Supplement Analysis for the Proposed Shipment of High Burnup Research Cask to Idaho National Laboratory for Research and Development Purposes

DOE/EIS-0203-SA-10
DOE/EIS-0250F-S-1-SA-03

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Office of Nuclear Energy
U.S. Department of Energy

U.S. DEPARTMENT of ENERGY

April 2026

PNNL-38351

PACIFIC NORTHWEST NATIONAL LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC05-76RL01830

Printed in the United States of America

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ACRONYMS AND ABBREVIATIONS

BB	Buckingham Branch Railroad
CFA	Central Facilities Area
CFR	*Code of Federal Regulations*
DOE-NE	DOE Office of Nuclear Energy
EIS	environmental impact statement
EPRI	Electric Power Research Institute
ft	foot/feet
ft^2	square foot
GWd/MTU	gigawatt-day(s) per metric ton of uranium
HBU	high burnup
HBURC	High Burnup Research Cask
HBUSFDP	High Burnup Spent Fuel Data Project
HFEF	Hot Fuel Examination Facility
in	inch(es)
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
ISFSI	independent spent fuel storage installation
LCF	latent cancer fatality
LLW	low-level radioactive waste
MFC	Materials and Fuels Complex
m	meter(s)
mi	mile(s)
MLLW	mixed low-level radioactive waste
mrem	millirem(s)
mrem/h	millirem(s) per hour
mSv/hr	millisievert per hour
MTHM	metric ton(s) of heavy metal
MUA	multi-attribute utility analysis
NAPS	North Anna Power (or Generating) Station
NEPA	National Environmental Policy Act of 1969
NRC	U.S. Nuclear Regulatory Commission
NTSF	National Transportation Stakeholders Forum
PCS	permanent containment structure
ROD	Record of Decision
SA	supplement analysis
SNF	spent nuclear fuel
START	Stakeholder Tool for Assessing Radioactive Transportation
TEPP	Transportation Emergency Preparedness Program
UNF	used nuclear fuel

1 INTRODUCTION AND PROPOSED ACTION

1.1 BACKGROUND

In 2013, the U.S. Department of Energy (DOE) Office of Nuclear Energy (DOE-NE) instituted the High Burnup Spent Fuel Data Project (HBUSFDP) in collaboration with the Electric Power Research Institute (EPRI). This project was designed to obtain data to support the enhancement of technical bases for the extended dry storage and transportation of high burnup (HBU) used nuclear fuel (UNF)[1]. HBU UNF is characterized as UNF that has been irradiated in a reactor for more than 45 gigawatt-days per metric ton of uranium (GWd/MTU). Most UNF discharged today from nuclear power plants is HBU. Under the HBUSFDP, a TN-32B bolted lid cask was loaded with 32 HBU UNF assemblies. This cask, referred to as the High Burnup Research Cask (HBURC), was built by AREVA-TN (now Orano) and was modified to allow radial and axial temperature profiles to be measured using thermocouple lances inserted through the lid. The TN-32B cask is licensed for storage and U.S. Nuclear Regulatory Commission (NRC)-certified for transportation (NRC, 2024).

After a period of approximately 10 years under the HBUSFDP, the cask is planned to be transported to a facility to be opened so the UNF can be examined and tested to provide confirmation of laboratory data. The HBURC is currently in a safe storage configuration in an independent spent fuel storage installation (ISFSI) at the North Anna Power Station (NAPS) in Louisa County, Virginia.

In April 2025 the State of Idaho and DOE agreed to a targeted waiver of the 1995 Settlement Agreement that would allow a shipment of spent nuclear fuel (SNF) from NAPS to the Idaho National Laboratory (INL) for the purposes of examination, testing, and development of advanced storage technologies (Idaho, 2025). This research will provide data to support licensing for the extended storage of UNF in the U.S. Currently, UNF is stored at over 100 sites, in 35 States (PNNL, 2024). Fifty-three nuclear power plants are relying on data from the HBURC to support license renewals for their onsite ISFSIs, which is necessary for those power plants to continue to operate. DOE will also need this data to license a Federal UNF staging facility.

Idaho Settlement Agreement

In October 1995, the State of Idaho, U.S. Navy, and DOE reached an agreement settling a lawsuit filed by the State to require several actions, including, but not limited to, the following:

- prevent shipments of SNF to INL for permanent storage,
- remove various forms of transuranic waste from Idaho,
- treat and remove certain high-level radioactive waste streams from the State, and
- transfer SNF from wet storage into dry storage.

The agreement commits DOE to move SNF out of Idaho by January 1, 2035.

[1] The term “used nuclear fuel” is intended to be synonymous with the term “spent nuclear fuel” as used and defined in the Nuclear Waste Policy Act of 1982, as amended, and the Standard Contract for the Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste (Title 10 of the *Code of Federal Regulations* [10 CFR] Part 961). For clarity and consistency, this document uses the term "spent nuclear fuel" when referencing prior agreements, such as the 1995 Idaho Settlement Agreement, along with names of existing facilities, project names, and historical documentation and analyses. All other instances, the term “used nuclear fuel” is used.

1.2 PURPOSE AND NEED FOR AGENCY ACTION

DOE needs to continue with the HBUSFDP and transfer the HBURC to a facility capable of examination and testing of HBU UNF. These types of facilities do not exist at NAPS but are available at some DOE national laboratories. The removal and eventual opening of the TN-32B research cask will provide DOE with the opportunity to gather data that will support continued safe storage of UNF at existing nuclear power plants, or a future Federal staging facility. This effort will also help build public trust and confidence by demonstrating DOE's ability to safely and securely transport commercial UNF using DOE's certified Atlas rail consist.

1.3 FEDERAL PROPOSED ACTION

In coordination with EPRI, DOE-NE is proposing to ship the loaded HBURC, by rail from NAPS to the INL site for further examination. The HBURC shipment would also represent the first rail shipment of UNF using the Atlas rail consist, which includes the 12-axle Atlas cask-carrying railcar, 2 buffer railcars, and the rail escort vehicle. The Atlas rail consist was developed by DOE and specifically designed to safely and securely transport UNF[2].

INL has been demonstrated to have the necessary existing infrastructure and capabilities to receive, store, and open the HBURC, and to examine the UNF[3].

The Federal proposed action to be evaluated in this supplement analysis (SA) includes activities prior to shipment at NAPS, during the shipment, and associated with receipt and handling at the INL site. The basic list of these activities is included below, while more detail on each activity is provided in Sections 1.3.1 through 1.3.3. While there are planning and engagement activities that will occur prior to the initiation of the HBURC shipment, they are not evaluated in detail in this SA because their impacts would be limited to meetings and demonstrations involving no hazardous materials and limited to actions within existing infrastructure. The specific activities addressed in this SA include:

- Activities at NAPS (Section 1.3.1)
  - Transfer of the loaded TN-32B cask from the ISFSI at NAPS to the NAPS Fuel Handling Building for preliminary testing (e.g., gas sampling of the interior cavity of the TN-32B cask)[4].
  - Implementation of any required infrastructure improvements at NAPS to facilitate the shipment of the TN-32B HBURC.

[2] Details about the Atlas railcar can be found at: https://www.energy.gov/ne/articles/new-railcar-designed-transport-spent-nuclear-fuel-cleared-operation.

[3] Additional background on the INL facilities can be found at: https://idaho-environmental.com/Documents/ProjectFiles/wm/INTEC_062123.pdf and https://mfc.inl.gov/SiteAssets/FACILITY_FACT_SHEETS/MFC%20factsheets%20updated%20March%202021/21-50083_HFEF_R0.pdf.

[4] The loaded TN-32B cask consists of a UNF basket assembly, a containment vessel, a forged steel shell body, a radial neutron shielding, and impact limiters. The UNF basket consists of a honeycomb-like structure of stainless-steel cells, housing 32 fuel assemblies (~264 rods per assembly), separated by aluminum and poison plates that form a sandwich panel. The total combined weight of the TN-32B cask, cradle, personnel barrier, and end stops is about 180 tons and the UNF would represent about 14.9 metric tons of heavy metal (MTHM).

- Shipment planning and transportation of the loaded TN-32B cask to the INL site using the Atlas rail consist (Section 1.3.2).
- Activities at the INL site (Section 1.3.3) include:
  - Implementation of any required infrastructure improvements at INL to facilitate the receipt of the TN-32B HBURC.
  - Receipt and storage of the cask at an existing CPP-2707 Cask Pad Facility (CPP-2707 storage pad)[5] inside the security area at the Idaho Nuclear Technology and Engineering Center (INTEC).
  - Transfer of the HBURC to the CPP-603 (Irradiated Fuel Storage Facility) for opening of the cask (likely after some predetermined storage time).
  - Transfer of select fuel rods to the onsite hot cell in the Materials and Fuels Complex (MFC) located on the INL site.
- Internal gas sampling and other post-irradiation examination including non-destructive and destructive examination of full and partial fuel rods and cladding (activities would occur within MFC).
  - Storage of remaining fuel rods and assemblies in the TN-32B cask on the CPP-2707 storage pad at INTEC.
  - Handling, storage, and disposal of generated waste (hazardous and radioactive) in accordance with DOE Order 435.1, Radioactive Waste Management.

1.3.1 Activities at North Anna Power Station

The TN-32B storage system at NAPS is shown in Figure 1-1. The cask body is composed of carbon steel that is 8-inches (in) thick and provides radiation shielding and structural stability. The cask stands approximately 202 in (16 feet [ft], 10 inches [in]) tall with a 102 in (8 ft, 6 in) diameter and weighs approximately 180 tons when fully loaded, including impact limiters, cradle, personnel barrier, and end stops. The cask has a bolted confinement lid, a top neutron shield plate, a neutron shield surrounding the cask body, a protective cover, and an overpressure monitoring system. The lid is bolted with dual metallic O-rings to create a leak-tight seal, preventing the release of radioactive gases. Internally, the TN-32B features a borated stainless-steel basket that holds 32 fuel assemblies. Each basket compartment is designed to house a single fuel assembly, maintaining proper spacing to ensure adequate thermal dissipation and subcriticality. The basket design includes plates with high boron content to enhance neutron absorption, which is important to maintaining subcriticality. The basket's cell walls are reinforced to prevent the fuel assemblies from shifting during handling, ensuring that they remain fixed in place throughout storage and transport.

The HBURC has been modified from the standard TN-32B casks to allow for thermal monitoring during UNF storage. The HBURC is licensed for storage under the NAPS site-specific license (SNM-2507). The TN-32B HBURC has also been certified for a one-time use shipment (NRC, 2024).

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[5] The CPP-2707 Cask Pad Facility comprises a 6,900 square foot (ft^2) reinforced-concrete storage pad designed to accommodate fuel-loaded casks, supported by an asphalt apron and enclosed by a perimeter security fence with controlled, gated entry and exit points.

The loaded HBURC cask is currently stored in an ISFSI at NAPS under its current license with the NRC under Title 10 *Code of Federal Regulations* (10 CFR) Part 72. Any operations or activities within the NAPS boundary would be accomplished in accordance with that NRC license and is not the subject of review under this SA. However, for completeness, the SA describes the proposed activities associated with the HBURC shipment and the onsite infrastructure.

Prior to shipment of the HBURC from NAPS, the cask would be transferred to the NAPS cask receiving area for preliminary testing (e.g., gas sampling of the interior cavity of the TN-32B cask). The HBURC would be cleared for transport in accordance with site operating procedures before leaving the cask receiving area (e.g., verified absence of external contamination).

Figure 1-1. TN-32 storage casks at the North Anna Power Station site independent spent fuel storage installation (showing the TN-32B HBURC with solar panel).

The NAPS site is directly rail-served by a Class III short line railroad called the Buckingham Branch Railroad (BB). There is a northern rail spur that serves NAPS from the point of switch[6] on the BB short line. Figure 1-2 provides an overview of the NAPS site and shows the BB short line and available onsite haul routes that would be used to move the HBURC from the ISFSI to the cask receiving area and to the potential onsite transload location.

In 2024, the NAPS northern rail spur was refurbished to support receipt of a new transformer. The transformer unloading location is at location ⑤ in Figure 1-2. The track extends west to the NAPS point of switch for approximately another 2,943 ft that could be used for staging cars. Ideally, NAPS could choose to add additional track to the northern spur, east of the switchyard for more flexibility in loading trains or multiple cars. The refurbishments completed at this point are adequate for transport of the HBURC.

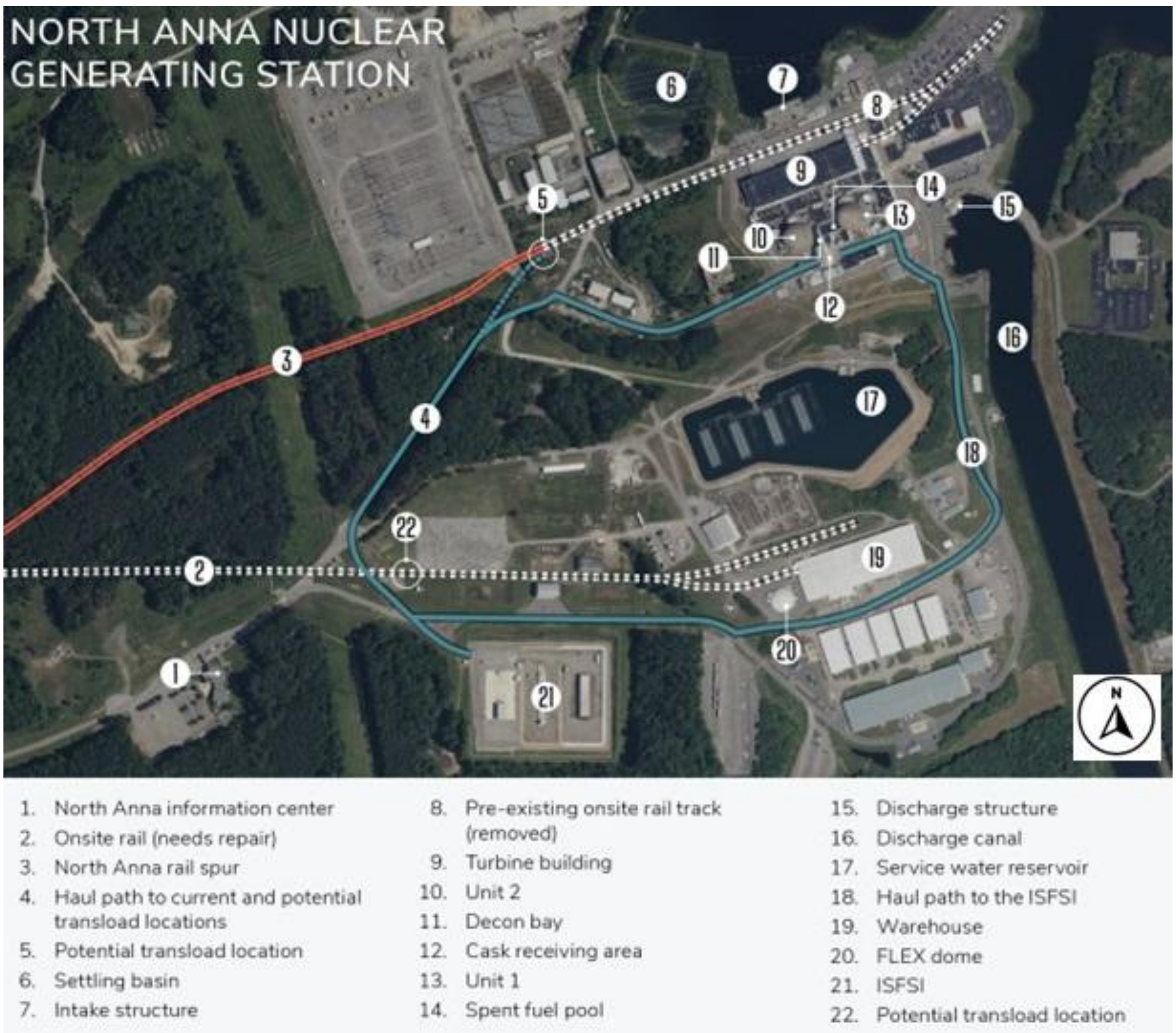

Figure 1-2. North Anna Power Station site structure and layout.

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[6] A point of switch is mechanical installation-enabling railway trains to be guided from one track (in this case the NAPS site spur line) to another, such as at a railway junction or where another spur or siding branches off.

1.3.2 Transportation Activities

Transportation of the HBURC from NAPS to the INL site would use the Atlas rail consist and involve significant shipment planning and coordination activities. Preliminary routes have been developed for this analysis, however, the final route for the HBURC shipment will not be identified by rail carriers until closer to its implementation. These elements are briefly described in the following sections.

1.3.2.1 Atlas Rail Consist

DOE developed the Atlas rail consist to support future, large-scale DOE transport of UNF from nuclear power plants. The Atlas rail consist includes the 12-axle Atlas cask-carrying railcar, 2 buffer railcars, and the rail escort vehicle for security personnel (Figure 1-3). All railcars have completed the necessary testing and meet North American freight rail safety standards.

The Atlas railcar is designed to carry UNF casks weighing between 82 tons and 210 tons. The railcar design process included extensive dynamic computer modeling to simulate how the railcar design would perform with different railcar components, different container attachment mechanisms, and different container weights. In addition, single-car and multiple-car testing occurred, including a revenue service test and a demonstration test run. The Atlas railcar received certification by the Association of American Railroads in June 2024[7].

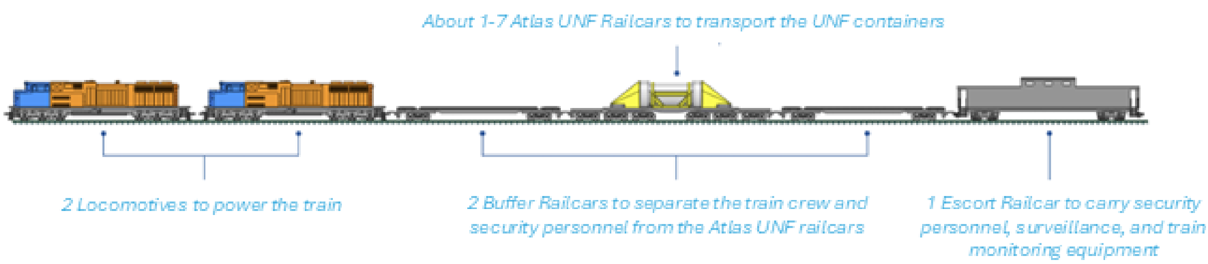

Figure 1-3. Atlas rail consist.

1.3.2.2 Shipment Planning

Shipment planning is a collaborative effort among DOE, EPRI, Orano, Dominion Energy, and DOE national laboratory staff. Shipment planning activities have been ongoing. Examples of completed activities include certification of the TN-32B for transport and a visit to NAPS and INL to evaluate the onsite and near-site transportation infrastructure.

Shipment planning activities to be conducted in the near term include fabricating impact limiters and a transport cradle for the HBURC, evaluation of the potential impacts in accordance with the National Environmental Policy Act of 1969 (NEPA) (this SA), developing a route-specific transportation plan, exploring options for providing armed escorts that would have the necessary authorizations and training to escort the shipment, preparing for a dry run and possible other

[7] Additional information about the Atlas railcar certification and testing can be found at: https://www.energy.gov/ne/articles/new-railcar-designed-transport-spent-nuclear-fuel-cleared-operation.

engagement opportunities for local first responders along the transportation route, and maintaining close communications with the origin and receiving sites.

Fabricating Impact Limiters and a Cradle

Impact limiters, a transport cradle, and end stops would be manufactured in preparation for the shipment. Figure 1-4, which is a picture of a demonstration configuration using a test weight instead of the real TN-32B cask, illustrates the location and purpose of these elements associated with shipping the HBURC. As shown in Figure 1-4, the impact limiters are the large round disks (generally constructed of wood and other materials) at each end of the cask, which would be designed to absorb much of the energy in a potential accident. Constructing the impact limiters would require a sufficient supply of wood that meets the specific material standards for the TN-32B. Once completed, the impact limiters would be delivered to a location where they would be fit-tested on an empty TN-32B cask. Prior to shipment, they would be transported to NAPS and installed onto the HBURC. Additionally, a specialized cradle designed to securely attach the TN-32B to the Atlas railcar's deck, as well as end stops essential for its safe rail transport, would be fabricated. The steel cradle, similar to the example shown in the center of Figure 1-4, would securely restrain lateral movement of the HBURC in the center of the railcar and the end stops (similar to the examples at each end of the test weight in Figure 1-4), would restrain any longitudinal movement of the cask.

Figure 1-4. Atlas railcar at the National Transportation Stakeholders Forum.

Route-Specific Transportation Plan

A detailed transportation plan will be developed describing how transportation requirements and other project-specific objectives would be met. The plan would cover topics such as analysis for expected modes of transportation, handling operations, regulatory expectations for compliance, radiation protection, emergency response, accident recovery, and communications.

Armed Escorts

The HBURC would be shipped in accordance with DOE Order 460.2B, Departmental Materials Transportation Management. DOE Order 460.2B requires that shipments of SNF by rail be accompanied by a minimum of two armed escorts. The HBURC shipment planning team is investigating and evaluating options for armed escorts to accompany the shipment. Options such as railroad police and DOE-trained and DOE-authorized security personnel would be considered. Regardless of the approach used to meet the requirements for armed escorts, DOE would maintain engagement with security staff at the origin (NAPS) and destination (INL) sites and coordinate with local law enforcement agencies in the vicinities of the origin and destination sites and along the transportation route in preparation for the shipment.

Dry Run and Other Outreach Events

Prior to the actual shipment, DOE expects to conduct a dry run and other events to support public outreach and training. The dry run would involve placing an empty TN-32B onto the Atlas railcar, transporting it to the INL site along the planned transportation route and practice sessions of the unloading operations. This activity allows a real-life exercise for both physical and communications operations in advance of the actual shipment. Other outreach events could include public engagement opportunities during the return trip to NAPS along the potential route. Like the dry run, the empty TN-32B would not contain any radiological materials but would demonstrate the cask, cradle, and impact limiters that would be used on the actual shipment. The schedule for the dry run would leave sufficient time between its implementation and the actual shipment to change plans or refine operations, if needed.

Following the HBURC shipment to INL, the empty TN-32B cask and associated equipment (cradle, mock impact limiters) that was used for the dry run would be shipped from NAPS to the INL site for storage.

1.3.2.3 Engagement and Outreach

DOE plans to launch a series of activities and engagements to promote readiness along the transportation route and build public trust and confidence in UNF transportation safety and security. The series of engagements could include tabletop and/or simulation exercises with security and emergency response officials; training events in cooperation with DOE Office of Environmental Management Transportation Emergency Preparedness Program; training events in cooperation with the Federal Bureau of Investigation, and National Nuclear Security Administration; meetings with local officials at the origin, destination, and sites along the transportation route; and close coordination with other DOE public engagement efforts.

Because the HBURC shipment would be the first cross-country rail shipment by DOE of commercial UNF since 2003 and because the railcars and casks used would be conspicuous, DOE would initiate some public engagement efforts in advance of the shipment to familiarize jurisdictions and communities along the route with the upcoming shipment and address concerns and questions they may have. Engagements would range from conversations and information exchanges with Tribal and State officials along the route to online public webinars to other potential in-person events to demonstrate and discuss the safety and security of UNF transport using the Atlas rail consist as an exhibit. Public information sharing in advance of the shipment will be subject to security assessments of what level of information is appropriate to be shared and with whom.

Under DOE Order 460.2B, the shipper is required to coordinate with Transportation Emergency Preparedness Program to determine the emergency response planning and training needs of Tribal, State and local first responders along the transportation route.

DOE is, and will continue, engaging directly with Tribes and States at the origin site and destination site and along the route(s). Once the final route is determined, DOE will focus engagement along that route rather than the preliminary routes discussed in the next section. This engagement includes offering information exchange and consultation with federally-recognized Tribes with reservation or trust lands within 50 mi (miles) of the origin site, destination site, and route(s).

Regarding the additional outreach events, once the dry run has been completed, the Atlas railcar and ancillary equipment for the HBURC would return to NAPS. There’s a possibility of a training exercise in coordination with the Naval Reactors transport program in Virginia, to unload the empty cask and prepare for the HBURC shipment. This engagement would be similar to the exhibition of the Atlas railcar at the 2024 meeting of the National Transportation Stakeholders Forum (NTSF) in Denver, shown earlier in Figure 1-4. For the NTSF exhibition, the Atlas railcar was not carrying an UNF cask but rather a test weight designed to be equivalent in mass and center of gravity to the HI-STAR 190XL, which is the maximum design load for the Atlas railcar. Outreach events prior to the HBURC shipment would use an empty TN-32B cask in order to appear as similar as possible to the actual HBURC shipment (i.e., the Atlas railcar would have a real transportation cask but no labels or placards, because it would not be carrying radioactive materials).

1.3.2.4 Rail Routing

As part of the preliminary planning for the eventual de-inventory of the UNF stored at NAPS, DOE is preparing an initial site-specific de-inventory report for NAPS (DOE, 2025). The draft de-inventory report includes a multi-attribute utility analysis (MUA) to evaluate several potential routes and modes for shipping the transportation systems from the NAPS ISFSI to either a Federal staging facility or a deep geologic repository. The diversity of these routes reflects the multiple viable approaches to shipping the UNF (i.e., by direct rail, heavy-haul truck [HHT], or barge), and the access of NAPS to these modes of transport. Furthermore, these routes potentially have both positive attributes (e.g., safe and secure transport) and negative attributes (e.g., expense), meriting an assessment approach that can evaluate these attributes in a combined manner that may distinguish one route from another and/or rank and prioritize routes. For the MUA in the draft NAPS de-inventory report, DOE is using a generic point referred to as the geographic center of the U.S. This point is used for comparison of all de-inventory reports for other commercial nuclear plants.

The MUA is in a draft stage but is a structured methodology designed to handle the trade-offs among multiple objectives (e.g., attributes). The MUA provides a transparent, rational, and defensible analysis that is easy to communicate. Along with an evaluation of security and vulnerability, other examples of the positive and negative attributes evaluated in the MUA include the following:

- Cost
  - hardware procurement
  - infrastructure improvement
  - labor
  - permitting
  - transport costs
- Environmental impact
  - aesthetic changes resulting from improvements
  - proximity to cultural, archeological, or historic resources
  - route characteristics (e.g., terrain, grade, tunnels)
  - number of water bodies
- Institutional consideration
  - sensitive populations (e.g., schools, hospitals, malls, churches)
  - Tribal lands
- Permitting
  - ease of permit procurement
  - number of permits
  - insurability
- Resource requirements
  - number of personnel for transfers
  - availability of specialty equipment (e.g., rigging, transfer cask)
- Safety
  - cumulative worker or population radiation exposure
  - risks associated with intermodal transfer
  - average accident frequency on route
  - number of fire stations and trained personnel near route
- Schedule
  - transit duration
  - duration for infrastructure improvements
  - immediacy of ability to perform transfer (i.e., trained crew)

The preliminary results of the NAPS MUA indicate that of the six reasonable route combinations, the two most preferred would be direct rail routes from NAPS directly to the destination, therefore the likely shipment route to the INL site would involve direct rail shipment leaving the NAPS on the northern NAPS spur line to the BB short line.

For analytical purposes, the potential route characteristics are obtained from DOE's Stakeholder Tool for Assessing Radioactive Transportation (START) program[8]. Figure 1-5 provides a graphical representation of three potential routes from NAPS to the INL site that consist of multiple route segments that could be used in several combinations. Examples of the route characteristics that are available from the START program include (1) length of route, (2) duration of the proposed shipment, and (3) number of residents within predetermined distances (800 and 2,500 m) from the route. Because the actual route used for the shipment would be determined closer to the actual shipment, the characteristics used in this analysis represent a range of parameters based on these three route options. For the purposes of the analysis in this SA, it is more important to understand the range of particular characteristics of the various route possibilities as opposed to limiting the analysis to a single route that could change in the future.

Figure 1-5. Potential rail routes from North Anna Power Station to the Idaho National Laboratory site.

Based on these potential rail routes (or combinations of route segments), the parameters used in the analysis are presented in Table 1-1. Note that the peak values of each parameter were not all associated with a single route. Therefore, the analysis presented would bound any selection of routes within this range.

Table 1-1. Rail route parameters.

Parameter	Range	Value Used
Length of the route (mi)	2,869–3,175	3,175
Duration of Shipment (h)	78-80	80
Population within 800 meters (m) (×1,000)	1,330–1,610	1,610

800 m is roughly equivalent to 0.5 mi.

[8] https://start.energy.gov/Account/Login?ReturnUrl=%2f.

In addition to the analytical parameters described in Table 1-1, other information regarding these routes and route segments can be obtained from the START program. Examples include the length of the route that crosses sensitive environmental areas (6 to 10 percent of the route segment length) or Tribal lands (0.1 to 3.0 percent of the route segment length). Because these are existing rail corridors that currently support commerce in the U.S. and DOE is not proposing any land disturbance or construction along those corridors, these parameters do not affect the evaluation of potential environmental impacts are not discussed further.

1.3.3 Activities at Idaho National Laboratory

After transportation from NAPS, the ultimate destination for the HBURC at INL is the CPP-2707 storage pad inside the security area at INTEC. Once onsite, activities at INL would be grouped into two parts (1) cask receipt and offloading, and (2) onsite UNF actions.

1.3.3.1 Cask Receipt and Offloading

Cask receipt and offloading of the HBURC from the main rail line could occur in either of two locations. The options are described here for comparative analysis; however, a particular selection has not yet been made. These options would require different levels of preparation and would affect the workload for cask receipt. A decision on which option to proceed with is expected to be made by DOE by the end of 2025.

Option 1—Offload from rail at the Central Facilities Area (CFA) spur or rail yard

The HBURC would be offloaded from the main rail line at the CFA railyard (dark blue line in Figure 1-6 running from upper right to lower left) located in the south-central portion of the INL site, approximately 3 mi west-northwest of the intersection of Highways 20 and 26 (Figure 1-7). This option may require sections of existing rail to be refurbished. Refurbishment would consist of replacing ties, rail retention hardware, and ballast within the existing railbed. Improvements, including grading, placement of base material and pavement, to existing roadways may also be needed. Several areas at CFA could be suitable. These are shown in Figure 1-6 with red lines. Selection would depend on the duration needed for Atlas to be present and therefore blocking other traffic and the necessary scope for refurbishment, ground preparation, and heavy equipment access. Once offloaded, the HBURC would be transferred to a heavy-haul truck or self-propelled modular transporter. Example photos are shown in Figure 1-8. The distance from the CFA railyard to the CPP-2707 storage pad at INTEC is about 3.5 mi to the north.

Figure 1-6. Idaho National Laboratory (INL) Central Facilities Area railyard options (INL site).

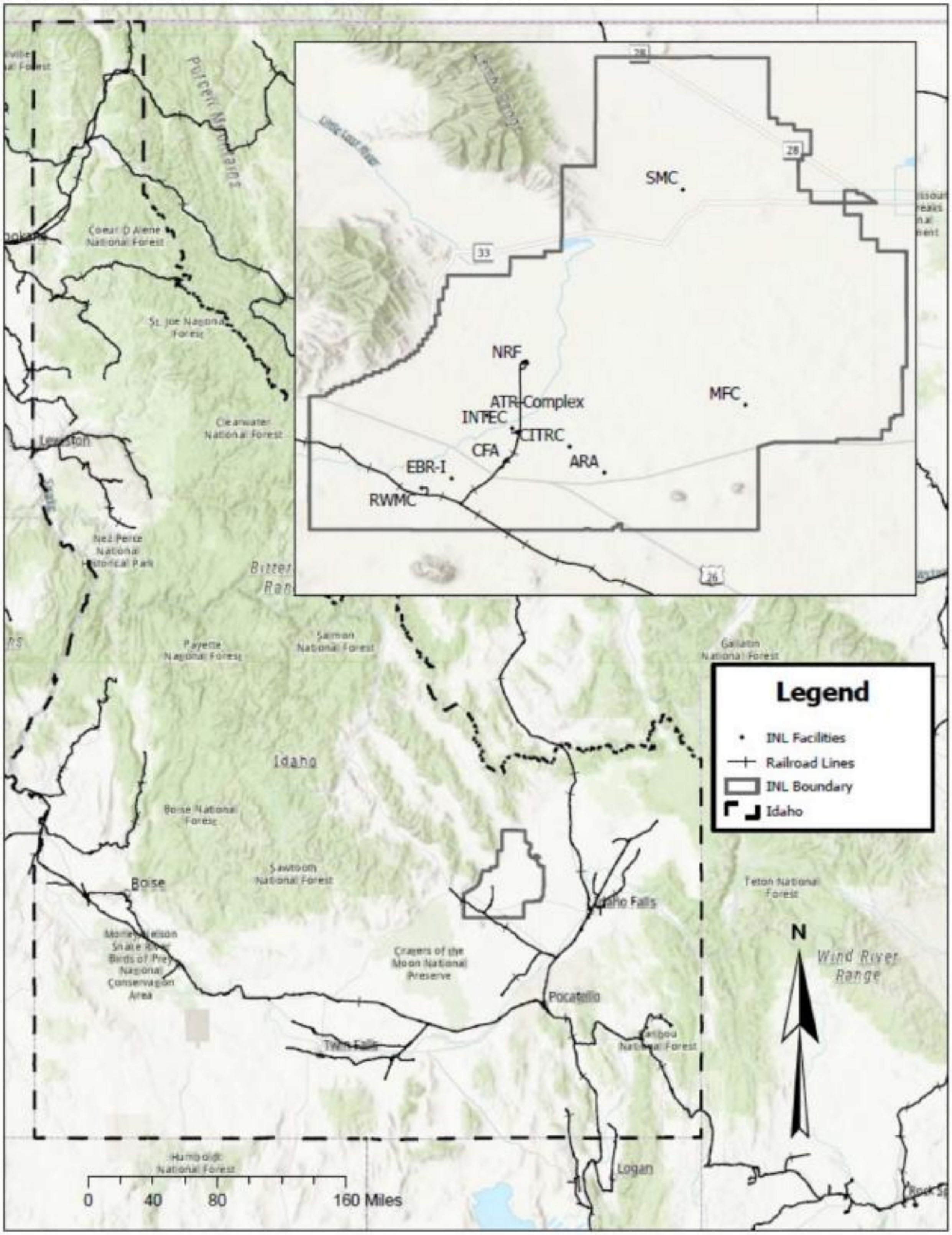

Figure 1-7. Idaho National Laboratory railway system and facility locations.

Figure 1-8. Transportation options—Heavy-haul truck (left) and self-propelled modular transporter (right).

Option 2—Offload from a rail spur at the nearest location to INTEC

This option is similar to Option 1 but would involve a different section of the onsite rail system for refurbishment (about 3.5 mi north of the CFA). The main rail line runs adjacent to INTEC (dark blue line on Figure 1-9 on the right side of the figure). Parts of the inactive rail line (red line in Figure 1-9) may require upgrades for planned activities as described in Option 1. An area near the rail may need to be prepared for heavy equipment (crane) operation, such as by clearing or compaction, although existing areas may be sufficient. After offloading, the HBURC would be transferred to the CPP-2707 storage pad.

Figure 1-9. Idaho Nuclear Technology and Engineering Center rail access options (Idaho National Laboratory site).

1.3.3.2 Onsite UNF Actions

After receipt of the HBURC within the INTEC fence line, the cask initially would be placed on the existing CPP-2707 storage pad (as shown in Figure 1-9). The cask is expected to remain on the pad for a predetermined amount of time until onsite processing takes place in the Irradiated Fuel Storage Facility (CPP-603) (also shown on Figure 1-9) and in the Hot Fuel Examination Facility (HFEF) at MFC.

When ready for onsite processing, the HBURC would be transferred to the CPP-603 facility. The essential elements of the CPP-603 facility include (refer to Figure 1-10 for a plan view of the CPP-603):

- cask receiving area,
- permanent containment structure (PCS),
- transfer pit and cask transfer car, and
- fuel-handling cave.

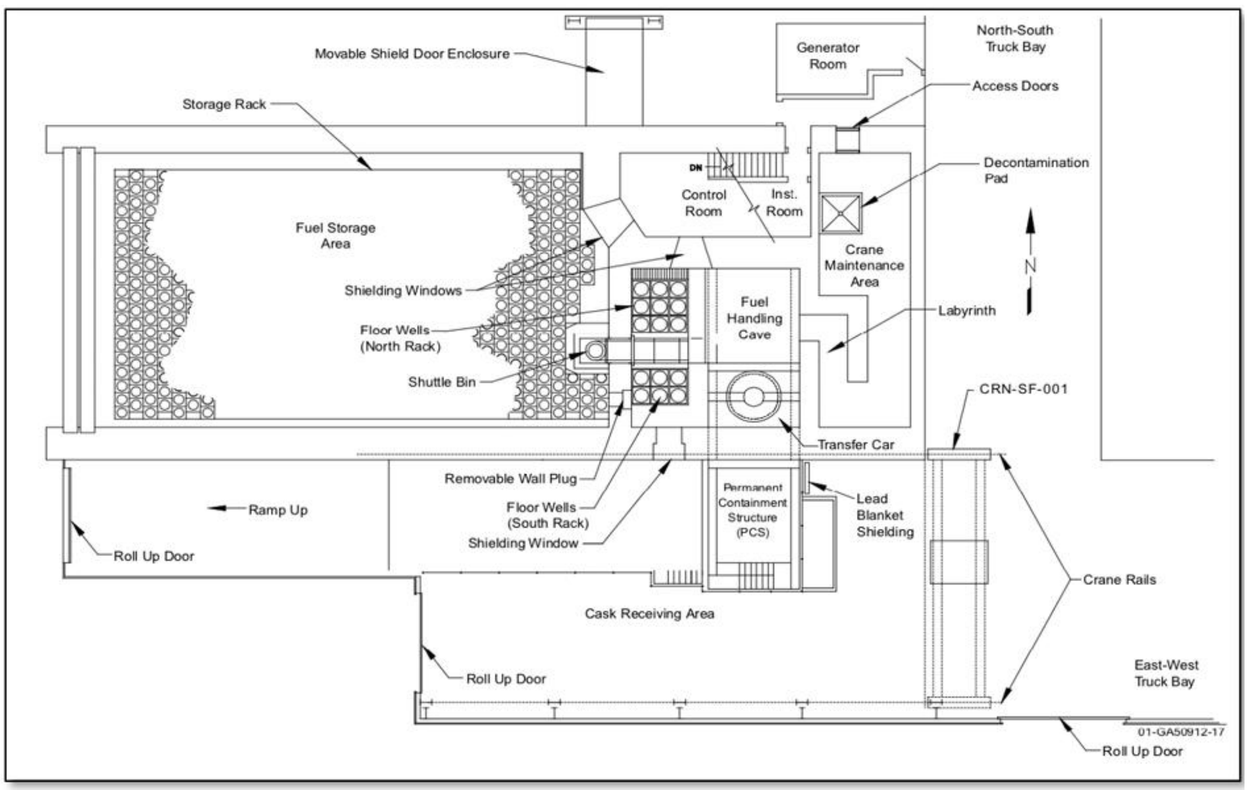

Figure 1-10. Plan view of CPP-603.

The transfer vehicle with the HBURC would enter the cask receiving area; the HBURC may need to be down-ended and/or up-ended depending on the type of cask transporter used to transfer the cask from the CPP-2707 storage pad to the CPP-603 building, and the overhead crane clearance and condition of the truck ramp inside CPP-603. Once secured in the cask receiving area, the HBURC would be lifted by overhead crane and moved into the cask transfer car positioned inside the PCS. The PCS, sitting above the south end of the transfer pit, has top and side panels that can be opened to provide crane access and allow the transfer of the cask to and from the cask transfer car. The PCS is the radiological boundary between the fuel-handling cave and the cask receiving area and confines any possible contamination that could be transferred out of the fuel-handling cave during operational use. Once inside the PCS, a cask going to or from the fuel-handling cave can be surveyed, vented, and decontaminated, if necessary. Cask lids are normally unbolted or unsealed, but not removed, in the PCS prior to movement of the cask into the fuel-handling cave.

Once inside the fuel-handling cave, the existing cranes would remove and set aside the HBURC lid, and the desired fuel assemblies would be retrieved for examination. The fuel-handling cave is equipped with two cranes, one with an electromechanical manipulator with a hoist, mounted on a common trolley and bridge; wall-mounted manipulators; two shielding windows; a video camera system; and floor wells for temporarily storing fuel storage canisters.

Beyond the in-cave fuel examination, selected fuel rods would be transferred out of the INTEC CPP-603 fuel-handling cave and moved to other fuel examination facilities at MFC. These selected fuel rods would be removed from an assembly and placed in a transfer cask-specific internal basket, for later placement in a canister specific to the chosen transfer cask that will be used to move the rods to the HFEF at MFC. These fuel rods would be replaced by inert pins in the assembly, as appropriate. Fuel examinations and testing at the HFEF are expected to be conducted according to appropriate test and examination plans. These activities, including internal gas sampling and other non-destructive and destructive examination of full and partial fuel rods and cladding are consistent with the current operating basis and documented safety analyses for the facilities at HFEF.

After the select fuel rods have been removed and transferred to the HFEF, the HBURC (with the remaining UNF) would have its lid replaced and returned to the CPP-2707 storage pad to await final disposition. DOE's current plan is that final disposition would require shipment to either a Federal staging facility or a deep geologic repository; an action which would require additional NEPA evaluation. The HBURC can be safely stored on the CPP-2707 storage pad until that time.

1.4 SCOPE OF THIS SUPPLEMENT ANALYSIS

This SA has been prepared in accordance with DOE NEPA implementing procedures[9]. This SA evaluates whether the Federal proposed action warrants preparing a supplemental environmental impact statement (EIS), a new EIS, or no further NEPA documentation. In this SA, DOE considers whether there are substantial changes to the original proposed action evaluated in an earlier EIS or significant new circumstances or information relevant to environmental concerns.

1.5 PUBLIC PARTICIPATION

Pursuant to DOE implementing procedures and guidance, the preparation of a SA does not necessitate comment solicitation. Nevertheless, both the State of Idaho and the Shoshone-Bannock Tribes were afforded the opportunity to review and provide input on the SA. All comments received were duly considered, and the final document was revised as necessary.

[9] *See* https://www.energy.gov/nepa/articles/doe-nepa-implementing-procedures-june-2025.

1.6 RELEVANT NATIONAL ENVIRONMENTAL POLICY ACT DOCUMENTS

The following NEPA documents are relevant to the Federal proposed action described in Section 1.3. The discussions that follow describe the relevance of these NEPA documents to the Federal proposed action and explain how DOE used these documents to help determine whether there are any significant new circumstances or information relevant to environmental concerns.

- ***Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement*, DOE/EIS-0203 (1995 programmatic EIS-DOE, 1995).** The 1995 programmatic EIS contains an analysis of the potential environmental impacts associated with managing DOE's complex-wide UNF program from 1995 until 2035. The 1995 programmatic EIS, Record of Decision (ROD), and amended ROD provide the NEPA analysis for:

  – Shipments of SNF, such as those proposed in this SA, to the INL site (see specifically Appendix I of the 1995 programmatic EIS; Section 3.1 and 3.2.1 of the ROD; and Tables 1.1 and 1.2 of the amended ROD).

  – Research and operations involving UNF, such as those proposed in this SA, at INL (see specifically Section 3.1.4.4 of Appendix B of the 1995 programmatic EIS). As discussed in that section, DOE evaluated operations that would be conducted at INL with UNF. Specifically, that section states that, "this alternative [the selected Alternative 4a] would include the continuation of activities related to the treatment of spent nuclear fuel, including research and development (e.g., Electrometallurgical Process Demonstration Project), and the construction of the Dry Fuels Storage Facility. DOE would initiate pilot programs as needed to support future decisions on spent nuclear fuel management and disposition. DOE would use historic data on spent nuclear fuel to provide the bounding case for a determination of the impacts associated with potential pilot program activities."

  The 1995 programmatic EIS provides a baseline against which the potential impacts of the Federal proposed action in this SA can be compared and evaluated. Specifically, this SA evaluates (1) the potential transportation impacts of the Federal proposed action against the transportation analysis in Appendix I of the 1995 programmatic EIS; and (2) the potential impacts associated with research and operations at the INL site related to the treatment of UNF (including research and development), against the analysis in the 1995 programmatic EIS.

- ***Final Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada,* DOE/EIS-0250F-S1 (DOE, 2008).** In June 2008, DOE completed the Yucca Mountain supplemental EIS, which provides an analysis of the potential environmental impacts associated with constructing, operating, monitoring, and eventually closing a deep geologic repository at Yucca Mountain for the disposal of UNF and high-level radioactive waste. The supplemental EIS also evaluates the potential impacts of transporting UNF by truck and rail, including commercial UNF associated with the Federal proposed action evaluated in this SA. The SEIS provides a baseline against which the potential impacts of SNF transportation from the Federal proposed action in this SA can be compared and evaluated; including those from potential accidents and intentional destructive acts.

2 ENVIRONMENTAL CONSEQUENCE EVALUATION

2.1 INTRODUCTION

DOE conducted an initial screening review to identify the differences between the Federal proposed action from the actions evaluated in the 1995 programmatic EIS and the 2008 Yucca Mountain supplemental EIS. Resource areas that would be unaffected or any impacts that would be minimal and clearly bounded by the previous analyses were screened from detailed analysis in this HBURC SA. Section 2.2 describes the results of that initial screening review. For those resource areas that warranted additional evaluation, Section 2.2 provides the analysis of the potential environmental impacts associated with the differences identified in Section 2.2.

2.2 INITIAL SCREENING REVIEW

Implementation of the Federal proposed action represents activities that were listed and defined in detail in Section 1.3 and include activities at NAPS, transportation activities, and activities at the INL site.

As noted in Section 1.3.1, any operations or activities within the NAPS boundary would be performed in accordance with the existing NRC license and NEPA purview and are not the subject of review under this SA[10]. Therefore, the movement of the HBURC on the NAPS site, gas sampling of the interior cavity, and loading of the HBURC on the Atlas rail consist is not further addressed in this SA.

As described in Section 1.3.2 (transportation activities), there are a number of planned actions that would be a precursor to the actual transportation of the HBURC. Many of these predecessor activities (e.g., shipment planning, outreach and training) are administrative in nature and not considered further in the evaluation of potential environmental impacts. Others are standard activities that are not unique to the Federal proposed action. These include the fabrication of impact limiters and cradle for the HBURC shipment and the demonstration (or dry) run of the Atlas consist without the loaded HBURC. DOE would build (or have built) the custom-made parts to fit the TN-32B cask for the shipment. This action would not involve hazardous or radiological materials, would not involve any land disturbance, would not use unique or specialized construction materials, or introduce any unique risks to workers or the public. The dry run would involve a single transport of the Atlas rail consist on existing rail lines with no hazardous or radiological cargo. The dry run of the Atlas rail consist would be part of DOE's planning and preparation and would not result in notable environmental impacts beyond those addressed in the 1995 programmatic EIS or Yucca Mountain supplemental EIS. The only contributions to potential impacts would be the emissions of criteria pollutants associated with the single shipment, the noise from the locomotive, and the nonradiological accident risks associated with a potential transportation incident involving the unloaded rail consist. Since the additional impacts from the above mentioned contributions are minor when added to the total impact of the actual transportation of the HBURC, they are not discussed further. The transportation of the HBURC is

[10] NRC NEPA evaluation of the license renewal at NAPS can be found at https://www.nrc.gov/docs/ML2420/ML24204A104.pdf.

further evaluated in Section 2.3, both for incident-free impacts (Section 2.3.1) and potential accidents (Section 2.3.2).

Section 1.3.3 describes the activities that would occur at INL, which include (1) cask receipt and offloading and (2) established research actions for UNF on the INL site. Cask receipt may require refurbishment of existing rail and roadway infrastructure at one of two possible locations (the CFA railyard or a rail spur near INTEC) per the discussion in Section 1.3.3.1. Refurbishment would consist of replacing ties, rail retention hardware, ballast within the existing railbed[11], and placement of road base and pavement. There would be no new land disturbance associated with the refurbishment. Whether the receipt occurs at the CFA railyard or the rail spur near INTEC is immaterial to the evaluation in this SA.

The onsite UNF actions at INL would include:

- unloading of the HBURC at the INL site;
- transfer of the HBURC to the existing CPP-2707 storage pad;
- transfer of the HBURC to the CPP-603 facility to remove select fuel rods or assemblies for testing and return of the HBURC to the CPP-2707 storage pad;
- transfer of select fuel rods or assemblies to MFC (HFEF) or other suitable INL facilities;
- post-irradiation examination and testing (destructive and non-destructive) of select fuel rods or assemblies at MFC or other suitable INL facilities; and
- staging of the HBURC on the CPP-2707 storage pad.

Table 2-1 provides a review of the environmental resource areas that were evaluated in the 1995 programmatic EIS and the Yucca Mountain supplementary EIS and justification for either carrying that resource area further for more detailed analysis or eliminating it from further analysis in this SA. Those resource areas carried forward (both transportation-related) are evaluated in more detail in Section 2.3.

The 1995 programmatic EIS separated the resource evaluation into those areas that were considered “key discriminator disciplines,” which refers to those resources that were considered critical in the programmatic EIS decision making, and other resource areas that were not evaluated in as much detail. Table 2-1 considers all resource areas but starts with the key discriminator disciplines at the top of the table.

[11] A possibility exists that some refurbishment would be outside of the actual railbed. In that event, the adjacent areas selected for the refurbishment would still be previously disturbed and contiguous to the rail line. Per INL site procedures, there would be clearance of the affected property for any potential cultural or biological concerns prior to construction.

Table 2-1. Resource area screening.

Resource Area	Discussion	Conclusion
Key Discriminator Discipline—Socioeconomics	The Federal proposed action would not change workforce requirements, nor notably impact socioeconomic resources in the region of influence. Additional funding associated with the research activities at INL could be a positive contribution to the region around the INL site.	No further analysis required.
Key Discriminator Discipline—Materials and Waste Management	The Federal proposed action would not contribute to additional waste streams or quantities that have been analyzed in previous NEPA documents. The HBU UNF is destined for a deep geologic repository (as analyzed in DOE, 2008). Whether the UNF departs from NAPS or the INL site is immaterial to waste management impacts. Operations at INL UNF facilities (e.g., CPP-603) generate LLW, mixed LLW, and transuranic waste. Including the HBU UNF rods or assemblies in the operations would not noticeably change the waste management processes or volumes from that expected on an annual basis and previously evaluated as part of the 1995 programmatic EIS (DOE, 1995).	No further analysis required.
Key Discriminator Discipline—Human Health (facility operations and accidents)	The Federal proposed action would not change or introduce unique operations at the INL facilities. No additional health impacts would be expected from continued normal operations or from facility accidents, which are addressed in a Documented Safety Analysis for the INL nuclear facilities. Operations of the INL facilities were addressed in the 1995 programmatic EIS (DOE, 1995).	No further analysis required.
Key Discriminator Discipline—Transportation (incident-free and accidents)	The single HBURC shipment from NAPS to the INL site is a small subset of the UNF transportation evaluated in the 1995 programmatic EIS and the Yucca Mountain supplemental EIS, however, a specific shipment from this origin to this destination was not evaluated in either NEPA document. Additionally, since the 1995 programmatic EIS was published, DOE has implemented guidance to evaluate intentional destructive acts in NEPA documents. This analysis was included in the Yucca Mountain supplemental EIS.	Further evaluate incident-free transportation (Section 2.3.1). Further evaluate transportation accidents and intentional destructive acts (Section 2.3.2).

Resource Area	Discussion	Conclusion
Environmental Resource Area—Land Use	Any construction included as part of the Federal proposed action would occur within existing disturbed areas (e.g., existing rail beds or roadways) and would not change land uses or ownership[(a)].	No further analysis required.
Environmental Resource Area—Cultural and Paleontological	The Federal proposed action would not disturb land (other than within existing rail beds or roadways) and would not impact cultural or paleontological resources[(a)].	No further analysis required.
Environmental Resource Area—Aesthetic and Scenic Resources	The Federal proposed action would not require new construction of facilities and would not change visual characteristics. The addition of the HBURC on the CPP-2707 storage pad within INTEC would be consistent with other UNF casks already in storage.	No further analysis required.
Environmental Resource Area—Geologic Resources	The Federal proposed action would not disturb land (other than within existing rail beds or roadways) and would not impact geologic or soil resources[(a)].	No further analysis required.
Environmental Resource Area—Air Quality	The Federal proposed action would involve as many as three trips of the rail consist (dry run, outreach/training events, and HBURC shipment) to and from INL. There would be no radiological air emissions resulting from the Federal proposed action and the nonradiological emissions from the locomotive would represent a miniscule contribution to criteria air pollutants in the various air basins along the route. Especially considering that the shipments would occur on commercial rail lines that are active in providing rail access for ongoing commerce. Any radiological air emissions generated during proposed activities is expected to be minor, and concentrations are not expected to exceed the existing monitored air emissions from existing facilities.	No further analysis required.
Environmental Resource Area—Water Resources	The Federal proposed action would not disturb land (other than within existing rail beds, roadways, or other previously disturbed areas) and therefore would not affect the amount of impermeable surfaces. There would be no effluents associated with the Proposed Action and therefore DOE anticipates no potential impacts to surface or groundwater resources.	No further analysis required.
Environmental Resource Area—Ecological Resources	The Federal proposed action would not disturb ecological habitats and would not result in impacts that could affect ecological resources.	No further analysis required.

Resource Area	Discussion	Conclusion
Environmental Resource Area—Noise	The Federal proposed action would not introduce new noise sources at NAPS or the INL site and would not change background noise levels. The addition of up to three trips of the rail consist (dry run, whistle-stop tour, and HBURC shipment) on the existing rail lines would be an insignificant addition to the noise along the operating railroads.	No further analysis required.
Environmental Resource Area—Utilities and Energy	The Federal proposed action would not result in any measurable energy of utility consumption changes compared to existing requirements.	No further analysis required.

DOE = U.S. Department of Energy; EIS = environmental impact statement; HBU = high burnup; HBURC = High Burnup Research Cask; INL = Idaho National Laboratory; INTEC = Idaho Nuclear Technology and Engineering Center; LLW = low-level radioactive waste; MFC = Materials and Fuels Complex; MLLW = mixed low-level radioactive waste; NAPS = North Anna Power Station; NEPA = National Environmental Policy Act of 1969; UNF = used nuclear fuel.

(a) A possibility exists that some refurbishment would be outside of the actual railbed. In that event, the adjacent areas selected for the refurbishment would still be previously disturbed and contiguous to the rail line. Per INL site procedures, there would be clearance of the affected property for any potential cultural or biological concerns prior to construction.

2.3 DETAILED EVALUATIONS

The environmental resource area screening process described in Section 2.2 (as supported by Table 2-1) identified two resource areas related to the implementation of the Federal proposed action that require a more detailed evaluation (1) incident-free transportation, and (2) transportation accidents and intentional destructive acts. These resources are discussed in the following sections.

2.3.1 Incident-Free Transportation

The 1995 programmatic EIS addressed the impacts of transporting approximately thousands of UNF shipments across the country in a variety of alternatives. Each alternative evaluated shipment involved the use of truck and rail. Under the selected Alternative 4a (regionalization alternative), the programmatic EIS analyzed 1,926 rail shipments of various types of UNF (e.g., research reactor fuel, foreign reactor fuel, DOE UNF). Of these analyzed shipments under this alternative, 436 rail shipments were destined for the INL site. For national shipments of DOE UNF (including special-case commercial UNF), the 1995 programmatic EIS addressed the transportation impacts associated with 147 rail shipments (DOE, 1995, Appendix I, Table I-2). For this alternative, the potential impacts associated with the incident-free[12] rail transportation of DOE UNF were estimated for the population along the routes across the U.S. as follows (DOE, 1995, Appendix I, Table I-8):

- 0.0044 radiation-related latent cancer fatality (LCF) for transportation workers,
- 0.0085 radiation-related LCF for the general population, and
- 0.0081 nonradiological fatality from vehicular emissions.

LATENT CANCER FATALITY

A latent cancer fatality (LCF) is a death from a cancer that results from, and occurs an appreciable time after, exposure to ionizing radiation. Death from radiation-induced cancers can occur any time after the exposure. Using a conversion factor of 0.0006 LCF per rem of radiation exposure, the result is the increased lifetime probability of developing an LCF. For example, if a person received a dose of 0.033 rem (or 33 millirem), that person's risk of a LCF from that dose over a lifetime would be 0.00002. This risk corresponds to 1 chance in 50,000. These risks are statistical, and the results often indicate less than 1 LCF for cases that involve low doses or small populations. For instance, if a population collectively received a dose of 500 person-rem (e.g., if 100,000 persons each received 5 millirem), the number of potential LCFs in that population would be 0.3.

There are questions in the scientific community regarding overestimation of LCFs by using the linear no-threshold theory.

These fatalities were estimated over the 40-year period from 1995 through 2035 and were based on an assumption that external dose rates would be the maximum allowed by regulation (10 millirem per hour [mrem/h] at any point 2 m from the transport vehicle)[13]. The impacts per shipment for DOE UNF would be:

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[12] "Incident-free" refers to transportation activities without accidents or other unexpected or unusual occurrences.

[13] *See* 10 CFR 71.47, "External Radiation Standards for All Packages."

- 3.0×10^{-5} radiation-related LCF for transportation workers,
- 5.8×10^{-5} radiation-related LCF for the general population, and
- 6.7×10^{-5} nonradiological fatality from vehicular emissions.

As discussed in Section 1.3.2.4, DOE used the START tool to assess parameters for the potential routing of the HBURC shipment from NAPS to the INL site. Information regarding assumptions related to START data analysis can be found in START's user guide on the START website (see Section 1.3.2.4). The data provided in Table 1-1 is used for the analysis in this SA. As reported in Table 1-1, the maximum length of the reasonable rail routes is about 3,175 mi. The START model also has the capability of estimating the potential incident-free impacts to the collective population within 800 m (roughly 0.5 mi) of the analyzed route (in units of person-rem).

START uses projected dose rates associated with a loaded transportation cask from an example commercial ISFSI of 0.035 millisievert per hour (mSv/hr) at a distance of 2 m[14], with 0.0159 mSv/hr from gamma radiation and 0.0191 mSv/hr from neutron radiation (Connolly, 2019). These dose estimates were selected from their use in previous conservative DOE analyses; exact dose rates and dose rate fractions for this shipment may vary from these estimates but even if the dose rates were closer to the regulatory limit of 0.1 mSv/hr the resulting doses would still be well below projected dose rates from the 1995 PEIS.

The results from the START tool take into account a number of changes that have occurred since the 1995 programmatic EIS was issued. One of the key changes includes actual population data along the specific routes based on current Census data as opposed to generic population data based on theoretical population densities that were applicable across the country.

As shown in Table 2-1, the potential impacts associated with the incident-free rail transportation of the HBURC shipment for the Federal proposed action evaluated in this SA would be very small and bounded by the impacts presented in the 1995 programmatic EIS for shipments of DOE UNF. To add some perspective, the average annual radiological exposure to a person in the U.S. is about 620 millirem (mrem), about half of which comes from natural sources (e.g., radon gas, cosmic radiation, terrestrial)[15]. The other half of the average annual radiation exposure comes from human-made sources (e.g., medical procedures, industrial/commercial products air travel). The additional contribution from this shipment would be miniscule.

Table 2-2. High Burnup Research Cask shipment incident-free radiological impacts.

Factor	Model Result
Maximum length of the route (mi)	3,175
Population within 800 m (0.5 mi)[(a)]	Up to 1,610,000
Incident-Free Radiological Impact—Collective dose to the crew (person-rem)	0.00531
Incident-Free Radiological Impact—Increase to crew LCF risk	3.2×10^{-6}
Incident-Free Radiological Impact—Collective dose to inspectors (person-rem)	0.00021
Incident-Free Radiological Impact—Increase to inspector LCF risk	1.3×10^{-7}
Incident-Free Radiological Impact—Collective dose to population (person-rem)	0.0102

14 0.035 mSv/hr is equivalent to 3.5 mrem/h.
15 https://www.nrc.gov/about-nrc/radiation/around-us/doses-daily-lives.html.

Factor	Model Result
Incident-Free Radiological Impact—Increase to population LCF risk	6.1×10^{-6}
Incident-Free Radiological Impact—Average dose to a member of the population along the route (millirem)	3.4×10^{-6}

LCF = latent cancer fatality

(a) 800 m on either side of the route equates to a band of 1,600 m (or close to 1 mi) for the purpose of determining affected population.

2.3.2 Transportation Accident Risk

The 1995 programmatic EIS contains a detailed analysis of the potential impacts associated with transportation accidents involving UNF (DOE, 1995, Appendix I, Section I-5). As noted in Section 2.3.2 of this SA, the 1995 programmatic EIS ROD selected the Regionalization Alternative 4a. For that alternative, the total accident risk[16] (1995–2035) for rail transportation was estimated to be:

- 0.0003 LCF and 0.25 traffic fatality (see DOE, 1995, Appendix I, Table I-34).

Similar to the analysis for incident-free transportation impacts in Section 2.3.1, DOE used the START tool to determine the potential consequences and risks associated with an accident involving the HBURC. Information on assumptions related to START analysis for accident-related impacts can be found in START's user guide[17]. The loss of shielding scenario for START is based on Connolly et al. (2020). This scenario is based on loss of shielding based on lead slump. This would be highly unlikely because the TN-32B HBURC is a steel resin cask and does not contain lead and would not experience lead slump. However, the model always assumes the loss of neutron shielding. The NRC transportation risk assessment (NRC, 2014) states in Section 5.4.2 that external neutron radiation would have an impact on receptors close to the cask but not on the general public and that the loss of neutron shielding produces a much smaller dose to an emergency responder that would happen if there were a loss of gamma shielding.

As shown in Table 2-3, START calculates the potential consequences of an accident to the crew and the public within a ½ mi (either side of the route) of the accident and estimates these consequences based on whether the HBURC shielding stays in place or if there is a potential loss in the effectiveness of the shielding. There are no credible accident scenarios involving an NRC-certified cask like the TN-32B where DOE would expect a release of radiological materials from the cask.

Appendix J to the Yucca Mountain EIS (DOE, 2008) discusses the radiological consequences from transportation of SNF due to accidents involving radionuclide release. For a rail cask, this assessment was based on a 24-assembly cask with relatively similar burnup, enrichment and cooling time to the assemblies within the HBURC. The HBURC has 32 assemblies, which would result in the overall radionuclide inventory being larger for the HBURC on a per-cask basis, however, the evaluation performed within the Yucca Mountain EIS is still bounding for this shipment based on the very conservative release fractions used to determine radiological consequences within the Yucca Mountain supplemental EIS. The release fraction of each isotope

[16] Risk is calculated by multiplying the consequence of an accident times the probability that the accident would occur. The total accident risk is the compilation of all risks.

[17] https://start.energy.gov/Account/Login?ReturnUrl=%2f

is the fraction of that isotope in the cask that could be released in a given severity of accident. The release fractions used in the Yucca Mountain supplemental EIS were based on NUREG/CR-6672 (Sprung et al., 2000). The NRC has since published a new spent fuel transportation risk assessment (NRC, 2014), which states: "…the purpose of this analysis was to reproduce (and, in some cases, extend) risk analyses previously considered in…NUREG/CR-6672 using updated models and methods." As a result of this study, the release fractions have decreased by several orders of magnitude. This was due to more advanced structural modeling of the cask used to determine the probability and extent of a breach, as well as better understanding of rod-to-cask release based on mechanical testing.

Table 2-3. High Burnup Research Cask shipment accident-related radiological impacts.

Conditions	Factor	Model Result
With no reduction of shielding	Collective dose to the crew (person-rem)	0.00076
With no reduction of shielding	Increase to crew LCF risk	4.6×10^{-7}
With no reduction of shielding	Collective dose to inspectors (person-rem)	0.00076
With no reduction of shielding	Increase to inspector LCF risk	4.6×10^{-7}
With no reduction of shielding	Collective dose to population (person-rem)	0.0024
With no reduction of shielding	Increase to population LCF risk	1.4×10^{-6}
With reduction of shielding (1.24% dose increase at 2 m and increased time stationary)	Collective dose to the crew (person-rem)	0.0015
With reduction of shielding (1.24% dose increase at 2 m and increased time stationary)	Increase to crew LCF risk	9.0×10^{-7}
With reduction of shielding (1.24% dose increase at 2 m and increased time stationary)	Collective dose to inspectors (person-rem)	0.0015
With reduction of shielding (1.24% dose increase at 2 m and increased time stationary)	Increase to inspector LCF risk	9.0×10^{-7}
With reduction of shielding (1.24% dose increase at 2 m and increased time stationary)	Collective dose to population (person-rem)	0.0048
With reduction of shielding (1.24% dose increase at 2 m and increased time stationary)	Increase to population LCF risk	1.9×10^{-6}

LCF = latent cancer fatality.

With regard to intentional destructive acts, the Yucca Mountain supplemental EIS evaluated the estimated consequences of a transportation sabotage event. The unclassified information regarding this analysis is included in Appendix G, Section G.8 of the Yucca Mountain supplemental EIS (DOE, 2008).

3 DETERMINATION

DOE prepared this SA in accordance with the DOE NEPA implementing procedures. The Federal proposed action evaluated in this SA is a shipment of the UNF loaded HBURC, by rail from NAPS to the INL site for further examination. This HBURC SA demonstrates that the elements of the Federal proposed action are not substantively different than the proposed action evaluated in the 1995 programmatic EIS or the 2008 Yucca Mountain supplemental EIS.

There would be no land disturbance outside of existing railbeds or other previously developed areas and UNF handling and testing at INL would be consistent with the existing facilities' operating envelopes and documented safety analyses. The potential transportation-related radiological impacts would be a very small subset of those presented in the previous NEPA documents related to transporting UNF.

Based on the analysis in this SA, DOE's Federal proposed action does not represent a substantial change to the proposal evaluated in the previous EISs or significant new circumstances or information relevant to environmental concerns that would require preparation of a supplemental EIS. DOE has preliminarily determined that no further NEPA analysis is required.

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