yes. Ability to meet this criterion is not a likely discriminator between alternatives for the S5G Prototype. Equipment, personnel, services, and disposal capacity are expected to be readily available. Notably, a trained D&D work force with extensive experience on similar projects is available, and the INL Site has CERCLA disposal facilities with available capacity for S5G low-level waste and demolition debris.	

Table 6-5. (continued).

CERCLA Evaluation Criteria	Alternative 3, In Situ Decommissioning	Alternative 4, Complete Prototype Removal
2C. Administrative feasibility	Yes. Administrative concerns, such as coordination between entities and the potential need for long-term controls, are not significant, as demonstrated by the ongoing cooperation between DOE programs and the successes at the INL Site in managing long-term stewardship functions (e.g., institutional controls).	Yes. Administrative concerns, such as coordination between entities, are not significant, as demonstrated by the ongoing cooperation between DOE programs. Long-term stewardship likely will not be unnecessary under Alternative 4.
3. Cost	The two alternatives have nearly equivalent cost estimates (Table 6-6). Cost is not a likely discriminator between alternatives for the S5G Prototype.	
	$73, 500,000	**$70,100,000**

A1W	Aircraft Carrier 1st Generation Westinghouse	ICDWL	INTEC CERCLA Demolition Waste Landfill
ALARA	as low as reasonably achievable	INL	Idaho National Laboratory
ARAR	applicable or relevant and appropriate requirement	INTEC	Idaho Nuclear Technology and Engineering Center
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	O&M	operations and maintenance
D&D	decommissioning and decontamination	PCB	polychlorinated biphenyl
DOE	U.S. Department of Energy	RAO	removal action objective
DOT	U.S. Department of Transportation	RCRA	Resource Conservation and Recovery Act
IC	institutional control	S1W	Submarine 1st Generation Westinghouse
ICDF	Idaho CERCLA Disposal Facility	S5G	Submarine 5th Generation General Electric

Table 6-6. Summary of estimated costs for Alternatives 3 and 4.

Category	Alternative 3: In Situ Decommissioning[a]	Alternative 4: Complete Prototype Removal[a]
Waste disposal[b] (EnergySolutions included as offsite example)	$388,000 (~$99K)	$721,000 (~$181,000)
Grouting and backfilling	$13,900,000	$3,340,000
Labor, infrastructure, and support costs	$40,200,000	$49,000,000
Miscellaneous costs[c]	$2,030,000	$882,000
Subtotal	$56,500,000	$53,900,000
30% adder	$17,000,000	$16,200,000
Total[d]	$73,500,000	$70,100,000

a. Rounding may introduce slight discrepancies.

b. Recycling is cost-neutral. That is, costs to recycle are comparable to disposal costs; therefore, potential recycling is not specifically addressed in cost estimates.

c. Miscellaneous costs are mostly associated with filling the basin and constructing a warehouse floor over the hull basin. Alternative 3 is substantially more complicated because it involves grouting and backfilling in and around remaining portions of the prototype, with complex engineering to design and construct the warehouse floor. Conversely, Alternative 4 includes simpler backfilling and compacting soil in the emptied hull basin followed by constructing a floor.

d. A 30% adder to the total cost accounts for items and activities that are not specified in this estimate.

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6.5 Conclusion of Alternative Evaluation

Both Alternatives 3 and 4 are expected to be effective and implementable, and they have similar costs. Significant advantages of Alternative 3 include shorter duration and less transport of waste over public roads. Alternative 4 reduces occupational hazards, offers more potential for recycling, and is a complete and permanent solution that is consistent with DOE objectives.

7. RECOMMENDED REMOVAL ACTION ALTERNATIVE

DOE recommends implementing Alternative 4, Complete Prototype Removal, for NRF-633P, the S5G Prototype Facility. Subsections below present ARARs to which the removal action must conform, discuss the basis for DOE's recommendation, and ensure that the NTCRA is not expected to impact future remedial actions at NRF.

7.1 Compliance with Environmental Regulations

CERCLA (42 USC 9621) requires the responsible CERCLA implementing agency (i.e., DOE-ID) to incorporate substantive requirements of the Hazardous Waste Management Act (HWMA; State of Idaho 1983)/RCRA and other applicable laws into the federal agency's design and operation of removal actions to the extent that they are ARARs. In accordance with Executive Order 12580, "Superfund Implementation," and the 1995 joint DOE and EPA *Policy on Decommissioning of Department of Energy Facilities Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)* (DOE and EPA 1995)*,* DOE-ID is the implementing agency for this NTCRA for decommissioning the S5G Prototype Facility. DEQ and EPA concur that an NTCRA is warranted to protect human health and the environment. Through the NTCRA process, risks presented in this EE/CA will be mitigated in a timely and responsible manner. Table 7-1 lists ARARs proposed for this removal action. Subsections that follow expand on approaches to compliance with specific ARARs.

7.1.1 Hazardous Substances and Hazardous Waste

CERCLA NTCRAs for decommissioning projects are required to meet ARARs and risk-based RAOs. ARARs and RAOs often necessitate removal of specific substances to comply with those requirements.

With respect to ARARs, RCRA hazardous waste regulations typically are the most significant in that these regulations drive the removal of all materials meeting the definition of "RCRA hazardous waste" from the facility being decommissioned. On the other hand, RAOs establish risk-based standards that must be met for the decommissioned facility. Risk assessment documents that are prepared in support of the EE/CA evaluate the presence (and the resultant risk) of "CERCLA hazardous substances" that could remain for each alternative in the EE/CA for specific future risk scenarios, as specified in DOE-ID agreements with EPA and DEQ. To meet RAOs, the mass of specific "CERCLA hazardous substances" could be limited based on the depth of that material from the surface. Any "CERCLA hazardous substances" exceeding that criterion must be mitigated to meet RAOs for an alternative to meet the "protectiveness" minimum threshold criterion and be viable for selection in the S5G action memorandum.

Table 7-1. Summary of proposed applicable or relevant and appropriate requirements for the S5G Prototype Facility non-time-critical removal action.

Requirement (Citation)	ARAR Type	Comments
Clean Air Act and Idaho Air Regulations		
"Toxic Substances," IDAPA 58.01.01.161 "Toxic Air Pollutants Non-Carcinogenic Increments," IDAPA 58.01.01.585 "Toxic Air Pollutants Carcinogenic Increments," IDAPA 58.01.01.586 "Environmental Remediation Source," IDAPA 58.01.01.210.16(a)	Applicable requirement	Applies to any toxic substances emitting during implementation of the removal action.
<10 mrem/yr, "Standard," 40 CFR 61.92	Applicable requirement	Applies to the waste-handling activities.
"Emission monitoring and test procedures," 40 CFR 61.93	Applicable requirement	Applies to the waste-handling activities.
"Compliance and reporting," 40 CFR 61.94(a)	Applicable requirement	Applies to the waste-handling activities.
"Standard for demolition and renovation," 40 CFR 61.145	Applicable requirement	Applies to any asbestos-containing materials removed during the decommissioning.
"Rules for Control of Fugitive Dust" and "General Rules," IDAPA 58.01.01.650 and IDAPA 58.01.01.651	Applicable requirement	Applies to the waste-handling activities.
Endangered Species Act		
"Endangered Species Act," 16 USC 1531-1543	Applicable requirement	Applies if listed species are determined to range at the location of the removal actions.
Idaho Solid Waste Facilities Act		
"Applicable Requirements for Tier II Facilities," IDAPA 58.01.06.012	Relevant and appropriate requirement	Applies to disposal of solid wastes for operations at ICDWL.

Table 7-1. (continued).

Requirement (Citation)	ARAR Type	Comments
RCRA and Idaho Hazardous Waste Management Act		
Generator Standards:		
"Standards Applicable to Generators of Hazardous Waste," IDAPA 58.01.05.006, and the following, as cited in it:		
"Hazardous Waste Determination," 40 CFR 262.11	Applicable requirement	Applies to waste that would be generated during the removal action.
General Facility Standards:		
"Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities," IDAPA 58.01.05.008, and the following, as cited in it:		
"Temporary Units (TU)," 40 CFR 264.553	Applicable requirement	Hazardous remediation waste may be treated or temporarily stored in a temporary unit prior to disposal.
"Staging piles," 40 CFR 264.554	Applicable requirement	Waste may be temporarily staged prior to disposal.
"General inspection requirements," 40 CFR 264.15	Applicable requirement	Applies to a facility staging, storing, or treating hazardous waste prior to transfer to the ICDF or an offsite facility.
"Preparedness and Prevention," 40 CFR 264, Subpart C	Applicable requirement	Applies to a facility staging, storing, or treating hazardous waste prior to transfer to the ICDF or an offsite facility.
"Contingency Plan and Emergency Procedures," 40 CFR 264, Subpart D	Applicable requirement	Applies to a facility staging, storing, or treating hazardous waste prior to transfer to the ICDF or an offsite facility.
"Disposal or decontamination of equipment, structures and soils," 40 CFR 264.114	Applicable requirement	Applies to contaminated equipment used to remove, treat, or transport hazardous waste.
Use and management of containers, 40 CFR 264.171-178	Applicable requirement	Applies to containers used during the removal and treatment of hazardous waste.
Land Disposal Restrictions:		
"Land Disposal Restrictions," IDAPA 58.01.05.011, and the following, as cited in it:		
"Applicability of treatment standards," 40 CFR 268.40(a)(b)(c)	Applicable requirement	Applies to hazardous waste and secondary waste if treatment is necessary to meet the disposal facility's WAC or if treatment is required before placement.

Table 7-1. (continued).

Requirement (Citation)	ARAR Type	Comments
"Treatment Standards for Hazardous Debris," 40 CFR 268.45	Applicable requirement	Applies to hazardous debris if treatment is necessary to meet the disposal facility's WAC or if treatment is required before placement.
"Universal Treatment Standards," 40 CFR 268.48(a)	Applicable requirement	Applies to nondebris hazardous waste and secondary waste if treatment is necessary to meet the disposal facility's WAC or if treatment is required before placement.
"Standards for Universal Waste Management," IDAPA 58.01.05.016 and the following, as cited in it:		
"Standards for Large Quantity Handlers of Universal Waste," 40 CFR 273, Subpart C	Applicable requirement	Applies to management of universal wastes.
Idaho Groundwater Quality Rules		
"Ground Water Quality Rule," IDAPA 58.01.11	Applicable requirement	The waste-handling activities must prevent migration of contaminants from the S5G Prototype Facility that would cause the SRPA groundwater to exceed applicable State of Idaho groundwater quality standards in 2095 and beyond.
Toxic Substances Control Act		
"Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," 40 CFR 761 "Applicability," 40 CFR 761.50 "PCB waste," 40 CFR 761.50(b)(1), (2), (3), (4), and (7) "Storage for disposal," 40 CFR 761.50(c) and 761.65 "PCB Articles," 40 CFR 761.60(b) "PCB Containers," 40 CFR 761.60(c) "PCB remediation waste," 40 CFR 761.61 "Disposal of PCB bulk product waste," 40 CFR 761.62 "Decontamination standards and procedures," 40 CFR 761.79	Applicable requirement	Applicable to removal, decontamination, storage, and disposal of waste generated from removal action (including equipment) with PCB contamination.
"PCB/Radioactive waste," 40 CFR 761.50(b)(7)(ii)	Relevant and appropriate requirement	Relevant and appropriate for in situ disposition of subgrade structural material (e.g., concrete and steel) with PCB-containing paints upon demonstration of compliance for those subgrade structures with RAOs and cleanup levels.

Table 7-1. (continued).

Requirement (Citation)	ARAR Type	Comments
Migratory Bird Treaty Act of 1918		
"Protection of Migratory Game and Insectivorous Birds," 16 USC 703-712	Applicable requirement	Applies to disturbances of nesting migratory birds.
National Historic Preservation Act of 1966		
"National Historic Preservation Act of 1966," 16 USC 470 et seq.	Applicable requirement	Applicable to buildings of potential historical significance.
To-Be-Considered Orders, Policies, and Advisories		
"Radiation Protection of the Public and the Environment," DOE O 458.1 Chg 4	TBC	Applies to the S5G Prototype Facility after turnover from NNPP to DOE-ID until the completed facility is returned to NNPP. Substantive design and construction requirements would be met to keep public exposures as low as reasonably achievable.
"Occupational Radiation Protection Program," 10 CFR 835	TBC	Applies to the S5G Prototype Facility after turnover from NNPP to DOE-ID until the completed facility is returned to NNPP. Substantive design, construction, and operational requirements would be met to keep occupational radiation exposures as low as reasonably achievable.
"Radioactive Waste Management," DOE O 435.1 Chg 2	TBC	Applies to S5G Prototype Facility after turnover from NNPP to DOE-ID until the completed facility is returned to NNPP. Substantive design and construction requirements would be met to protect workers.
Region 10 Final Policy on the Use of Institutional Controls at Federal Facilities (EPA 2006)	TBC	Applies to residual radiological or other hazardous substances following completion of the removal action.

Table 7-1. (continued).

Requirement (Citation)	ARAR Type	Comments
"Lead Shielding for Radioactive Waste is a RCRA Solid Waste" (Kinch 1991)	TBC	EPA clarifies that lead is not a solid waste under RCRA when it is being used as shielding but recommends, as a best-management practice, that radioactive lead shielding should be treated to meet the RCRA land disposal restrictions treatment standard for radioactive lead solids in order to minimize the impact of this lead to man and the environment. For disposition on the INL Site, DOE-ID applies a best-management practice similar to that suggested by EPA.

ARAR	applicable or relevant and appropriate requirement	IDAPA	Idaho Administrative Procedures Act	S5G	Submarine 5th Generation General Electric
CFR	*Code of Federal Regulations*	NNPP	Naval Nuclear Propulsion Program	SRPA	Snake River Plain Aquifer
DOE-ID	U.S. Department of Energy Idaho Operations Office	PCB	polychlorinated biphenyl	TBC	to be considered
EPA	U.S. Environmental Protection Agency	RCRA	Resource Conservation and Recovery Act	USC	*United States Code*
ICDF	Idaho CERCLA Disposal Facility	RAO	removal action objective	WAC	waste acceptance criteria
ICDWL	INTEC CERCLA Demolition Waste Landfill				

7.1.1.1 CERCLA Hazardous Substances.

CERCLA hazardous substances are a much larger category of about 800 chemicals and 760 radionuclides. This list is derived by combining EPA's Clean Water Act (33 USC 1251) hazardous substances, Clean Water Act toxic pollutants, Clean Air Act (42 USC 7401 et seq.) hazardous air pollutants, and all RCRA hazardous waste. RCRA hazardous waste, by its very nature of meeting a specific criterion, such as failure of the Toxicity Characteristic Leaching Procedure test, must be removed. However, CERCLA hazardous substances are required to be removed only if they result in risk levels that exceed RAOs established for the project.

In the case of the S5G Prototype Facility, this is demonstrated by the need to remove copper-nickel piping that is within the surface interval (i.e., within 10 ft of the ground surface). Though the piping does not require removal as RCRA hazardous waste, it must be removed to meet RAO risk-based levels. Similarly, materials containing other hazardous substances that contribute to cumulative risk in excess of 1E-04 would be addressed.

7.1.1.2 RCRA Hazardous Waste.

With respect to decommissioning of the S5G Prototype Facility, all waste subject to RCRA hazardous waste regulations should be removed. The S5G Prototype Facility does not have any units with permits issued under HWMA/RCRA (State of Idaho 1983; 42 USC 6901 et seq.); however, D&D is expected to generate waste that would meet the definition of hazardous waste under HWMA/RCRA regulations. Waste generated from this NTCRA will be CERCLA waste. CERCLA waste that also meets the definition of HWMA/RCRA hazardous waste will be managed in accordance with the substantive requirements of HWMA/RCRA regulations. The INL Site does not have a HWMA/RCRA-permitted facility for disposal of HWMA/RCRA-regulated hazardous waste. Radiologically and nonradiologically contaminated hazardous waste will be shipped off the INL Site to a RCRA-permitted waste treatment and disposal facility authorized by EPA to accept CERCLA waste.

RCRA hazardous waste of known concern for this project currently is limited to characteristic waste (i.e., waste that exhibits a characteristic of ignitability, corrosivity, reactivity, or toxicity) (40 CFR 261, Subpart C). The most common material that will require removal will be items composed primarily of lead. Lead being used for its intended purpose as shielding is not categorized as a RCRA hazardous waste. Contaminated lead that is not being used as shielding will be removed as specified in the selected removal action and shipped off the INL Site for disposal at a RCRA-permitted disposal facility authorized by EPA to accept CERCLA waste. Noncontaminated lead will be recycled to the extent practicable.

The second most common waste anticipated for removal will be wastes containing alloys of lead, such as brass or bronze where lead is present in sufficient concentrations that the item would fail the Toxicity Characteristic Leaching Procedure test and be classified as D008. Other RCRA hazardous waste items could include mercury switches, lead acid batteries, lithium batteries, electronic components, and wastes containing or coated with mercury or cadmium. Nonradioactively contaminated materials will be recycled to the extent practicable to minimize generation of hazardous and other solid waste.

7.1.2 Lead Shielding for Disposition on the INL Site

Radioactive lead solids that continue to be used for their intended purpose as shielding are not a solid waste and, therefore, cannot be a hazardous waste. However, Richard Kinch, chief of EPA's Waste Treatment Branch in 1991 provided the following recommendation (Kinch 1991):

> While the lead shielding is not a solid waste, we recommend that it be macroencapsulated prior to disposal in or on the land to prevent the shielding from leaching. When this is done, the environment will be protected from radiation by the lead shielding, and from the leaching of lead by the macroencapsulation of the

entire waste package. Please note that this macroencapsulation is not required by the land disposal restrictions, but represents best management practice.

Consequently, for disposition on the INL Site, DOE applies a best-management practice similar to that suggested by EPA. When used in support of either in situ decommissioning of a radioactively contaminated facility or for disposition of radioactively contaminated waste at the ICDF, these materials are treated to meet the RCRA land disposal restrictions treatment standard for radioactive lead solids to minimize impacts on human health and the environment. Typically, grouting of lead shielding is the applied treatment.

7.1.3 Asbestos

Asbestos-containing wastes will be managed in accordance with 40 CFR 61.145, "Standard for demolition and renovation," and 40 CFR 61.150, "Standard for waste disposal for manufacturing, fabricating, demolition, renovation, and spraying operations."

7.1.4 Polychlorinated Biphenyls

PCBs will be managed in accordance with 40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions" and the substantive requirements of 40 CFR 761.62(c), "Risk-based disposal approval," for leaving subsurface structural materials in place when risk-based levels are met. PCB regulations [40 CFR 761.50(b)(7)] allow disposal of PCB/radioactive waste on the basis of its radioactive properties if the waste meets conditions established in 40 CFR 761.62(b)(1) for non-leachable PCB bulk product waste. 40 CFR 761.62(b)(1) specifically identifies the following PCB bulk product wastes that may be disposed of based solely on their radioactive properties:

- Plastics
- Preformed or molded rubber parts and components
- Applied dried paints, varnishes, waxes, or other similar coatings or sealants
- Caulking
- Galbestos
- Non-liquid building demolition debris
- Other PCB bulk product waste demonstrated to leach less than 10 μg/L of water.

PCB/radioactive waste meeting the definition of materials above, primarily applied dried paints and non-liquid building debris that are not easily removable in subgrade areas of Building NRF-633A, may be left in place upon demonstration of compliance with RAOs, ARARs, and cleanup levels as part of decommissioning. These materials along with residual radiological contamination will be left in the building prior to backfilling. The final removal action report will discuss the residual source term in these materials. If appropriate, a new CERCLA site will be identified as determined through the NSI process under OU 10-08 (DOE-ID 2009, 2010).

7.1.5 Cultural Resources

Section 106 of the National Historic Preservation Act (16 USC 470 et seq.) requires federal agencies to consider the potential effects of their undertakings on historic properties and consult on measures to avoid, minimize, and mitigate adverse effects on historic properties. Historic properties may include prehistoric or historic districts, sites, buildings, structures, or objects that are included, or eligible for, inclusion in the National Register of Historic Places. Section 106 also requires agencies to consult with any federally recognized Indian tribe that attaches religious or cultural significance to historic properties that may be affected by the undertaking.

In October 2021, after considering input from interested parties, NNPP and the Idaho State Historic Preservation Office finalized a programmatic agreement, in accordance with National Historic Preservation Act, to mitigate the loss of three NRF prototypes, including S5G. Mitigating actions include producing a documentary about NRF prototype operations by Idaho Public Television; collecting oral histories from individuals associated with NRF prototype operations for archiving in the Library of Congress Veterans History Project; installing roadside displays to provide information about the history of the prototypes; and providing artifacts such as pieces of the hull and valve handwheels to local museums for display.

As part of this effort, NNPP sent information on the project and invitations to participate in consultations to Bannock, Bonneville, Bingham, Butte, Clark, and Jefferson counties; the cities of Arco, Idaho Falls, and Pocatello; the American Nuclear Society, Idaho Section; DOE-ID; Navy Historic Foundation; DOE Federal Preservation Officer; DEQ; INL; Museum of Idaho; National Museum of Nuclear Science and History; Naval Order of the United States; Preservation Idaho; Idaho Public Television; Advisory Council on Historic Preservation; Shoshone-Bannock Tribes; and Submarine Force Museum and Historic Ship Nautilus. Interested parties participated in the discussions, and their inputs were considered and incorporated as appropriate into the programmatic agreement.

Soil inside the NRF perimeter fence has been disturbed repeatedly, and the geological context has been lost. No identifiable archeological sites are present inside the NRF fence, an area that includes the S5G Prototype Facility. If archeological material is inadvertently encountered during implementation of this project, work would be halted in the vicinity of the finds until they can be inspected and assessed by the appropriate consulting parties.

7.1.6 Natural Resource Concerns

The following subsections evaluate the need for NTCRA to take additional precautions to minimize or mitigate potential impacts to natural resources.

7.1.6.1 U.S. Fish and Wildlife Consultation Need. DOE-ID representatives accessed the F&WS Information for Planning and Consultation website (F&WS 2023). This website helps government agencies integrate the F&WS environmental review process into their project design. The first step was to enter the project location to identify species and resources that may be impacted by activities at that location. The NRF location was entered by zooming in on the satellite image to the point where the NRF boundaries were clearly visible. The website provided a polygon tool to trace the NRF fence line, thereby establishing the entire NRF as the location of concern. These boundaries encompass Building NRF-633A, which houses the S5G Prototype Facility (Figure 7-1).

The website then produced a report specific to the selected location with respect to threatened and endangered species. The only species identified in this report for NRF was the monarch butterfly (*Danaus plexippus*). The monarch butterfly was identified as a candidate for listing under the Endangered Species Act (16 USC 1531 et seq.) but was precluded at this time by higher-priority listing actions. The report, provided in Appendix A, did not identify any critical habitat. DOE-ID was then responsible for determining whether any of the alternatives would impact the monarch butterfly and if formal consultation with the F&WS was required for this action.

DOE-ID determined that Endangered Species Act, Section 7, consultation with the F&WS on the S1W and A1W D&D projects was not needed (Holmes 2022). The S5G project is within the same area evaluated for the S1W and A1W projects. Updated Information for Planning and Consultation results

(F&WS 2023) indicate no changes to the status of monarch butterfly populations; therefore, an Endangered Species Act, Section 7, consultation with the F&WS on the S5G D&D project is not needed. Project activities would occur within an existing building within the NRF perimeter and are not likely to jeopardize the continued existence of the monarch butterfly. No critical habitat for the monarch butterfly is in the project area.

7.1.6.2 Greater Sage Grouse. In 2014, DOE-ID and F&WS entered into a Candidate Conservation Agreement for greater sage-grouse (*Centrocercus urophasianus*; hereafter sage-grouse) on the INL Site (DOE-ID and F&WS 2014). The agreement establishes a framework that protects lands within a 0.6-mi radius of all known active leks (i.e., traditional breeding grounds) on the INL Site and establishes the Sage-Grouse Conservation Area, which limits infrastructure development and human disturbance within the designated area. The S5G Prototype Facility is not within the Sage-Grouse Conservation Area, and no known leks are within 0.6 mi of this facility.

Figure 7-1. Area outlined on U.S. Fish and Wildlife Service Information for Planning and Consultation website to identify species and resources that might be impacted by activities at Naval Reactors Facility.

7.1.6.3 Bat Protection Program. Five species of bats are currently listed as Idaho Species of Greatest Conservation Need (SGCN); the silver-haired bat (*Lasionycteris noctivagans* – SGCN Tier 2), hoary bat (*Lasiurus cinereus* – SGCN Tier 2), Townsend's big-eared bat (*Corynorhinus townsendii* – SGCN Tier 3), western small-footed myotis (*Myotis ciliolabrum* – SGCN Tier 3), and little brown myotis (*Myotis lucifugus* – SGCN Tier 3) have been identified as occurring on the INL Site. Summer bat activity has been monitored at NRF since 2012, and except for the Townsend's big-eared bat, all have been detected utilizing the area around NRF (Bybee, Whiting, and Claver 2022). Additionally, the little brown myotis is a species that has experienced severe population declines in eastern North America due to white-nose syndrome and is subject to significant mortality by wind turbines. Impacts from these activities have prompted FWS to identify the species as a Focus Species.

If necessary, protective measures to minimize impacts to bats from removing anthropogenic roosting structures within the project area would be implemented in accordance with the *Idaho National Laboratory Bat Protection Plan* (DOE-ID 2018). These measures would include (a) weekly inspections of structures anticipated for imminent demolition during the months of June through August (i.e., the presumed pup season) for signs of maternity colonies and (b) surveys during the hibernacula season (November 1 to March 31) 1 week before demolition begins for signs of hibernating bats. If maternity colonies or hibernating bats are detected during these periods, demolition work would be restricted to prevent disturbance, as required by the INL Bat Protection Plan.

7.1.7 Compliance with Disposal Facility Waste Acceptance Criteria

Waste generated from the NTCRA for the S5G Prototype Facility would be managed as CERCLA waste. Waste would be shipped to appropriate disposal facilities dependent upon the waste qualifications and contingent upon meeting the applicable WAC. Disposal facilities—either on the INL Site, such as at the ICDF, or off the INL Site—would have been approved for disposal of CERCLA waste by EPA.

7.1.8 Radioactive Waste Disposal

Radiologically contaminated waste from the S5G NTCRA that is not categorized as hazardous waste under HWMA/RCRA will be shipped to a facility designed for the disposal of low-level radioactive CERCLA waste (e.g., ICDF) or to a facility off the INL Site that is approved by EPA for receipt of radiologically contaminated CERCLA waste. Compliance with facility-specific WAC is required prior to waste shipment.

7.1.9 Nonradioactive Waste Disposal

Generation of waste that is both nonradiological and does not contain other hazardous substances will be minimized by recycling to the extent practicable. If recycling is not practicable, such waste will be sent to an appropriate landfill on the INL Site approved by the CERCLA Agencies for nonmunicipal industrial demolition-type waste. Appropriate landfills include the ICDWL and the Central Facilities Area Landfill, both of which are on the INL Site.

7.1.10 Waste Disposal at Facilities off the INL Site

According to EPA's "Off-Site Rule" (40 CFR 300.440), waste generated from CERCLA NTCRAs that is being shipped offsite (equivalent to off the INL Site) for disposal can be disposed of only in a facility that has been determined by EPA to be acceptable for disposal of CERCLA-generated waste. ICP's practice is to confirm that disposal facilities off the INL Site currently are approved to accept CERCLA-generated waste for disposal through contact with the EPA region associated with the disposal facility. A verification of continued acceptability is requested to confirm that the facility continues to be acceptable. The EPA verification of continued acceptability will be filed as part of the CERCLA waste disposition record and will be available for review upon request of CERCLA Agency project managers. A verification of continued acceptability is valid for 60 days. If wastes are planned to be sent after 60 days, a new verification of continued acceptability is requested.

7.2 Basis for the Recommended Alternative

DOE recommends Alternative 4, Complete Prototype Removal, for NRF-633P because it is the only alternative that is a complete and permanent solution. It meets proposed RAOs for human health and environmental protectiveness and complies with ARARs. Though Alternative 3, In Situ Decommissioning, would generate less waste and take less time, it would leave hazardous substances behind that would necessitate long-term management and institutional controls. Under Alternative 4, the S5G Prototype and its associated peripheral equipment would be completely removed. D&D wastes, including the prototype reactor vessel with its associated lead shielding, would be removed and transported to a low-level waste disposal facility authorized by EPA to accept CERCLA waste, such as ICDF. Mixed waste, such radiologically contaminated lead solids that no longer serve as shielding, would be removed and shipped off the INL Site to a mixed waste facility authorized by EPA to accept CERCLA waste. Following removal, an EPA- and DEQ-approved sampling plan would be used to validate that RAOs have been met. The hull basin and subgrade cells would be backfilled and covered with a floor sufficient to support warehouse operations.

Upon completion of the NTCRA, a CERCLA removal action report would be completed for NRF-633P and would include identification of any trace contamination left in place (e.g., PCBs in paint on subsurface structures). Institutional controls are not anticipated following Complete Prototype Removal; however, the removal action report will provide the basis for completion of the OU 10-08 CERCLA NSI process, if necessary, which would determine institutional control requirements.

Complete Prototype Removal also satisfies the DOE goal of reducing the “risk footprint” in consideration of (a) the principles of keeping exposures of decommissioning personnel to radiological hazards ALARA, (b) safe engineering standards, (c) applicable disposal facility WAC, and (d) desired CERCLA site end state (i.e., a functioning warehouse without characteristics that once caused NRF-633A to be categorized as a “major facility” in the list of NTCRAs under the General Action Memorandum).

7.3 Future Remedial Actions

Implementation of the recommended alternative for the S5G Prototype Facility is not expected to have any significant impact on potential future remedial actions that may become necessary at NRF under the OU 8-08 ROD (DOE-NR 1998).

8. REFERENCES

10 CFR 835, 2023, “Occupational Radiation Protection,” *Code of Federal Regulations*, Office of the Federal Register, June 2023.

40 CFR 61.92, 2023, “Standard,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 61.93, 2023, “Emission monitoring and test procedures,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 61.94(a), 2023, “Compliance and reporting,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 61.145, 2023, “Standard for demolition and renovation,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 61.150, 2023, “Standard for waste disposal for manufacturing, fabricating, demolition, renovation, and spraying operations,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 261, Subpart C, 2023, “Characteristics of Hazardous Waste,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 262.11, 2023, “Hazardous waste determination and recordkeeping,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 264, Subpart C, 2023, “Preparedness and Prevention,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 264, Subpart D, 2023, “Contingency Plan and Emergency Procedures,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 264.15, 2023, “General inspection requirements,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 264.114, 2023, “Disposal or decontamination of equipment, structures and soils,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 264.171, 2023, “Condition of containers,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 264.172, 2023, “Compatibility of waste with containers,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 264.173, 2023, “Management of containers,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 264.174, 2023, “Inspections,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 264.175, 2023, “Containment,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 264.176, 2023, “Special requirements for ignitable or reactive waste,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 264.177, 2023, “Special requirements for incompatible wastes,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 264.178, 2023, “Closure,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 264.553, 2023, “Temporary Units (TU),” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 264.554, 2023, “Staging piles,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 268.40, 2023, “Applicability of treatment standards,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 268.45, 2023, “Treatment standards for hazardous debris,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 268.48, 2023, “Universal treatment standards,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 273, Subpart C, 2023, “Standards for Large Quantity Handlers of Universal Waste,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 300, 2023, “National Oil and Hazardous Substances Pollution Contingency Plan,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 300.415, 2023, “Removal action,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 300.415(n), 2023, “Community relations in removal actions,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 300.440, 2023, “Procedures for planning and implementing off-site response actions,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 761, 2023, “Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 761.50, 2023, “Applicability,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 761.50(b)(1), 2023 “PCB liquids,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 761.50(b)(2), 2023 “PCB items,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 761.50(b)(3), 2023 “PCB remediation waste,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 761.50(b)(4), 2023 “PCB bulk product waste,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 761.50(b)(7), 2023, “PCB/Radioactive waste,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

40 CFR 761.50(c), 2023, “Storage for disposal,” *Code of Federal Regulations*, Office of the Federal Register, July 2023.

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Appendix A

U.S. Fish and Wildlife Service Website Identification of Threatened and Endangered Species

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Appendix A

U.S. Fish and Wildlife Service Website Identification of Threatened and Endangered Species

Representatives from the U.S. Department of Energy Idaho Operations Office accessed the U.S. Fish and Wildlife Service (F&WS) Information for Planning and Consultation (IPaC) website. This website helps government agencies integrate the F&WS environmental review process into their project design. The first step was to enter the project location, allowing the system to find species and resources that may be impacted by activities at that location. The Naval Reactors Facility (NRF) location was entered by zooming in on the satellite image to the point where the NRF boundaries were clearly visible. The website provided a polygon tool to trace the NRF fence line, thereby establishing the entire NRF as the location of concern. These boundaries encompassed the S5G Prototype Facility within Building NRF-633A, as shown in Figure A-1.

The website then produced a report specific to NRF with respect to threatened and endangered species. The report is provided as Attachment A-1 below. The watermark "NOT FOR CONSULTATION" is applied to this report by the F&WS IPaC website to indicate that additional information would be required if formal consultation under Section 7 of the Endangered Species Act is warranted. Based on the report, U.S. Department of Energy Idaho Operations Office representatives conclude that formal consultation with the F&WS is not required, as discussed in Subsection 7.1.6.1.

Figure A-1. Fence line around the Naval Reactors Facility.

Attachment A-1

**U.S. Fish and Wildlife Service
Information for Planning and Consultation Report for the
Naval Reactors Facility**

IPaC **U.S. Fish & Wildlife Service**

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

Butte County, Idaho

Local office

Idaho Fish And Wildlife Office

(208) 378-5243
(208) 378-5262

1387 South Vinnell Way, Suite 368

Attachment A-1
(continued)

Boise, ID 83709-1657

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are not shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

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1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information. IPaC only shows species that are regulated by USFWS (see FAQ).

Attachment A-1
(continued)

2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Insects

NAME	STATUS
Monarch Butterfly Danaus plexippus Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9743	Candidate

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

There are no critical habitats at this location.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern https://www.fws.gov/program/migratory-birds/species
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf

There are no migratory birds of conservation concern expected to occur at this location.

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the list of migratory birds that potentially occur in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets.

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may query your location using the RAIL Tool and look at the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If a bird

Attachment A-1
(continued)

on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

There are no refuge lands at this location.

Fish hatcheries

There are no fish hatcheries at this location.

Wetlands in the National Wetlands Inventory (NWI)

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Attachment A-1
(continued)

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

FRESHWATER POND

- PUBHx

RIVERINE

- R2UBHx
- R4SBC
- R5UBFx
- R2UBH
- R5UBH

A full description for each wetland code can be found at the National Wetlands Inventory website

NOTE: This initial screening does **not** replace an on-site delineation to determine whether wetlands occur. Additional information on the NWI data is provided below.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Attachment A-1
(continued)

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.