Ecological Resources Assessment for the Resumption of Transient Testing of Nuclear Fuels and Material Environmental Assessment

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ACRONYMS

ACRR	Annular Core Research Reactor
ATR	Advanced Test Reactor
BBS	Breeding Bird Survey
BCGs	Biota Concentration Guides
CAA	Clean Air Act
DOE	U. S. Department of Energy
DOE-ID	U. S. Department of Energy – Idaho Operations Office
EPA	U. S. Environmental Protection Agency
HFEF	Hot Fuel Examination Facility
INL	Idaho National Laboratory
MFC	Materials and Fuels Complex
MNS	Mission Need Statement
NAAQS	National Ambient Air Quality Standards
NE	Nuclear Energy
NERP	National Environmental Research Park
NRAD	Neutron Radiography Reactor
NRC	U. S. Nuclear Regulatory Commission
PALM	Powered Axial Locator Mechanism
PSD	Prevention of Significant Deterioration
R&D	research and development
RTT	Resumption of Transient Testing
SNL	Sandia National Laboratories
SRPA	Snake River Plain Aquifer
TREAT	Transient Reactor Test
U. S.	United States
USFWS	United States Fish and Wildlife Service

1. PURPOSE AND NEED[1]

The primary mission of the DOE Office of Nuclear Energy (NE) is to advance nuclear power as a resource capable of meeting the nation's energy supply, environmental, and national security needs by resolving technical, cost, safety, proliferation and security barriers through research, development, and demonstration as appropriate. NE's research and development (R&D) activities help address these challenges, thereby enabling new reactor technologies that will support the current fleet of reactors and facilitate constructing new ones.

Developing new and advanced fuels and the enhanced predictive capability of fuel behavior requires substantial experimental and testing support. In particular, new fuel materials and geometry present significant uncertainties in using methods for predicting fuel performance under a broad range of abnormal conditions, including loss of coolant accidents with fuel damage and melting. Transient test data are important in justifying to a licensing authority that the transient behavior of the newly designed nuclear fuel system is understood and predicted by accident analysis codes.

The U.S. DOE is proposing to resume transient testing of nuclear fuels and materials. This document has been prepared to assess the relative differences between environmental impacts of alternative actions that meet the mission need.

1.1 Why Does the United States Need To Do Transient Testing?

The United States (U.S.) Department of Energy (DOE) needs to test nuclear fuels under conditions that subject them to short bursts of intense, high-power radiation called '*transient testing*' (see Glossary and Section 1.2 'What is Transient Testing' for details). Transient testing is an important step in the process to license new nuclear fuels for use in U.S. nuclear power plants. Nuclear fuel and reactor licensing authorities such as the U.S. Nuclear Regulatory Commission (NRC) require information about fuel behavior under transient conditions to determine if a fuel is safe for use. Developing and designing modern fuel systems for nuclear power plants relies on computer modeling to simulate the behavior of fuels under operating and accident situations. Results from these tests provide information essential to developing and validating such computer models.

Transient testing also develops information to help improve current nuclear power plant performance and sustainability, makes new generation reactors more affordable, develop recyclable nuclear fuels, and to develop fuels that inhibit their use in nuclear weapons. These studies require a nuclear reactor capable of delivering short bursts of high-power radiation and testing equipment to support different types of experiments with appropriate instruments to detect changes in fuel behavior.

The U.S. has not conducted significant transient testing of nuclear fuels in over a decade, and there are few operating test facilities where transient testing can take place (see Section 2 'Alternatives'). The alternatives analyzed in this environmental assessment would resume a testing program to meet the needs described above. Additional details of the mission need can be

[1] Content contained in Section 1 was provided by Battelle Energy Alliance from the Preliminary Draft "Environmental Assessment for the Resumption of Transient Testing of Nuclear Fuels and Materials" 2013.

found in DOE's "Mission Need Statement for the Resumption of Transient Fuel Testing" (MNS), December 3, 2010.

1.2 What is Transient Testing?

Transient testing subjects nuclear fuels and materials to short bursts of high-power radiation using specialized test reactors. In general, there are two types of transient experiments: static tests and loop tests. Static tests evaluate the impact of transient conditions on the physical and chemical configuration of nuclear fuel. Loop tests complete the impact of transient conditions on a bundle of fuel rods and represent nuclear fuel or materials in an operating nuclear reactor.

Transient experiment assemblies can vary in complexity from static to loop tests. Static experiment assemblies are relatively simple consisting of the nuclear fuel or material sealed inside a capsule with water, helium, or other coolant. The size of a static experiment can be as small as a single test piece (or sample of nuclear fuel) with dimensions of 1/2-inch in diameter and 1-1/2-inch in height. Larger capsule experiments may also be performed with test pieces of about 1/2-inch in diameter and 93-inches in length. Loop experiment assemblies are more complex and include nuclear fuel or material sealed inside a larger test vessel charged with coolant and containing all the pumps and other equipment needed to circulate coolant past the nuclear fuel or materials.

The steps performed before, during, and after a transient test include:

1. Selecting a nuclear fuel system that meets test objectives including the nuclear fuel or material, fuel *cladding* (see Glossary), and a coolant system.
2. Transporting the nuclear fuel and experiment assemblies to a *hot cell* (see Glossary) to pre-examine the nuclear fuel or material.
3. Placing the nuclear fuel or material in an experiment assembly. The experiment assembly is a sealed metal vessel containing coolant and all the pumps and other equipment needed to circulate coolant past the nuclear fuel while in the transient test reactor. The experiment assembly isolates the nuclear fuel or material from the surroundings before, during, and after the transient test. In addition, the experiment assembly is placed into a robust metal transportation cask that is sealed for transport. At this stage, the nuclear fuel is at a minimum double contained for safety during transport operations.
4. Transporting the complete experiment assembly to the transient test reactor, performing pre-test radiography, placing the experiment assembly into the transient test reactor, and performing post-test radiography. **Figure 1** shows the top of an example transient test reactor.
5. Irradiating the experiment assembly with *neutrons* (see Glossary) causing the nuclear fuel or materials (test materials) to heat rapidly. During irradiation, information is collected using the instrumentation that is attached to the transient test reactor and experiment assembly. **Figure 2** shows a schematic diagram of the transient test reactor shown in **Figure 1** with an experiment assembly inserted into the test section of the reactor core.

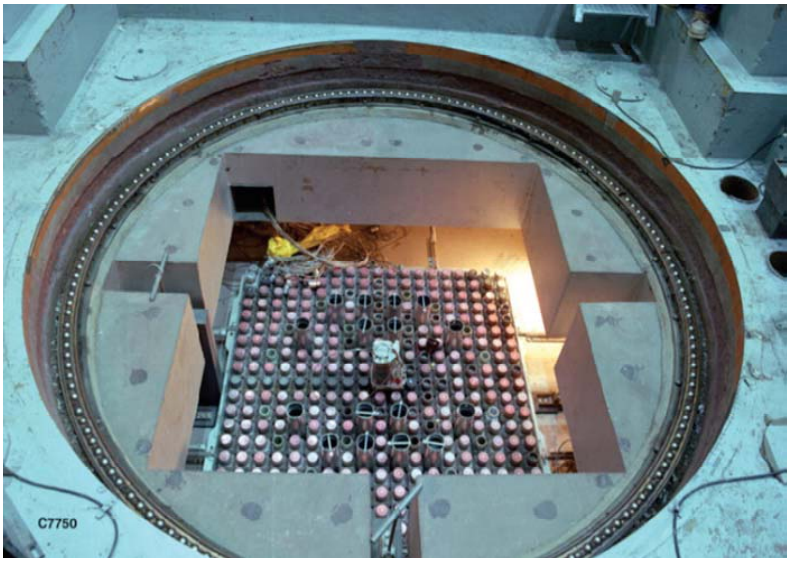


Figure 1. Photograph of the top of the TREAT reactor at the INL showing the circular top of the fuel elements supported by the rectangular fuel plate; the experiments are usually placed in the center, of the reactor. The rotating shield plug is not present in the picture.

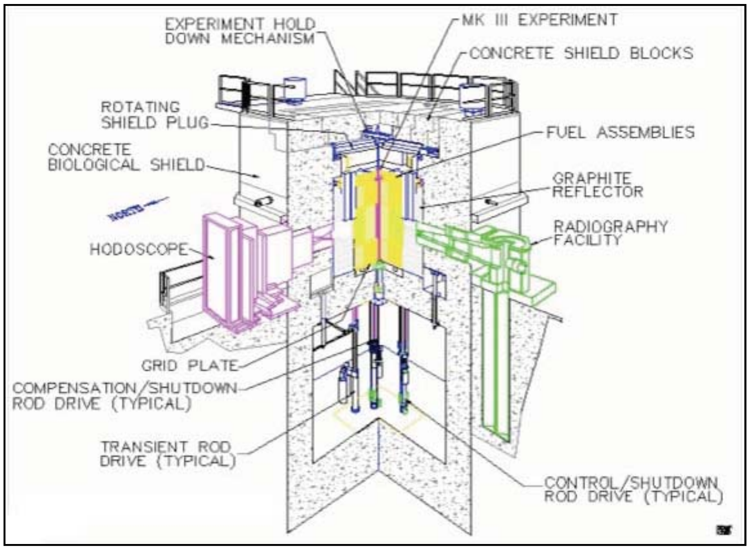


Figure 2. Schematic diagram of a transient test reactor with an experiment inserted into the center of the reactor core.

6. Measuring important parameters during the test, including the parameters of most interest such as motion and chemistry, the temperature, and the pressure of the fuel at selected locations within the experiment.
7. Removing the experimental assembly and transporting the irradiated experimental assembly back to a hot cell. Following the irradiation, the experiment assemblies are placed back into the robust transportation casks, sealed, and transported back to a hot cell for post-irradiation examination.

8. Examining experimental assembly components. Technicians conduct post-irradiation examination of the fuel and materials in the hot cell by opening the transportation cask and experiment assembly.

Following a transient experiment, researchers use the information collected to support developing safer fuels, extending the life of nuclear fuel use in power reactors, and *improve* computer models used to predict nuclear fuel and material behavior under conditions similar to those in the transient test.

During the fuel licensing process, the NRC compares model predictions to the results of the transient test to verify that the computer models are accurate and to qualify nuclear fuel systems. The essential facilities required to conduct transient testing include the following:

- A hot cell for pre-test assembly and examination and post-irradiation examination disassembly and capable of:
    - Placing nuclear fuel and materials into experiment assemblies and sealing them for safe transport to and from the test reactor.
    - Examining highly radioactive nuclear fuel and materials using specialized scientific instruments such as scanning electron microscopes, x-ray diffractometer, and gas chromatographs. These instruments allow scientists and engineers to understand changes to the physical shape, microstructure, and chemistry of nuclear fuel or material during a transient test. This information contributes to improved nuclear fuel designs.
- A specially-designed transient test reactor that safely provides short-bursts of high-intensity neutrons that mimics accidents conditions in a commercial nuclear reactor during accidents.

  The test reactor is designed so that a relatively large amount of energy is safely deposited into a sample of nuclear fuel or material (100 to 1,670 cal/g) in a short period of time (1/10th of a second). The results of the test are used to improve the safety of nuclear fuel or material.

  Requirements of a transient test reactor include ‘in-the-reactor’ real-time imaging technology (using a radiation detection system such as a *hodoscope* (see Glossary). This technology shows fuel motion as it occurs over time, which is important in developing a thorough understanding of the underlying science of fuel behavior. Post-irradiation examination augments in-reactor imaging to confirm the fuel condition after testing. In addition, transient test reactors must have the ability to induce specific observable changes to nuclear fuel systems. Nuclear fuel systems in this context include nuclear fuel, coolant, pumps to circulate the coolant past the nuclear fuel, and onboard instrumentation. The test reactor must be able to accommodate the experimental assembly in the reactor core, where short bursts of intense, high-power radiation induce observable changes in nuclear fuel.

2. ALTERNATIVES[2]

The Council on Environmental Quality's National Environmental Policy Act (NEPA) regulations require agencies to identify and assess reasonable alternatives (40 Code of Federal Regulations [CFR] 1500.2(e)) when proposing new activities. DOE reviews and analyzes two reasonable alternatives, plus the No Action alternative in the environmental assessment. Section 2.1 describes how DOE selected the two alternatives from a larger set of alternatives. Sections 2.2 and 2.3 describe the two selected alternatives. Section 2.4 describes the 'No Action' alternative.

2.1 How DOE Selected the Alternatives

DOE developed a set of selection criteria, based on programmatic objectives to help identify alternatives that meet the purpose and need and to satisfy program requirements.

DOE, using a group of experts with experience in transient testing, reactor operations, and hot cell operations, evaluated facilities from around the world to identify a range of alternatives that would meet the mission need for performing transient testing of nuclear fuels and materials (DOE 2013). The purpose of evaluating potential facilities or facility combinations was to identify the alternative that would represent the best value to the government in support of filling the mission need. Alternatives evaluated included several located in the U.S. and internationally.

2.1.1 Alternative Selection Process and Selection Criteria

DOE reviewed several alternatives, including building a new reactor and domestic and international facilities (**Table 1**). DOE applied a set of criteria to help identify a reasonable set of alternatives to analyze in this environmental assessment. After applying the screening criteria, DOE chose to analyze two alternatives to meet the mission need and a no action alternative. The screening criteria include:

- A reasonable alternative must be:
  1. Located in the U.S. to provide the necessary access, security, and control to support U.S. DOE research activities.
  2. Capable of producing transient neutron bursts able to deposit energy of up to 7,000 J/g (1670 cal/g) into nuclear fuel within periods of 100 micro-seconds to 10 seconds.
  3. Capable of performing transient experiments on fuel test assemblies up to 200 inches in length and 6 inches in diameter.
  4. Capable of performing real time fuel motion monitoring using a radiation detection system such as a hodoscope during a transient experiment.
  5. Capable of providing the necessary infrastructure to prepare and handle experiments (e.g., co-located hot cell facilities).

2.1.2 Alternatives Selected for Analysis

DOE identified two alternatives that meet all of the selection criteria (described above). They are:

[2] Content contained in Section 2 was provided by Battelle Energy Alliance from the Preliminary Draft "Environmental Assessment for the Resumption of Transient Testing of Nuclear Fuels and Materials" 2013.

1. Restarting the reactor at the Transient Reactor Test (TREAT) Facility at Idaho National Laboratory (INL)
2. Modifying the Annular Core Research Reactor (ACRR) Facility at Sandia National Laboratories (SNL) to include a fuel motion monitoring device to the reactor and constructing a hot cell adjacent to the reactor

In addition, this assessment is also considering the “No Action” alternative, which means not restarting the TREAT reactor or modifying the ACRR.

Table 1. Alternatives considered by DOE for transient testing.

Alternative Considered	Description
New Transient Test Reactor	Constructing a new reactor near a hot cell facility with all required capabilities.
TREAT Reactor /HFEF	Transient testing at the Transient Reactor Test (TREAT) Facility and required hot cell work at the Hot Fuel Examination Facility (HFEF) at Idaho National Laboratory (INL)
ACRR Alternatives	
ACRR/IFEL	Transient testing at the Annular Core Research Reactor (ACRR) Facility at Sandia National Laboratories (SNL) and required hot cell work at the Irradiated Fuels Examination Facility (IFEL) at Oak Ridge National Laboratory (ORNL)
ACRR/New Hot Cell/HFEF.	Transient testing at the ACRR Facility at SNL; constructing a new hot cell at SNL to assemble, disassemble, and package nuclear fuel and material specimens into a commercial transportation cask; and all other hot cell work at HFEF at INL
ACRR/New Hot Cell/HFEF/Installation of an in-reactor fuel motion monitoring device (Hodoscope)	Transient testing at ACRR, constructing a new hot cell at SNL to assemble, disassemble, and package nuclear fuel and material specimens into a commercial transportation cask; installing a new fuel motion monitoring device into the or other neutron detection system into ACRR; and all other hot cell work at HFEF at INL
HFIR/IFEL	Transient testing at High Flux Isotope Reactor (HFIR) at ORNL and required hot cell work at IFEL at ORNL
ATR/PALM/HFEF	Transient testing at the Advanced Test Reactor (ATR) equipped with the Powered Axial Locator Mechanism (PALM) and required hot cell work at HFEF – all at INL
NSRR	Performing all transient testing and hot cell work at the Nuclear Safety Research Reactor (NSRR) that is located in Japan
CABRI	Performing all transient testing and hot cell work at the transient test facility operated in France by CEA
IGR	Performing all transient testing and hot cell work at the Impulse Graphite Reactor (IGR) in Kazakhstan
MURR	Performing all transient testing at the Missouri University Research Reactor (MURR) and all hot cell work at HFEF at ORNL

2.2 Alternative 1 – Restart TREAT Reactor

The TREAT Facility, part of INL’s Materials and Fuels Complex (MFC), is located on the INL Site in southeast Idaho and about 0.8 miles northwest of the MFC in the south-central portion of INL (**Figures 3 and 4**). Original construction of the TREAT Facility began in February 1958 and was completed in early November 1958. The TREAT Facility includes a high bay for receipt of test assembles and for decontamination after irradiation, a reactor control building that contains computer consoles (located about 0.45 mi. east of the reactor building), and the TREAT Reactor. The reactor achieved initial criticality on February 23, 1959. The TREAT Facility was a principal reactor safety transient testing facility in the U.S. for 35 years, performing more than 2,885 experiments on thermal and fast reactor fuels. During that time, the TREAT Facility has undergone several facility upgrades to enhance reactor capability and safety. Since 1994, the TREAT Reactor has been in standby status.

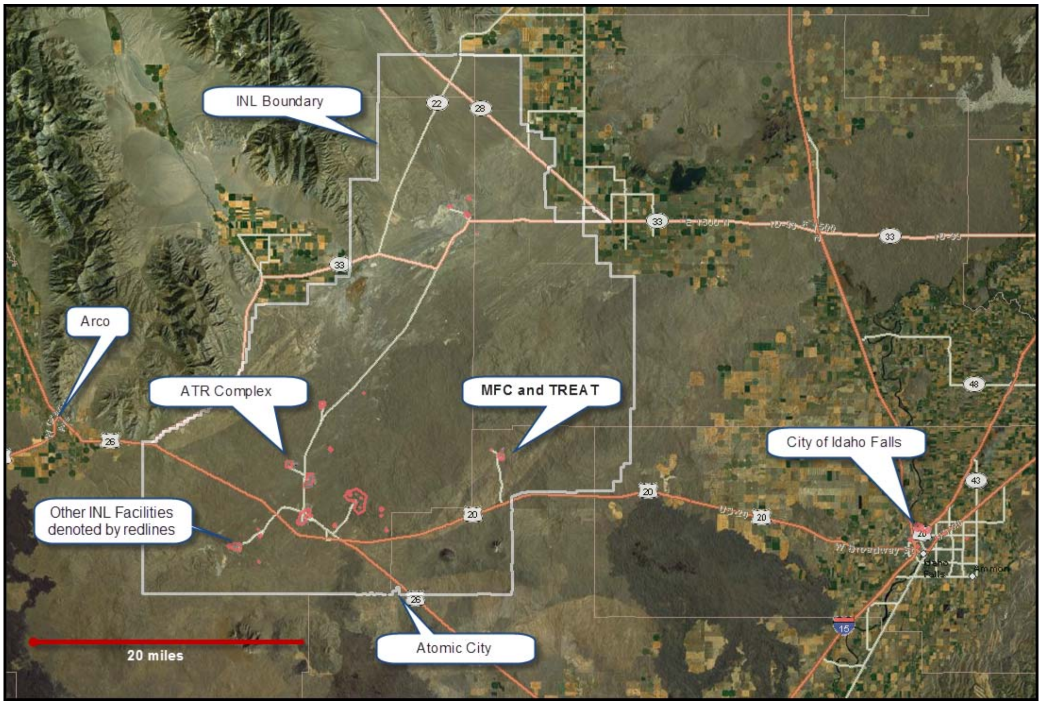


Figure 3. MFC and the TREAT Facility (near center of figure) within the INL's 890 Square Mile Boundary) shown in relation with nearby cities.

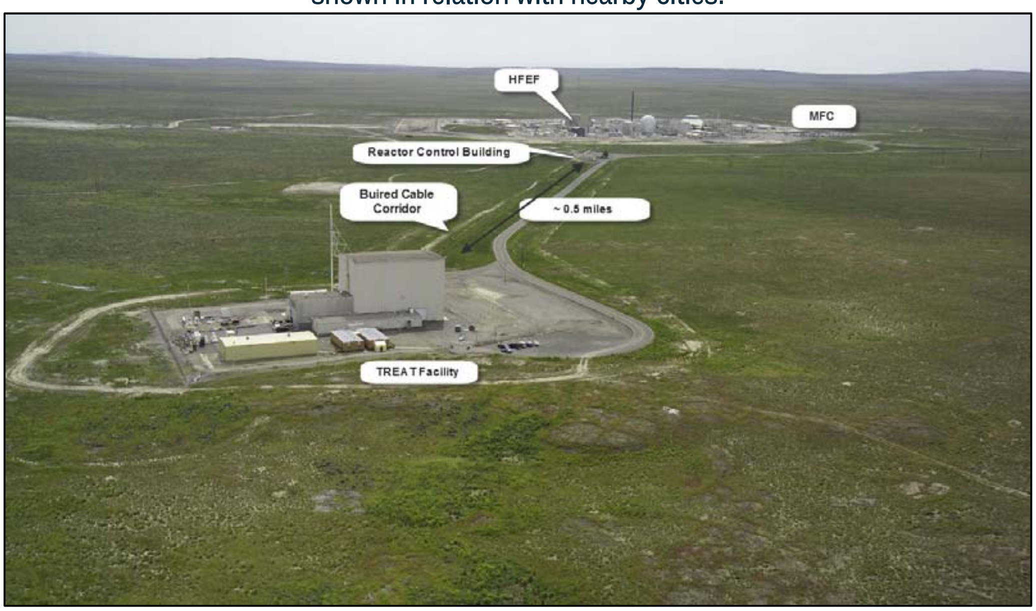


Figure 4. TREAT Facility (foreground) with Reactor Control Building, MFC and HFEF (background). The TREAT Facility and the Reactor Control Building are part of MFC.

The TREAT Reactor was specifically designed to test nuclear fuel and materials under transient (or high-power) conditions. The TREAT Reactor core can safely reach temperatures of about 1500 °F because it is constructed of materials that tolerate high temperatures. Operating temperatures are limited to about 1067 °F to ensure that the fuel cladding is not damaged during a test. Unlike many other reactors in operation today, the TREAT Reactor is cooled by air.

The TREAT Reactor core was designed to accommodate a variety of experiments, including experiment assemblies containing coolants (e.g., sodium or water). Because the core is air cooled, experiment assembly can be easily inserted into the core and observed and monitored during testing. Horizontal, line-of-site access to the core is possible by removing shielding blocks along the sides of the reactor. Vertical access to the core is possible by removing shielding blocks above the reactor.

Characterization of fuel and other support activities for testing completed at the TREAT Facility would occur at the Hot Fuel Examination Facility (HFEF) located within MFC (**Figures 4 and 5**). The operating HFEF hot cells are designed to receive, handle, and process irradiated nuclear fuel assemblies, construct test experiment assemblies with either fresh or irradiated fuels, receive the tested transient experiments containing irradiated fuel, and perform post-irradiation examination on the fuel.

Figure 5. HFEF within MFC.

Project activities include construction and operation phases consisting of several steps that prepare the TREAT Facility and the TREAT Reactor for restart and operations as a transient reactor. **Table 2** outlines those project phases and steps, along with steps that help minimize the environmental impacts of construction and operation activities.

Table 2. Constructing, modifying, and operating activities to perform transient tests as described in Section 2.2.3 in the TREAT Reactor - Alternative #1 and the controls used to minimize environmental impacts from construction and operation activities.

Constructing, Modifying, and Operating Activities

Constructing / Upgrading / Modifying Activities of the TREAT Facility and Support Facilities:

- Remove selected fuel elements from the TREAT Reactor, and/or storage, conduct inspections and return
- Remove old computer equipment and replace with new equipment in both the TREAT Facility and the TREAT Reactor Control building and/or instrumentation & control room
- Perform preventative/corrective maintenance on and/or replace pumps, compressors, sensors, electrical connections, and other equipment, as necessary
- Perform corrective maintenance on, and/or replace: reactor control rods drives, hodoscope, blowers, diesel generators, uninterruptable power supplies, and casks, as necessary
- Install new radiation monitoring equipment
- Perform seismic/structural upgrades (weld or bolt on additional structural steel to selected building and crane members), to make sure that the facility meets the applicable seismic requirements
- Replace cabling from the TREAT Facility to the reactor control building, and the original reactor control building (Building 721)
- Move reactor controls to original reactor control building, and replace the reactor control cables between the original reactor control building and the TREAT Facility
- Replace the high efficiency particulate air (HEPA) filter housing
- Following refurbishment activities, perform routine maintenance of equipment in the TREAT Facility and the Reactor Control building, operate the reactor, perform transient experiments
- Replace reactor control cables between reactor control building and TREAT Facility. Assume that this would require disturbance of soil covering the cables.

Operating Activities of the TREAT Facility and Support Facilities, including experiments:

- Perform routine maintenance of equipment in the TREAT Facility, including the reactor control room
- Perform experiments as described in Section 2.2
    - Identify test parameters and design of interest
    - If necessary, pre-irradiate nuclear fuel or material in ATR or other reactor
    - Transport the desired nuclear fuel or material test samples to HFEF
    - Prepare experimental assemblies in HFEF
    - Transport experiment assemblies to the TREAT Facility
    - If necessary, perform pre-test radiography
    - Perform transient testing
    - If necessary, perform post-test radiography
    - Transport irradiated test assemblies back to HFEF
    - Disassemble the test assemblies in HFEF
    - Perform post-test examination of nuclear fuel and materials
    - Dispose of experiment residual materials.

Constructing and Operational Controls

Controls use to minimize construction impacts:

- Exercise INL Timeout/Stop Work Authorities (Laboratory Wide Procedures [LWP]-14002) and contact the INL Cultural Resource Management (CRM) Office immediately if cultural artifacts or remains are unexpectedly discovered during project activities.
- Initiate consultation with the Idaho State Historic Preservation Office and Shoshone-Bannock Tribes through transmittal of cultural resource investigation report (Pace and Williams 2013) and EA.

- Expand archaeological survey coverage and resource assessments in any future areas of project activity outside the defined direct and indirect areas of potential effects.
- Minimize any areas of soil or vegetation disturbance, manage weeds, reseed and revegetate with native species, and practice good housekeeping to stabilize soil, prevent the spread of noxious and invasive species, and reduce disturbances to plant and wildlife species.
- Comply with weed management strategies outlined in PLN 611.
- Perform nesting bird surveys between May 1st and September 1st in compliance with the Migratory Bird Treaty Act for any construction activities that will disturb soil/vegetation outside the facility fences.
- Control fugitive dust during soil disturbing activities
- Seed areas where soil is disturbed with native species and control noxious weeds (e.g., area between reactor control building and the TREAT Facility)

<u>Controls used to minimize operation impacts:</u>

- Conduct pre-test radiography and post-test radiography
- Safety structures, systems, and components (SSCs) of the TREAT Facility including the HEPA filtrations/cooling system, facility structural design, reactor controls and components
- Safety design and review of experiments suitable containment of experiments in pressure vessels that are designed to withstand the transient test conditions, safety management programs, technical safety requirements (TSRs) including specific administrative controls (SACs), and "safety analysis commitments" including extensive training for all personnel involved with facility operations.

2.2.1 Experimental Sequence using the TREAT Reactor

Described below are specific steps, facilities, and transport processes involved during transient testing using the TREAT Facility and Reactor (Expanded from Section 1.2 'What is Transient Testing' and specific to the Restart of TREAT Alternative). It includes a calibration step to determine a reactor-to-fuel coupling factor, pre-experiment assembly of the experiment assembly, the steps conducted during the experiment, and steps conducted after the experiment is completed.

1. Transient testing using the TREAT Reactor would begin by selecting the nuclear fuel to be tested and delivery of the fuel to the HFEF at INL. In some experiments, the nuclear fuel would be fuel that has not been previously irradiated (i.e., "new fuel"), while in other tests, the fuel may be pre-irradiated. In the case of pre-irradiated fuel, the irradiation would occur at the INL ATR (Advanced Test Reactor) Complex (**Figure 6**) or at a domestic commercial nuclear reactor.
2. Transport from the ATR Complex to HFEF would occur on non-public roads with access controlled by INL security. HFEF is located within the MFC as shown in **Figure 5**. It is located 4.5 miles north of Highway 20 that crosses the southern INL. Transport of research fuels to HFEF from commercial facilities would occur on public roadways for transport to INL.
3. HFEF contains equipment to safely disassemble and inspect nuclear fuel or material. While in HFEF, non-destructive examinations of the pre-experiment fuel would be performed, pre-irradiated fuel would be loaded into the test assembly with the coolant, coolant circulation equipment, and instrumentation as required by the experiment assembly test to be performed, and preliminary checks of the loaded test equipment would be performed. For comparison of post-irradiated fuel conditions, non-destructive

and destructive examinations of un-irradiated fuel samples from the same fuel the irradiated fuel is taken from might also be performed.

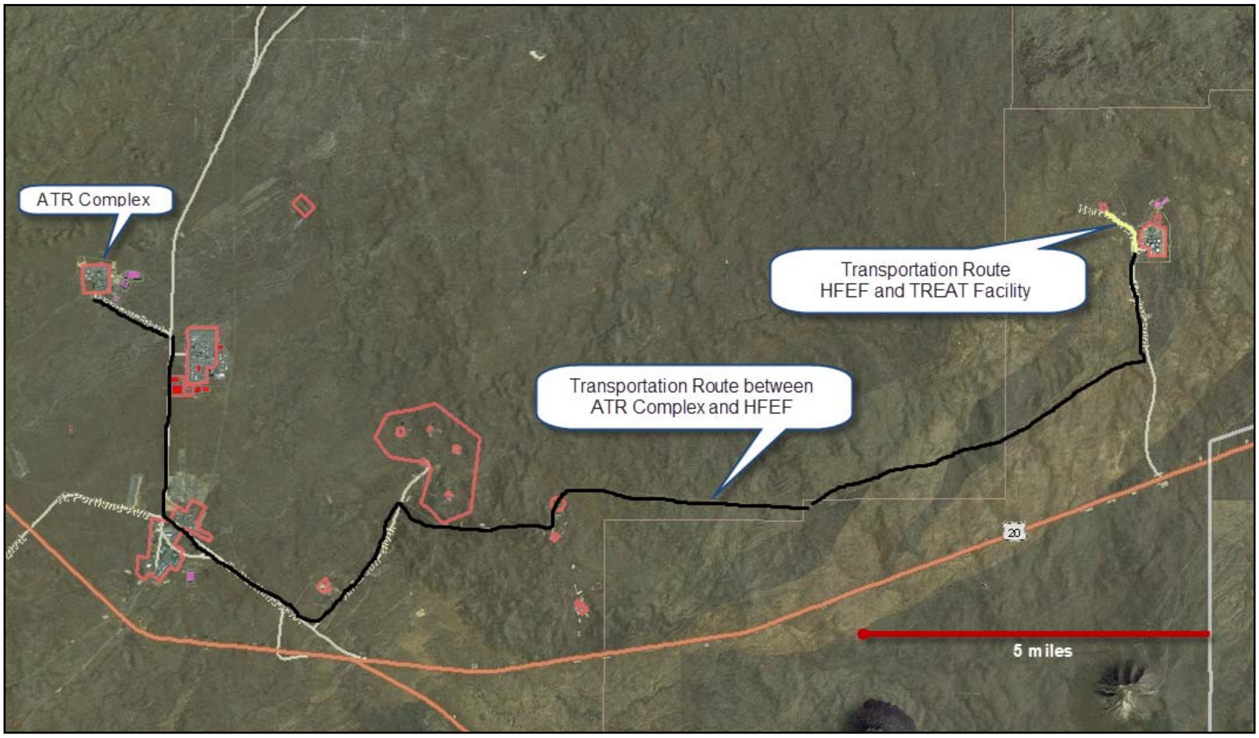


Figure 6. Transportation route between ATR and HFEF and between HFEF and TREAT Facility (all on INL non-public roads); red lines are fenced or administrative boundaries around INL facilities.

4. Transport to the TREAT Reactor from HFEF would occur by first transferring the loaded experiment assembly into an on-site transfer cask. The transfer cask containing the loaded test assembly would be picked up with an approved transport vehicle and delivered to the TREAT Reactor. The road between HFEF and the TREAT Facility is entirely on the INL site with no public access. The distance between HFEF and the TREAT Facility is ¾ mile.
5. While at the TREAT Facility, the test assembly would generally be neutron *radiographed* (see Glossary) and functionally checked while in the radiography facility. Thereafter, it would be inserted into the core, connected to supporting equipment, and subjected to the planned TREAT Reactor irradiation(s).
6. After irradiation, the test assembly would be decontaminated, re-radiographed (if necessary), and transferred back to HFEF in the on-site transfer cask over the non-public road connecting the TREAT Facility and HFEF.
7. Post-irradiation examination at HFEF would depend upon the outcome of the test. Undamaged fuel pins would generally be removed from the test assembly vehicle and non-destructively examined. In-cell operations may be conducted to preserve and refurbish contaminated test vehicles for reuse. If vehicle reuse is not desired, the test vehicle might be stripped of external equipment to allow better neutron radiography of its contents at Neutron Radiography Reactor (NRAD), located at HFEF. Dissecting

disrupted fuel remains and destructive examinations of transient-tested fuel samples would be performed mostly at HFEF, although small samples might be transferred to an on-site specialized examination facility or shipped off-site to another facility. Preparing the waste for disposition and transferring the waste to a suitable (most likely on-site) facility would conclude the activity.

2.3 Alternative 2 – Modify ACRR

Description provided by Sandia National Laboratory.

2.4 Alternative 3 – No Action

DOE must consider a 'No Action' alternative that establishes a baseline against which this environmental assessment compares the other analyzed alternatives. No action does not necessarily mean doing nothing, but often involves maintaining or continuing the 'status quo'.

In this document, no action means: (1) not restarting TREAT Reactor and (2) not modifying ACRR to conduct transient testing as described in previous sections. Under this alternative, certain aspects of transient testing would still be pursued at facilities where they are capable of being conducted. However, the capabilities that do not exist would not be developed. This alternative does not meet the mission needs described in Section 1.1.

3. AFFECTED ENVIRONMENT

3.1 Idaho National Laboratory

The INL Site consists of nine facilities, each less than 2-square miles, situated on an 890-square-mile expanse of otherwise undeveloped, cool, desert terrain, and with most INL Site buildings and structures occurring within these developed site areas and separated by miles of primarily undeveloped land. DOE controls all INL Site land which is located in southeastern Idaho, which occupies portions of five Idaho counties: Butte, Bingham, Bonneville, Clark, and Jefferson. Population centers in the region include large cities (>10,000) such as Idaho Falls, Pocatello, Rexburg, and Blackfoot, located greater than 30 miles to the east and south, and several smaller cities/communities (<10,000) located around the site (about 1-30 miles away), such as Arco, Howe, Mud Lake, Fort Hall Indian Reservation, and Atomic City. Craters of the Moon National Monument is less than 20 miles to the west of the western INL boundary; Yellowstone and Grand Teton National Parks and the city of Jackson, WY are located more than 70 miles northeast of the closest INL boundaries.

Populations potentially affected by INL Site activities include INL Site employees, ranchers who graze livestock in areas on or near the INL Site, hunters on or near the Site, residential populations in neighboring communities, travelers along U.S. Highway 20/26, and visitors at EBR-I. No permanent residents reside on the INL Site.

The five Idaho counties that are part of the INL Site are all in an *attainment area* (see Glossary) or are unclassified for National Ambient Air Quality Standards (NAAQS) status under the *Clean Air Act (CAA)* (see Glossary). The nearest *nonattainment area* (see Glossary) is located about 50 miles south of INL Site in Power and Bannock counties. The INL Site is classified under the *Prevention of Significant Deterioration (PSD)* (see Glossary) regulations as a Class II area—an area with reasonable or moderately good air quality.

Surface waters on the site include the Big Lost River and Birch Creek; both streams carry water on an irregular basis, with the majority of the flow diverted for irrigation before entering the INL Site. Most of the INL Site is underlain by the Snake River Plain Aquifer (SRPA), which lies between 220 feet (at the north end of the site) to 610 feet (at the south end of the site) below the surface of the site. The geology above the SRPA, the *vadose zone* (see Glossary), is generally comprised of basalt (95%) with a layer of soil (loess) and/or sediment on top of the basalt with thin layers of sediments (1 to 20-foot intervals) between basalt flows. The SRPA has similar geology as the overlying vadose zone and is generally 250 to 900-feet thick.

The natural vegetation of the INL Site consists of a shrub overstory with a grass and forbs understory. The most common shrub is Wyoming big sagebrush *(Artemisia wyomingensis)*, where basin big sage *(Artemisia tridentata)* may dominate or co-dominate in areas with deep or sandy soils (Shumar and Anderson 1986). Other common shrubs include green rabbitbrush *(Chrysothamnus viscidiflorus)*, winterfat *(Krascheninnikovia lanata)*, spiney hopsage *(Grayia spinosa)*, gray horsebrush *(Tetradymia canescens)*, gray rabbitbrush *(Ericameria nauseosa)*, and prickly phlox *(Linanthus pungens)* (Anderson et al. 1996). The shrub understory consists of native grasses such as, thickspike wheatgrass *(Elymus lanceolatus)*, Indian ricegrass *(Achnatherum hymenoides)*, bottlebrush squirreltail *(Elymus elymoides)*, needle-and-thread grass *(Hesperostipa comata)*, Sandberg bluegrass *(Poa secunda)*, and bluebunch wheatgrass *(Pseudoroegneria spicata)* and abundant and diverse native forbs (i.e., tabertip hawksbeard, Hood's phlox, hoary false yarrow, paintbrush, globe-mallow, buckwheat, lupine, milkvetches, and mustards) (Anderson et al. 1996). In a 1999 proclamation, the Secretary of Energy designated a portion of the INL Site as the Sagebrush Steppe Ecosystem Reserve with a mission to provide research opportunities and preserve sagebrush steppe habitat. Representatives of the Bureau of Land Management, U. S. Fish and Wildlife Service, and the Idaho Department of Fish and Game co-signed the proclamation. In addition, the INL Site is designated as *National Environmental Research Park* (NERP) (see Glossary).

A wide range of vertebrate species are located within the site; several species are considered sagebrush-obligate species, meaning that they rely upon sagebrush for survival. These species include sage sparrow (*Amphispiza belli*), Brewer's sparrow (*Spizella breweri*), northern sagebrush lizard (*Sceloporus graciosus*), Greater sage-grouse (*Centrocercus urophasianus*), and pygmy rabbit (*Brachylagus idahoensis*) (Rowland el at. 2006).

There are currently no species that occur on the INL Site that are listed as Endangered or Threatened; however, Greater sage-grouse is a Candidate Species for protection under the Endangered Species Act. Also, several Species of Concern, including Townsend's big-eared bat (*Corynorhinus townsendii*), pygmy rabbit, Merriam's shrew (*Sorex merriami*), long-billed curlew (*Numenius americanus*), ferruginous hawk (*Buteo regalis*), northern sagebrush lizard, and loggerhead shrike (*Lanius ludovicianus*), do occur on the site.

Additionally, in 2010 the little brown myotis (*Myotis lucifugus*), which is a migratory species that roosts in caves and building on the INL Site, was petitioned for emergency listing under the Endangered Species Act. The USFWS is collecting information on this species—as well as the big brown bat (*Eptesicus fuscus*), which is a resident species and uses caves and buildings year round on the INL Site—to determine if existing threats increase the extinction risk of these bats.

3.1.1 TREAT and MFC Area

The TREAT Facility is located a little more than ½-mile to the west and outside the fence at the MFC. HFEF is located within the fence at MFC. A paved access road leads from MFC ½-mile to the TREAT Facility. A fence surrounds the perimeter of the TREAT Facility and encloses about 3 ½ acres (**Figure 4**).

3.1.1.1 Vegetation

The Resumption of Transient Testing (RTT) would affect a small amount of vegetation between the TREAT Facility and the Remote Control Buildings if the cable corridor needs to be replaced or rebuilt. This stretch of land is along the access road between the two locations and has been previously disturbed in the past and was recently burned in 2010 by the Jefferson Fire. At this time, two full growing seasons since the fire, the primary vegetation is crested wheatgrass *(Argropyron cristatum),* which is considered a non-native species. There are a few isolated sagebrush plants adjacent to the cable corridor, but they would unlikely be affected by the construction activities. On the south and west sides of the TREAT Facility, native grasses and forbs, are the predominant vegetation. Sagebrush is absent from that area as it was also burned in the Jefferson Fire.

Although the INL Site is known to have a number of sensitive plant species present, most inhabit areas closer to the foothill type topography found on the south and west sides of the INL Site. In addition, there are a number of ethnobotanical species that have cultural importance present across the INL Site. However, field surveys and historical data searches showed no presence of either sensitive species or ethnobotanical species in the project area.

A total of eleven Idaho Noxious Weeds have been identified on the INL Site. No noxious weeds were identified within the fence or immediately adjacent to the TREAT Facility or the Remote Control Buildings. However, musk thistle (*Carduus nutans)* has been observed in the general area and appears to be increasing/more visible since the Jefferson Fire. Other significant non-native and/or invasive plants found on or near the proposed location include halogeton (*Halogeton glomeratus*) and crested wheatgrass (*Agropyron cristatum*, *A. desertorum*, *A. sibericum*), with small amounts of cheatgrass (*Bromus tectorum*) and Russian thistle (*Salsola kali*).

Invasive non-native species present a challenge in disturbed areas. They establish very quickly and compete with the native species. Crested wheatgrass is the primary species at the proposed site. This non-native species is very quick to colonize any new disturbance and is very difficult to eradicate once it is present.

3.1.1.2 Wildlife

Several species of wildlife use the area surrounding TREAT Facility and the Remote Control Buildings. Greater sage-grouse have been documented using an area 2.4 miles to the southwest of the project location, and the closest active lek is located 2.5 miles to the southwest of the TREAT Facility.

Elk (*Cervus canadensis*), pronghorn (*Antilocapra americana*), and mule deer (*Odocoileus hemionus*) have been documented using water sources (**Figure 7**) in this area (**Figure 8**). A recent study documenting hourly locations of GPS-collared elk indicated that twelve of the 20 individuals collared used the area near the TREAT Facility extensively (**Figure 8**). These ungulates likely have been using the potable-water effluent expelled by the TREAT Facility for at least the past nine years.

In addition, big brown bats, western small-footed myotis (*Myotis ciliolabrum*), and Townsend's big-eared bats have used the MFC waste-water ponds and the concrete bridge at MFC (Whiting and Bybee 2011).

Figure 7. Effluent at the TREAT Facility used as a water source by various wildlife species.

3.2 Ecological Research and Monitoring

Thirteen Breeding Bird Survey (BBS) routes were established on the INL Site in 1985 (Shurtliff and Whiting 2009). Each of these routes is surveyed once each June and each route requires one day to complete. Five of the routes are in remote areas and the data from these are reported to the U. S. Geological Survey Biological Resources Division as part of a national effort to monitor the status of bird populations. A BBS route follows the perimeter fence at MFC and includes the TREAT Facility as well as the Remote Control Facility (**Figure 8**). Data from this route is used, along with information from other routes, to monitor the effects of INL Site activities on bird populations. The BBS route would not be disturbed by the RTT project.

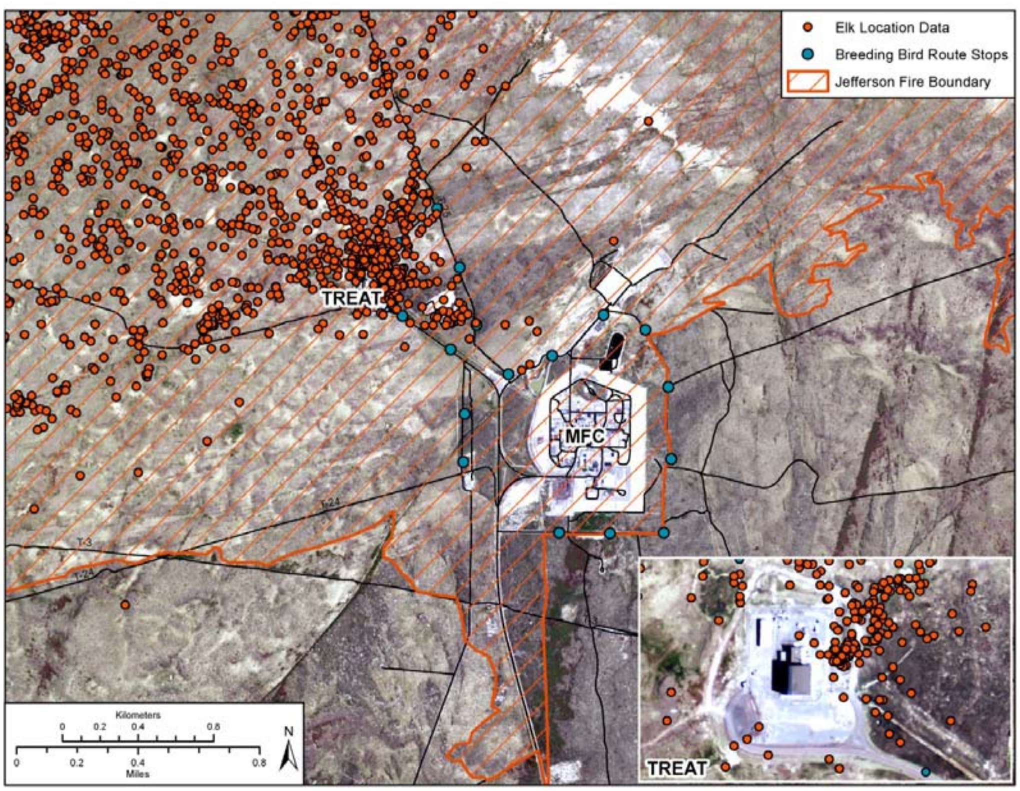


Figure 8. Project area showing all biological data in the vicinity near the TREAT Facility and the Remote Control Facility as well as MFC. Inset: Close up of TREAT showing the heavy use of the effluent on the east side of the facility. The red dots represent the locations of 12 GPS-collared elk at one hour increments.

4. ENVIRONMENTAL CONSEQUENCES

4.1 Alternative 1 – Restart TREAT

4.1.1 Biological Resources

4.1.1.1 Vegetation

Some of the proposed construction activities would result in vegetation and soil disturbance. An increase in soil disturbance would likely lead to an associated increase in weedy non-native species. Potential impacts to the vegetation communities at locations where vegetation removal is proposed could be minimized by limiting the size of the footprint of the disturbance. Weed management would also be necessary because even the slightest amount of soil disturbance would facilitate non-native species invasions. Prompt revegetation of disturbed areas with native species is recommended. However, crested wheatgrass has been used in the past at the INL Site to stabilize roadsides and was likely planted in the area during the last major road improvement. We recognize the ability of crested wheatgrass to form a monoculture and would expect this species to become dominant in any disturbances by the project, due to seed availability. At a minimum, soil should be stabilized and noxious weed species controlled. If disturbances are expected outside the buried cable corridor as identified in the construction outline (**Table 1**), revegetation with native seed would be required.

There will be no direct impact to species of ethnobotanical concern or to sensitive species as there are none present at the RTT location.

4.1.1.2 Wildlife

Vegetation and soil disturbance would have common unavoidable impacts to wildlife, including loss of certain ground-dwelling wildlife species and associated habitat. These impacts can be minimized by limiting the disturbance footprint, implementing a weed management strategy and promptly stabilizing the disturbed areas. Between May 1and September 1, any activity potentially disturbing vegetation or soils would require a nesting bird survey prior to disturbance. If this disturbance is to occur in the roadside areas that are mowed seasonally, there would be no threat to nesting birds.

Impacts to sage-grouse would not be anticipated due to the limited amount of disturbance planned, the lack of suitable habitat in the project area, and the extensive distance from the project area to the nearest active lek.

Although recent radio-collar data collected from elk indicate heavy use of this area by these ungulates, we would not anticipate that construction activity will impact elk, as these ungulates are already accustomed to accessing water near the facilities, and likely do not visit during the daylight or other times of peak human presence. Operations and activities associated with RTT would be unlikely to impact the bats found around the MFC waste-water ponds because of their nocturnal activity patterns as well.

The BBS route at MFC follows the perimeter fence of this facility and includes the TREAT Facility and the Remote Control Buildings (**Figure 8**); however, this survey is conducted on one day in June and starts at 5:30 a.m. Construction work would not likely begin until after this survey is complete; therefore construction activities would not limit access to biologists conducting this survey. We would advise that construction workers not remove any T-posts near the road which mark a BBS stop location (**Figure 8**), identifiable by a red T-post with a small round metal tag attached with wire.

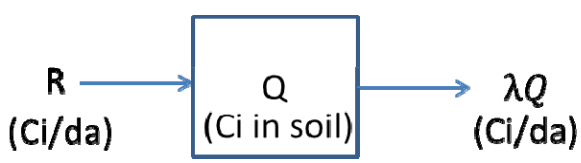
Finally, due to the nature of the construction along an existing road and within a pre-disturbed area, habitat fragmentation would not be a concern.

4.2 Radiological Impacts on Biota

To assess the environmental impacts of the resumption of the TREAT facility, radiological impacts to biota must be considered. The impact of environmental radioactivity at the INL Site on nonhuman biota can be assessed using *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2002) and the associated software, RESRAD-Biota (ISCORS 2004). The graded approach begins the evaluation using conservative default assumptions and maximum values for all currently available data. This general screening level (Level 1 in RESRAD-Biota) provides generic limiting concentrations of radionuclides in environmental media termed Biota Concentration Guides (BCGs). Each Biota Concentration Guide is the environmental concentration of a given radionuclide in soil or water that, under the assumptions of the model, would result in a dose rate 1 rad/d (10 mGy/d) to terrestrial plants or 0.1 rad/d (1 mGy/d) to terrestrial animals. Dose limits of 1.0 rad/day for terrestrial plants and 0.1 rad/day for terrestrial animals are intended to provide protection from chronic exposure of whole populations of individual species rather than individual members of the population.

Of the particulates produced by TREAT (Rb-88, Cs-140, Ba-140, and La-140), the only radionuclide with a half-life sufficient to potentially accumulate in soil outside the facility is Ba-140 ($T½ = 12.8$ d). The BCG for this radionuclide is 7.32 pCi/g for terrestrial animals and 3.84×10^4 pCi/g for terrestrial plants. Clearly, the most limiting BCG is for terrestrial animals.

To estimate the amount of Ba-140 that could conservatively accumulate in soil, it was assumed that the rate of radioactivity released is constant throughout the year (i.e., a maximum of 2×10^{-2} Ci per year = 5.5×10^{-5} Ci per day for a 3000 cubic feet per minute [cfm] release). It was also assumed that the majority of the release is deposited close to the facility boundary (within the perimeter road). The deposition, accumulation and radioactive decay can be described by a simple, first-order model illustrated as



and expressed mathematically by the following equation:

$$Q = R/\lambda(1-e^{-\lambda t})$$

Where,

Q = quantity of radionuclide in soil (Ci)

R = Rate of input into soil (Ci/da)

$\lambda = \ln(2)/t½$

t = time

Equilibrium is achieved in the environment when the release rate is equivalent to the loss through decay (λQ) (after approximately 6 half-lives or 80 days). It was calculated that about 1 mCi would remain in the soil.

The area of the TREAT facility bounded by the road can be approximated by a circle with a radius of 120 m (see **Figure 9**). If it is assumed that the majority of deposition occurs near the facility and within this region, the deposition area would be approximately 45,239 m^2. Small mammals could represent the population that has a territory limited to the vicinity adjacent to the TREAT facility. It was assumed that there is enough vegetation in the zone for small mammals to survive within this area. As such, the equilibrium soil concentration would be about 2.21×10^{-8} Ci/m^2 or 2.21 pCi/cm^2. Assuming an active soil layer of 1 cm and a soil density of 1.5 g/cm^3, the equilibrium soil concentration can also be expressed as 1.47 pCi/g. This is below the general screening level BCG of 7.32 pCi/g and therefore it can be concluded that if these radionuclide levels remain consistent, the resumption of the TREAT facility will not impact biota. It would require nearly a 5-fold increase in these concentrations to exceed the BCG and require additional assessment of impacts to biota.

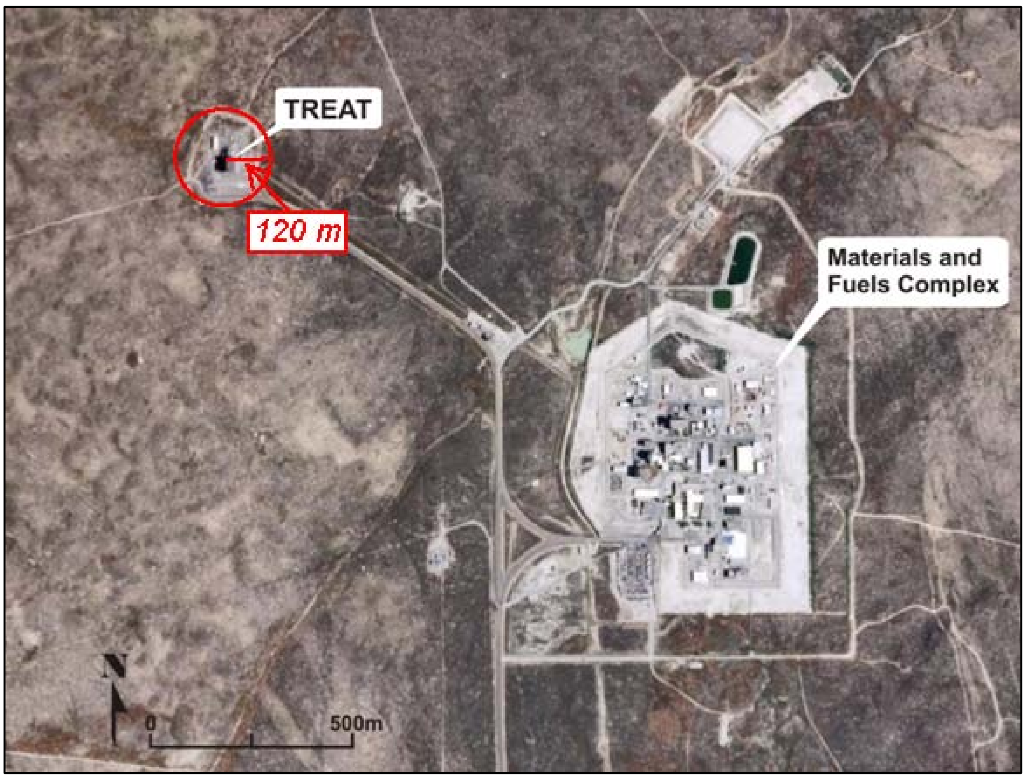


Figure 9. Area modeled for potential maximum potential impact to biota.

4.3 Permits and Regulatory Requirements

Soil and vegetation disturbing activities, including those associated with mowing, blading and grubbing, have the potential to increase noxious weeds and invasive plant species that would be managed according to 7 USC § 2814, "Management of Undesirable Plants on Federal Lands" and Executive Order 13112, "Invasive Species." The INL Site would follow the applicable requirements to manage undesirable plants.

In analyzing the potential ecological impacts of the action alternative for this project, DOE-ID has followed the requirements of the Endangered Species Act (16 USC §1531 et seq.) and has reviewed the most current lists for threatened and endangered plant and animal species. Other federal laws that could apply include: the Fish and Wildlife Coordination Act (16 USC § 661 et seq.), Bald Eagle Protection Act (16 USC § 668), and the Migratory Bird Treaty Act (16 USC § 715–715s).

4.4 Ecological Research and Monitoring

There would be no effect on the continuity and utility of the BBS route at MFC. Continuation of the monitoring route would also provide information on the potential impacts the proposed action could be having on local bird populations, although no impacts are expected.

4.5 Cumulative Impacts

The impacts associated with the proposed action would appear to have no new footprint, have low intensity, and be located in or near areas with much larger impacts to ecological resources. Because of that, no cumulative effects would be anticipated.

4.6 Alternative 2 – Modify ACRR

4.6.1 Biological Resources

This information provided by Sandia National Laboratory.

4.7 Alternative 3 – No Action

5. REFERENCES

7 USC § 2814, 2006, "Management of Undesirable Plants on Federal Lands," United States Code.

16 USC § 661 et seq., 1960, "Fish and Wildlife Coordination Act," United States Code.

16 USC § 668, 1940, "Bald Eagle Protection Act," United States Code.

16 USC § 715-715s, 1918, "Migratory Bird Treaty Act," United States Code.

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6. GLOSSARY

Attainment Area: An area considered to have air quality as good as or better than the National Ambient Air Quality Standards (NAAQS) as defined in the Clean Air Act (CAA). An area may be an attainment area for one pollutant and a nonattainment area for others.

Cladding: The outer layer of nuclear fuel rods that is between the coolant and nuclear fuel; cladding prevents radioactive fission fragments from escaping the fuel into the coolant and contaminating it.

Clean Air Act (CAA): The Federal Clean Air Act, or "CAA," is the basis for the national air pollution control effort. Basic elements of the act include national ambient air quality standards for major air pollutants, hazardous air pollutants, state attainment plans, motor vehicle emission standards, stationary source emission standards and permits, acid rain control measures, stratospheric ozone protection, and enforcement provisions.

Hodoscope: An instrument used to detect passing charged particles that is used to monitor changes in shape of nuclear fuel during a transient experiment.

Hot Cell: Shielded containment chambers that are used to protect workers from radioactive isotopes by providing a safe, containment box in which they can control and manipulate the equipment required.

Neutron: A subatomic particle that has no net electrical charge and mass slightly greater than a proton.

Nonattainment Area: The CAA and its Amendments of 1990 define a “nonattainment area” as a locality where air pollution levels persistently exceed NAAQS (see glossary entry), or that contribute to ambient air quality in a nearby area that fails to meet those standards. The EPA gives nonattainment areas a classification based on the severity of the violation and the type of air quality standard they exceed. EPA designations of nonattainment areas are only based on violations of national air quality standards for carbon monoxide, lead, ozone (1-hour), particulate matter (PM-10), and sulfur dioxide.

Prevention of Significant Deterioration: This term applies to new major sources or major modifications at existing sources for pollutants where the area the sources are located is in attainment or unclassifiable with the NAAQS. It requires installing Best Available Control Technology, air quality analysis, additional impacts analysis, and public involvement.

Transient testing: “Short-term” or “passing quickly.” A test that is completed on nuclear fuels or materials, called an experiment that involves placing the fuel or material into the core of a nuclear reactor and subjecting it to short bursts of intense, high-power radiation. After the experiment is completed, the fuel or material is analyzed to determine the effects of the radiation.

Vadose Zone: A subsurface zone of soil or rock containing fluid under pressure that is less than that of the atmosphere. Pore spaces in the vadose zone are partly filled with water and partly filled with air. The vadose zone is limited by the land surface above and by the water table below.