Chapter 5
Cumulative Impacts

5.0 CUMULATIVE IMPACTS

The National Environmental Policy Act (NEPA) established the Council on Environmental Quality (CEQ) to oversee Federal environmental impact regulations. CEQ defines cumulative impacts as "the impact on the environment which results from the incremental impact when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. Cumulative impacts can also result from spatial (geographic) or temporal (time) crowding of environmental perturbations (i.e., concurrent human activities and the resulting impacts on the environment are additive if there is insufficient time for the environment to recover) (Spaling 1994). The region of influence (ROI) is the geographic area over which past, present, and reasonably foreseeable future actions (activities) could contribute to cumulative impacts, and is dependent on the type of resource analyzed.

This chapter's analysis of cumulative impacts does not include an evaluation of activities at facilities preparing experiments for the Versatile Test Reactor (VTR). As described in Chapter 2, Section 2.2.3, preparation of the test packages would be performed in existing facilities across the United States, and potentially internationally, in accordance with applicable regulations and permits. Although not all types of experiments that would be performed in the VTR can be foreseen at this time, preparation of an experimental test package would likely be a small-scale activity that would not consume large quantities of resources or result in extensive emissions. Therefore, these experiments would not substantially contribute to cumulative impacts.

In addition, the cumulative impacts of offsite waste management and disposal are not included in this *Versatile Test Reactor Environmental Impact Statement* (VTR EIS). As described in Chapter 4, Section 4.9, the management of wastes at offsite facilities would not exceed the facilities' capacities. The impacts of these activities were already evaluated in the licensing or permitting processes for these facilities and would not result in an additional cumulative impact. Furthermore, there are a number of options available for the disposal of U.S. Department of Energy (DOE) generated low-level radioactive waste (LLW) and mixed low-level radioactive waste (MLLW). DOE's Idaho National Laboratory (INL), Oak Ridge Reservation (ORR), and Savannah River Site (SRS) allow for disposal of onsite generated LLW. Two other DOE sites, the Hanford Site and the Nevada National Security Site (NNSS), allow for disposal of both onsite and offsite generated LLW and MLLW, as long as the waste meets each sites' waste acceptance criteria. In addition, there are two commercial facilities that can accept government-owned LLW: Energy*Solutions* LLW Disposal Facility near Clive, Utah; and Waste Control Specialists (WCS) near Andrews, Texas. Therefore, there are a number of available waste disposal options to address the relatively small volumes of LLW and MLLW generated by the proposed VTR activities.

The cumulative impacts methodology and assumptions are briefly described in Section 5.1. Reasonably foreseeable actions are listed in Section 5.2. Cumulative impacts are evaluated for activities at INL in Section 5.3, for the Oak Ridge National Laboratory (ORNL) in Section 5.4, and for SRS in Section 5.5. Cumulative impacts on transportation are analyzed in Section 5.6, and cumulative impacts on the global commons are analyzed in Section 5.7.

5.1 Methodology and Assumptions

In general, the following approach was used to estimate cumulative impacts for this VTR EIS:

- The ROIs were described for each resource area where impacts from the alternatives and options analyzed in this VTR EIS may occur. (See Chapter 3.)

- The affected environment and baseline conditions were identified, including the effects of past actions. (See Chapter 3.)
- Past, present, and reasonably foreseeable future actions were identified. (See Section 5.2.)
- The impacts of the activities described in Chapter 4 were assessed in combination with the aggregate (additive) effects of past, present, and reasonably foreseeable actions. (See Sections 5.3 through 5.7.)

Cumulative impacts were evaluated by combining the effects of activities at the INL Site, ORNL, and SRS for each of the alternatives assessed in this VTR EIS with the effects of other past, present, and reasonably foreseeable future actions in the ROI. Many of these actions occur at different times and locations and may not be truly additive. For example, actions affecting human health may occur at different times and locations across the ROI. Therefore, the maximum impacts described in the NEPA documents for the activities are unlikely to be truly additive. However, the effects were combined regardless of the time and location of the impact, to encompass any uncertainties in the projected activities and their effects. This approach produces a conservative estimate of cumulative impacts for the activities analyzed.

5.2 Reasonably Foreseeable Actions

In addition to actions related to the alternatives evaluated in this VTR EIS, other actions may contribute to cumulative impacts at the INL Site, ORNL, and SRS. These actions include onsite and offsite projects conducted by Federal, State, and local governments, the private sector, or individuals who are within the ROIs of the actions examined in this VTR EIS. Information about present and future actions was obtained from a review of site-specific plans and NEPA documents to determine if ongoing or reasonably foreseeable future projects could contribute to environmental impacts at the potentially affected sites. Reasonably foreseeable future actions, as defined in 43 CFR Part 46, are "federal and non-federal activities not yet undertaken, but sufficiently likely to occur, that a responsible official of ordinary prudence would take such activities into account in reaching a decision."[1] Ongoing and reasonably foreseeable projects at the INL Site, ORR, and SRS are listed in **Table 5–1**.

Two applications to the U.S. Nuclear Regulatory Commission (NRC) for Consolidated Interim Storage Facilities (CISF) have been submitted. On November 14, 2016, the NRC published the Notice of Intent (NOI) to prepare an EIS for the construction and operation of a CISF at Waste Control Specialists LLC (WCS) in Andrews County, Texas (81 FR 79531). In May 2020, NRC issued the *Environmental Impact Statement for Interim Storage Partners LLC's License Application for a Consolidated Interim Storage Facility for Spent Nuclear Fuel in Andrews County, Texas* (NRC 2020b) for public comment. On March 30, 2018, the NRC published the NOI to prepare an EIS for the construction and operation of Holtec International Inc's (Holtec's) proposed CISF in Lea County, New Mexico (83 FR 13802). In March 2020, NRC issued the *Environmental Impact Statement for the Holtec International's License Application for a Consolidated Interim Storage Facility for Spent Nuclear Fuel and High Level Waste* (NRC 2020a) for public comment. If constructed and operated, CISFs would store spent fuel from commercial nuclear reactors and would contribute to cumulative transportation impacts. Therefore, DOE has evaluated the environmental impacts of these activities in the cumulative transportation impact analysis for this VTR EIS.

[1] In this VTR EIS, reasonably foreseeable actions are generally understood to be those that have been identified in a NEPA document or are from another environmental impact analysis that is available and for which the effects can be meaningfully evaluated. These include actions unrelated to DOE.

Table 5–1. Other Actions Considered in the Cumulative Impacts Analyses [a]

Name	*Description*	*Location(s) [b]*	*Status*	*Source Document(s)*
Multiple DOE Sites				
Plutonium-238 Production for Radioisotope Power Systems (DOE/EIS-0310 and DOE/EIS-0310-SA-02)	This project evaluated alternatives for enhancement of DOE's nuclear infrastructure. In the ROD published on January 26, 2001 (66 FR 7877), among other things, DOE decided to reestablish domestic production of Pu-238 to support U.S. space exploration. For this purpose, ATR at the INL Site and HFIR at ORNL will be used to irradiate neptunium-237 targets. REDC at ORNL will be used for fabricating targets and isolating Pu-238 from the irradiated targets. In the Amended ROD issued on August 13, 2004 (69 FR 50180), DOE decided to transport neptunium-237, after conversion to neptunium oxide, from SRS to REDC at ORNL for use in production of Pu-238 in the future. The *Supplemental Analysis for the Nuclear Infrastructure Programmatic Environmental Impact Statement for Plutonium-238 Production for Radioisotope Power Systems* (DOE 2013a), determined that there are no significant new circumstances or information relevant to environmental concerns that warrant preparation of a Supplemental EIS or a new EIS. The 2001 decision referenced above (66 FR 7877) can be implemented without further NEPA review.	INL and ORNL	Ongoing	DOE 2000b 66 FR 7877 69 FR 50180 DOE 2013a
National Nuclear Security Administration Complex Transformation (DOE/EIS-0236-S4)	This action would transform the DOE nuclear weapons complex by reducing its size, increasing efficiency and security, and improving the ability to respond to changes in national security requirements. In the ROD, NNSA decided to consolidate tritium research and development at SRS (73 FR 77656) and keep uranium manufacturing and research and development at Y-12 on ORR, including construction and operation of a Uranium Processing Facility (73 FR 77644).	ORR, SRS, and other sites	Ongoing	DOE 2008a 73 FR 77644 73 FR 77656
Disposal of Greater-Than-Class C (GTCC) LLW and GTCC-Like Waste (DOE/EIS-0375 and DOE/EA-2082)	This project would construct and operate a new facility or facilities or use an existing facility or facilities for the disposal of GTCC LLW and GTCC-like waste. DOE has not issued a ROD for this action.	INL, SRS, and other sites	Proposed	DOE 2016a DOE 2018d
Construction and Demonstration of a Prototype Advanced Mobile Nuclear Reactor	This Department of Defense project would construct and demonstrate a prototype microreactor capable of producing 1 to 10 megawatts of electrical power. The INL Site and ORR are the two alternative locations being evaluated. The NOI was published in the *Federal Register* on March 2, 2020 (85 FR 12274).	INL and ORR	Proposed	85 FR 12274
Idaho National Laboratory				
Treatment and Management of Sodium-Bonded Spent Nuclear Fuel (DOE/EIS-0306)	This action treats and manages sodium-bonded SNF in facilities located at MFC at the INL Site. DOE identified electrometallurgical treatment as its preferred method for the treatment and management of all sodium-bonded SNF.	MFC	Ongoing	DOE 2000a 65 FR 56565
Sample Preparation Laboratory	The Proposed Action includes constructing a 44,000-square-foot 3-story building. This project includes a shielded cell(s) to support sample preparation of non-alpha bearing materials with the ability to receive small- and medium-sized casks, and to sort, size, polish, mount, and conduct initial analysis of materials specimens. A categorical exclusion for this action was issued on September 4, 2019 (DOE 2019b).	MFC	Ongoing	DOE 2019b

Name	Description	Location(s) [b]	Status	Source Document(s)
The Resumption of Transient Testing of Nuclear Fuels and Materials (DOE/EA-1954)	This project provides for the resumption of transient testing of nuclear fuels and materials. As a result, restart activities were conducted at TREAT at the INL Site, including refurbishment or replacement of systems and equipment. A FONSI was issued on February 26, 2014 (DOE 2014b). Restarted in 2017, TREAT is now operational.	MFC	Ongoing	DOE 2014b
Use of DOE-Owned High-Assay Low-Enriched Uranium (DOE/EA-2087)	DOE proposes to produce about 10 metric tons of HALEU through the electrometallurgical treatment process. This HALEU and other small quantities of HALEU stored at the INL Site will be available for research and development in support of the commercial nuclear industry and government agencies, including use in advanced reactors. HALEU is uranium that is enriched in the uranium-235 isotope to a value that is 5 to 20 percent of the total uranium. The production requires expansion of the fuel fabrication capability, including the purchase of new equipment and use of facilities at MFC and possibly also at INTEC. A FONSI was issued on January 10, 2019.	MFC and INTEC	Proposed	DOE 2019b
Multipurpose Haul Road (DOE/EA-1772)	This project was to construct and operate an alternative route between MFC and other INL Site facilities, other than the public highway, to transport several thousand shipments of materials and wastes expected over the next 10 years. The action was needed to reduce shipment costs, improve operational efficiency, improve highway safety, and reduce impacts on the public by minimizing road closures. A FONSI was issued on August 4, 2010 (DOE 2010d). The upgrades have been completed, and the roadway is operating.	INL	Completed	DOE 2010c DOE 2010d
Expanding Capabilities at the Power Grid Test Bed (DOE/EA-2097)	This action would include (1) installing a new 138-kilovolt overhead power line from INL's Central Facilities Area through the Critical Infrastructure Test Range Complex to MFC, (2) increasing the size of the fenced area at the Scoville substation, (3) enlarging old and establishing new test pads for expanded testing, and (4) expanding authorized uses of the Haul Road. A FONSI was issued on July 30, 2019.	INL	Ongoing	DOE 2019c
Expanding Capabilities at the National Security Test Range and Radiological Response Training Range (DOE/EA-2063)	The Proposed Action would expand the capabilities at NSTR and RRTR. Both ranges support the training of first responders from defense and homeland security organizations who are charged with safeguarding the public and protecting U.S. national security. DOE proposes to allow for the use of unmanned aerial systems, additional explosive materials, and additional radioisotopes for testing and training purposes. DOE proposes installation of permanent structures and utilities, an increase in the frequency of range activities, and an increase in testing capabilities. DOE proposes to equip NSTR with permanent infrastructure, which may include offices, classrooms, conference rooms, restrooms and kitchen facilities. Fixed utility infrastructure providing electricity, roadways, testing pads, and fencing are also proposed. A FONSI was issued on December 10, 2019.	NSTR and RRTR	Proposed	DOE 2019h

Name	Description	Location(s) [b]	Status	Source Document(s)
Recapitalization of Infrastructure Supporting Naval SNF Handling (DOE/EIS-0453-F)	Consistent with the ROD for the *Department of Energy Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE/EIS-0203-F), naval SNF is shipped by rail from shipyards and prototypes to the Expended Core Facility at the INL Site for processing. Significant upgrades are necessary to the Expended Core Facility infrastructure to allow NNPP to continue to safely unload, transfer, prepare, and package naval SNF for disposal. In the ROD (81 FR 87912), DOE decided to recapitalize the infrastructure supporting naval SNF handling at the INL Site by constructing a new facility in the northeast section of NRF.	NRF	Ongoing	DOE 2016b 81 FR 87912
Recapitalization of Naval Nuclear Propulsion Program Examination Capabilities	This project would upgrade or build new examination facilities to give NNPP the ongoing capability to examine naval SNF, components, and irradiated test specimens. This action will be evaluated in a separate NEPA document.	NRF or ATR	Planned	DOE 2016b
DOE Idaho Spent Fuel Facility/ Independent SNF Storage Installation (NUREG-1773)	Under this action, the DOE Idaho Spent Fuel Facility would receive SNF from INTEC and the Fort Saint Vrain storage facility for conditioning (e.g., drying) and packaging in canisters for offsite shipment. The SNF would be packaged to meet interim storage, transportation, and Yucca Mountain disposal criteria. Yucca Mountain disposal criteria are a bounding assumption for packaging. Limited storage to accommodate offsite transfers is included in the project.	INTEC	Ongoing	NRC 2004
Idaho HLW and Facilities Disposition (DOE/EIS-0287 and DOE/EIS-0287-SA-01)	This action is for the management and disposition of sodium-bearing waste, HLW calcine, and HLW facilities at INTEC. In the first ROD (70 FR 75165), DOE decided to treat sodium-bearing waste using a steam-reforming technology. DOE's preferred disposal for this waste is as TRU waste at the WIPP facility. For facilities disposition, DOE decided to conduct performance-based closure (depending on risk) of existing facilities directly related to the HLW program once their missions are complete. DOE's strategy for HLW calcine is to retrieve the calcine for disposal outside of Idaho. In the second ROD (71 FR 68811), DOE decided to conduct performance-based closure of the INTEC Tank Farm Facility. In the third ROD (75 FR 137), DOE decided to select hot isostatic pressing as the technology to treat calcine to create a volume-reduced monolithic waste form that is suitable for transport outside Idaho.	INTEC	Ongoing	DOE 2002a DOE 2005d 70 FR 75165 71 FR 68811 75 FR 137
New Remote-Handled LLW Disposal Facility (DOE/EA-1793)	This action would replace the existing RWMC disposal capability with a new capability for disposal of remote-handled LLW generated at the INL Site that would last up to 50 years. DOE expects to generate an estimated average of 150 cubic meters of remote-handled LLW each year at the INL Site. A FONSI was issued on December 21, 2011 (DOE 2011f).	Southwest of ATR	Ongoing	DOE 2011a DOE 2011f
Utah Associated Municipal Power Systems Small Modular Reactors	This project would construct and operate up to 12 small modular reactors, rated at 50 to 60 megawatts each, at the INL Site. In 2016, DOE issued a site use permit granting access to the INL Site for the purposes of identifying potential locations for the reactors. Currently, the project is focusing on an area near Highway 33 and Road T-11 within the Sage Grouse Conservation Area. The project may disturb up to 2,000 acres if constructed. UAMPS plans to commence site preparation in 2021, with nuclear construction commencing in 2023, and commercial operations in 2026 and 2027.	INL	Proposed	DOE-ID 2016 DOE-ID 2019a NuScale 2019 UAMPS 2019

Name	Description	Location(s) [b]	Status	Source Document(s)
Oklo Power LLC, AURORA Micro-reactor at the INL Site	Oklo Power LLC (Oklo) is proposing to build the Aurora, a 4-megawatt thermal advanced fission micro-reactor, near MFC at the INL Site. There are currently five sites that are under consideration for the exact location of the Aurora. All candidate sites are greenfield sites outside of any security fence. On March 11, 2020, Oklo submitted a combined license application to the NRC. The NRC accepted the application allowing Oklo to move forward with plans for the reactor at the INL Site.	MFC	Proposed	NRC 2020c Oklo Power 2020
Idaho National Laboratory – Offsite Actions				
NA	None identified within the Region of Influence.	NA	NA	NA
Oak Ridge Reservation				
ORNL Modernization Initiative (DOE/EA-1618)	This initiative would result in infrastructure replacement and upgrades at ORNL. The action would enhance the health and safety of workers, reduce operating costs, and accommodate projected program growth. It would allow relocation of staff and certain support services (e.g., emergency response and maintenance) out of the central campus and from other facilities that are in less than "mission ready" condition. A FONSI was issued on July 28, 2008.	ORNL	Ongoing	DOE 2008b
Oak Ridge Science and Technology Project at ORNL (DOE/EA-1575)	The Proposed Action would advance technology transfer and other missions of the DOE Office of Science at ORNL through the establishment of the ORSTP. The ORSTP would support technology commercialization, facilitate the creation of new companies, and stimulate technology-based recruitment as a part of its core purpose. To establish the ORSTP, DOE would lease underused facilities and land parcels at the ORNL Central Campus area. A FONSI was issued on February 20, 2008 (DOE 2008e).	ORNL	Ongoing	DOE 2008c DOE 2008e
U-233 Material Downblending and Disposition Project (DOE/EA-1651)	The Proposed Action would modify selected ORNL facilities, process the ORNL inventory of uranium-233, and transport the processed material to a long-term disposal facility. A FONSI was issued on January 13, 2010 (DOE 2010e).	ORNL	Ongoing	DOE 2010e
Oak Ridge Integrated Facility Disposition Project	Activities under the IFDP would dispose of legacy materials and facilities at ORNL and Y-12 using an integrated approach that reduces risk. The activities would eliminate $70 million to $90 million per year in operating costs. Under the IFDP, the decontamination and decommissioning of about 188 facilities at ORNL, 112 facilities at Y-12, and remediation of soil and groundwater contamination would occur over the next 30 to 40 years. The IFDP will be conducted as a remedial action under CERCLA.	ORR	Ongoing	DOE 2011c
Environmental Management Disposal Facility	Because the existing onsite Environmental Management Waste Management Facility is above 70 percent capacity and will soon be full. A new disposal facility is needed in the mid-2020s to complete critical cleanup projects at Y-12 and ORNL. The onsite disposal alternative located at Central Bear Creek Valley is the preferred remedy for disposal of waste from DOE's ORR CERCLA cleanup program. The final capacity assumed to be needed for completion of ORR clean-up is estimated at 2.2 million cubic yards. Waste types will include soil, sediment, and sludge, along with demolition debris. The majority of the waste (more than two-thirds) is anticipated to be debris.	ORR	Proposed	DOE 2017c DOE 2018e OREM 2018

Name	Description	Location(s) [b]	Status	Source Document(s)
Ongoing and Future Operations at Y-12 (DOE/EIS-0387, and DOE/EIS-0387-SA-01)	The Proposed Action is for ongoing and future operations at Y-12, including changes to site infrastructure and levels of operation using production capacity as the key metric. In the ROD dated July 20, 2011 (76 FR 43319), NNSA decided to construct and operate a capability-sized Uranium Processing Facility at Y-12 as a replacement for certain enriched uranium processing facilities that were more than 50 years old. In DOE/EIS-0387-SA-01, NNSA evaluated meeting uranium processing requirements using a hybrid approach of upgrading existing facilities and building new Uranium Processing Facility facilities. In the Amended ROD dated July 12, 2016 (81 FR 45138), NNSA decided to implement a revised approach for meeting enriched uranium requirements, by upgrading existing enriched uranium processing buildings and constructing a new Uranium Processing Facility. Additionally, NNSA decided to separate the single-structure Uranium Processing Facility design concept into a new design consisting of multiple buildings, with each constructed to safety and security requirements appropriate to the building's function.	Y-12	Ongoing	DOE 2011c 76 FR 43319 DOE 2016e 81 FR 45138
Y-12 Emergency Operations Center Project (DOE/EA-2014)	This project would design and build a new emergency response facility that would support the Y-12 missions more effectively and efficiently by consolidating the Plant Shift Superintendent's Office, the Emergency Command Center, the Technical Support Center, and the Fire Department Alarm Room from their present locations to a single facility. A FONSI was issued on October 26, 2015 (DOE 2015d).	Y-12	Ongoing	DOE 2015b DOE 2015d
Property Transfer to Develop a General Aviation Airport at East Tennessee Technology Park (DOE/EA-2000)	This action would transfer 170 acres of DOE property located at ETTP to the Metropolitan Knoxville Airport Authority for the purpose of constructing and operating a general aviation airport. A FONSI was issued on February 24, 2016 (DOE 2016d).	ETTP	Proposed	DOE 2016d DOE 2016h
Stable Isotope Production and Research Center	The Proposed Action would construct a facility south of White Oak Avenue in the 6,000 area of the ORNL campus that expands the ability to perform multiple isotope production campaigns. The project includes: (1) site preparation activities that include clearing and grading the land, and installing site utilities; (2) constructing a 43,000-square-foot facility that will house the equipment to produce the stable isotopes required; and (3) fabricating, installing, and initial testing of electromagnetic isotope separators and gas centrifuge equipment. The facility will consist of a main production area for the equipment generating the stable isotopes but will also have support rooms (including a maintenance shop, spare parts storage, control rooms, breakroom, and bathroom) to support the operation. Preparation of an EA is planned.	ORNL	Proposed	DOE-ORNL 2020b
Transformational Challenge Reactor	The Proposed Action would involve assembly, operation, and decommissioning of a 3-megawatt, helium-cooled reactor. The Transformational Challenge Reactor (TCR) would operate for a short period (days vs. months). The proposed location of the TCR is at the Health Physics Research Reactor site. The fuel for the TCR would be high-assay low-enriched uranium (< 20 percent enriched in uranium-235). The reactor core would be assembled and disassembled on site. The facility would be a Hazard Category 2 nuclear facility during initial core assembly, operation of the reactor, and core disassembly and inspection. After disassembly, the core would be shipped to a vendor for recovery of the	ORNL	Proposed	DOE-ORNL 2020c

Name	Description	Location(s) [b]	Status	Source Document(s)
	uranium. A small portion of the core may be relocated to an existing nuclear facility within ORNL for inspection and evaluation. An EA is being prepared for this action.			
Supplement Analysis for Construction of the Second Target Station at the Spallation Neutron Source	This action would construct and operate a Second Target Station for the Spallation Neutron Source. The Second Target Station project would fulfill the original master plan through the construction of 10 new structures. The Second Target Station was covered in the original Spallation Neutron Source EIS (DOE 1999a). The entire complex would include about 400,000 square feet of new construction. Preparation of an SA is planned.	ORNL	Proposed	DOE 1999a DOE-ORNL 2020a
Oak Ridge Reservation – Offsite Actions				
Clinch River Site for Small Modular Reactors	The Proposed Action would construct and operate small modular reactors at the Clinch River site. On December 17, 2019, TVA obtained approval for an early site permit from the NRC. The 20-year permit--referred to as an Early Site Permit--approves the 935-acre Clinch River site near Oak Ridge, Tennessee for a nuclear facility that can produce up to 800 megawatts total.	Oak Ridge, TN 4 miles west	Proposed	NRC 2019 TVA 2019
Energy*Solutions* – Bear Creek Processing Facility	This action is the continued operation of Energy*Solutions* – Bear Creek Processing Facility, including the processing and packaging of radioactive material for permanent disposal. The facility houses radioactive materials processing capabilities, including bulk waste assay, decontamination, recycle, compaction, incineration, metals melting, and a variety of specialty waste stream management options. The facility operates under regulatory authority of the Tennessee Department of Environmental Control, Division of Radiological Health, in agreement with NRC.	ORR 4.5 miles west	Ongoing	ES 2020
Manufacturing Sciences Corporation	This action is the continued operation of the Manufacturing Sciences Corporation facility, including uranium and specialty metals design, casting, rolling, fabrication, welding, and precision machining. Manufacturing Sciences Corporation operates the only depleted uranium rolling mill for commercial use in the United States. All of the work is performed under a Radioactive Material Operating License issued by the State of Tennessee, under NRC guidelines.	Oak Ridge, TN 5.5 miles northeast	Ongoing	MSC 2020
Centrus Energy Corporation	This action is the continued operation of Centrus' Oak Ridge facility, which is home to experts in gas centrifuge uranium enrichment technology, engineering, and advanced manufacturing. Centrus' Technology and Manufacturing Center facility has more than 440,000 square feet of space for advanced manufacturing, engineering, and testing work.	Oak Ridge, TN 6 miles northeast	Ongoing	Centrus 2020
TOXCO Inc. - Materials Management Center	This action is the continued operation of the TOXCO processing facility for materials and equipment previously used in a radioactive environment. TOXCO's processes minimize or eliminate high-cost disposal volumes, create opportunities for lower-cost, regulated, and licensed disposal, and greatly reduce radioactive waste disposal and decommissioning costs.	Oak Ridge, TN 6.5 miles northeast	Ongoing	TOXCO 2020
Bull Run Fossil Plant	Bull Run Fossil Plant is located on Bull Run Creek near Oak Ridge. The plant has a summer net capability of 865 megawatts and generates about 6 billion kilowatt-hours of electricity per year, which is enough to supply 400,000 homes. On February 14, 2019 following a review of public input and a detailed examination of fuel, transmission, economic and	Clifton, TN 8.5 miles northeast	Ongoing	TVA 2020a TVA 2020b

Name	Description	Location(s) [b]	Status	Source Document(s)
	environmental impacts, TVA approved the retirement of the Bull Run Fossil Plant by December 2023.			
Kingston Fossil Plant	Kingston Fossil Plant is located on Watts Bar Reservoir on the Tennessee River near Kingston, Tennessee. Kingston's 9 units boast a summer net capability of 1,398 megawatts and can generate about 10 billion kilowatt-hours per year, which is enough electricity to power about 700,000 homes. To meet the demand, Kingston burns about 14,000 tons of low-sulfur blend coal per day, an amount that would fill 140 railroad cars. Emissions-reducing features include the installation of selective catalytic reduction systems, which reduced nitrogen oxide emissions by 90 percent, and 2 scrubbers, which reduced sulfur dioxide emissions by 95 percent. TVA has cleaned up a coal ash spill that occurred in December of 2008.	Kingston, TN 11.5 miles west	Ongoing	TVA 2020c TVA 2020d
Savannah River Site				
Surplus Plutonium Disposition Program – Disposition 34 metric tons of surplus plutonium (DOE/EIS-0283 and DOE/EIS-0283-S2)	The Surplus Plutonium Disposition EIS (DOE 1999b) examined options for pit[c] disassembly and conversion of the plutonium to an oxide form, and options for disposition of the surplus plutonium. In 2015, DOE completed the Surplus Plutonium Disposition Supplemental EIS (DOE 2015a), which refreshed the analyses in the 1999 EIS and evaluated four options for pit disassembly and conversion using facilities at F, H, and K Areas at SRS and at TA-55 at Los Alamos National Laboratory (LANL) in New Mexico. After partial construction of the MFFF at SRS, DOE cancelled the project. On August 28, 2020, in an amended ROD for the Surplus Plutonium Disposition EIS (85 FR 53350), DOE decided to process 7.1 metric tons of non-pit plutonium for disposal as TRU waste at the WIPP facility. DOE now has an approved disposition path for 7.1 metric tons of the non-pit plutonium and is proceeding with establishing a new program of record for the remaining plutonium. DOE has not made a decision about pit disassembly and conversion.	F Area, H Area, and K Area	Proposed	DOE 1999b 65 FR 1608 67 FR 19432 68 FR 20134 DOE 2015a DOE 2020d 85 FR 53350
Surplus Plutonium Disposition Program - Process 13.1 metric tons of surplus non-pit plutonium in K Area for disposal at the WIPP facility (DOE/EIS-0283-S2)	This action would modify existing facilities and process up to 13.1 metric tons of surplus plutonium for disposal as TRU waste at the WIPP facility. On April 5, 2016, in a ROD for the Surplus Plutonium Disposition Supplemental EIS (81 FR 19588), DOE decided to process 6 metric tons of non-pit plutonium for disposal as TRU waste at the WIPP facility. DOE is proceeding with establishing a new program of record for the remaining plutonium.	K Area	Ongoing	DOE 2015a 81 FR 19588 SRNS 2020
SNF from Germany Containing U.S.-Origin Highly Enriched Uranium (DOE/EA-1977)	This action would receive, store, process, and dispose of German SNF packaged in casks. A FONSI was issued on December 20, 2017 (DOE 2017e).	H Area and L Area	Proposed	DOE 2017d DOE 2017e
H-Canyon Processing of Target Residue Material (DOE/EIS-0218-SA-07)	This action would receive liquid highly enriched uranium and process it in H-Canyon. An SA was prepared for this action, but an amended ROD was not needed.	H Area	Ongoing	DOE 2015e SRNS 2020

Name	Description	Location(s) [b]	Status	Source Document(s)
H-Canyon Processing of SNF (DOE/EIS-0279, DOE/EIS-0279-SA-01 and DOE/EIS-0218-SA-06)	This program, projected to operate through 2024 or possibly longer, would receive, dissolve, and process SNF in H-Canyon. In the ROD (65 FR 48224) DOE decided to implement the melt and dilute technology to manage about 97 percent by volume and 60 percent by mass of the aluminum-based SNF. DOE also decided to use conventional processing (i.e., the existing canyons) to stabilize about 3 percent by volume and 40 percent by mass of the aluminum-based SNF. DOE planned to ship about 20 MTHM of nonaluminum-based SNF from SRS to the INL Site. In an Amended ROD (78 FR 20625) DOE decided to manage about 3.3 MTHM of 22 MTHM at SRS using conventional processing at H-Canyon. DOE will continue to safely store the aluminum-clad SNF not addressed in this Amended ROD in L-Basin at SRS, pending future decisions.	H Area	Ongoing	DOE 2000c 65 FR 48224 DOE 2013b 78 FR 20625 SRNS 2020
Pit Manufacturing (DOE/EIS-0541)	Under this project, DOE would repurpose the former MFFF to produce a minimum of 50 war reserve pits per year at SRS and to develop the ability, beginning in 2030, to implement a short-term surge capacity to enable NNSA to meet the requirements of producing pits at a rate of not less than 80 war reserve pits per year for the nuclear weapons stockpile. In September 2020, the *Final Environmental Impact Statement for Plutonium Pit Production at the Savannah River Site in South Carolina* (DOE 2020a) was published. The Proposed Action includes, but is not limited to, reconfiguring (disassembly and removal of equipment) the MFFF and installing the equipment necessary for activities supporting pit production (disassembly/metal preparation, pit assembly, machining, aqueous processing, foundry operations, material characterization, and analytical chemistry operations for certification). It also includes constructing and repurposing other facilities surrounding the MFFF for support activities (waste handling, training, office space, roads, storage, and parking), making security and nuclear safety upgrades to support pit production, and providing reliable utilities and infrastructure. On November 5, 2020, in a ROD for the plutonium pit production EIS (85 FR 70601), DOE decided to implement the Proposed Action.	F Area	Proposed	Public Law 115-232 DOE 2020a 85 FR 70601
HLW Salt Processing (DOE/EIS-0082-S2)	Under this Proposed Action, DOE would implement a process to separate the high-activity and low-activity waste fractions in HLW solutions. This process would replace the in-tank precipitation process evaluated in the *Defense Waste Processing Facility Supplemental Environmental Impact Statement* (DOE/EIS-0082-S) (DOE 1994). The *Savannah River Site Salt Processing Alternatives Final Supplemental Environmental Impact Statement* (Salt Processing EIS) (DOE/EIS-0082-S2) (DOE 2001) evaluated four alternatives. The solvent extraction process was selected in the ROD (66 FR 52752). In a revised ROD (71 FR 3834), DOE adopted an approach that implements interim salt processing until the solvent extraction process becomes operational.	S Area	Ongoing	DOE 2001 66 FR 52752 71 FR 3834
Mark-18A Target Material Recovery Program (DOE/EIS-0220-SA-02 and DOE/EIS-0279-SA-06)	This action would process the 65 Mark-18A targets at SRS to recover the plutonium-244 and other valued isotopes in the form of solid oxides. Processing activities at SRS will occur at the Savannah River National Laboratory, Shielded Cells Facility in A Area. The oxides will be transported to ORNL for further processing and material recovery.	A Area	Ongoing	DOE 2016f 83 FR 9847

Name	Description	Location(s) [b]	Status	Source Document(s)
	Processing activities at ORNL will take place in accordance with its continuing research and development mission. An Amended ROD (83 FR 9847) was issued on March 8, 2018.			
Use of Savannah River Site Lands for Military Training (DOE/EA-1606)	The Proposed Action would enable the Army to conduct low intensity, nonlive-fire tactical maneuver training activities on SRS to support current and future Army mission requirements. A FONSI was issued on December 15, 2011 (DOE 2011h), and the revised FONSI was issued on July 26, 2012 (DOE 2012b).	SRS	Ongoing	DOE 2011g DOE 2011h DOE 2012b
Tritium Finishing Facility	This action would construct and operate a new Tritium Finishing Facility to replace SRS's HAOM, which currently houses the assembly, inspection, and packaging processes for tritium production. Built in the 1950s, the HAOM facility has potential problems inherent to its age that could pose a risk of negatively affecting tritium operations. Replacing HAOM would ensure safe, reliable, and efficient operations for the future. NNSA approved a cost range of $305 million to $640 million with a completion date expected from Fiscal Years 2029 to 2031. The Tritium Finishing Facility's construction would enable the continued safe and secure execution of this national security mission.	H Area	Proposed	NNSA 2020
Commercial Disposal of Defense Waste Processing Facility Recycle Wastewater (DOE/EA-2115)	This action would dispose of up to 10,000 gallons of stabilized (grouted) DWPF recycle wastewater at a commercial LLW disposal facility located outside of South Carolina. This effort would analyze capabilities for alternative treatment and disposal options using existing, permitted, offsite commercial treatment and disposal facilities. The DWPF recycle wastewater would be treated, characterized, and if the performance objectives and waste acceptance criteria of a specific disposal facility were met, DOE could evaluate whether to dispose of the waste as LLW under DOE's HLW interpretation. A FONSI was signed on August 5, 2020 (85 FR 48236).	S Area	Ongoing	DOE 2020e 85 FR 48236
Savannah River Site – Offsite Actions				
Vogtle Electric Generating Plant	This action is the continued operation of Vogtle Electric Generating Plant Units 1 and 2, and construction and operation of Units 3 and 4: two Westinghouse AP1000 nuclear reactors, 1,117 megawatts each. Units 3 and 4 are expected to be online in November 2021 (Unit 3) and November 2022 (Unit 4).	6.5 miles southwest of K Area	Ongoing	Georgia Power 2018 DOE 2015a:4-119 SRNS 2020
American Zinc Recycling LLC	This action is the continued operation of the American Zinc Recycling facility, a producer of zinc, zinc oxide, and zinc powder from recycled sources. It recycles thousands of tons of zinc-containing electric arc furnace dust and secondary materials, batteries, nickel bearing waste, and other metals. The Barnwell, South Carolina, facility has the capacity to process up to 180,000 tons per year of electric arc furnace dust.	10 miles northeast of K Area	Ongoing	AZR 2020a AZR 2020b
Energy*Solutions* LLW Disposal Facility	This action is the continued operation of the Barnwell Disposal Facility, owned by the State of South Carolina and operated by Energy*Solutions*. The Facility began operations in 1971. The facility is the host disposal site for the Atlantic Compact, which is composed of South Carolina, New Jersey, and Connecticut. The site is licensed to dispose of Class A, B, and C LLW.	11 miles northeast of K Area	Ongoing	DOE 2015a:4-119 SRNS 2020

ATR = Advanced Test Reactor; CERCLA = Comprehensive Environmental Response, Compensation and Liability Act; DWPF = Defense Waste Processing Facility; EA = environmental assessment; EIS = environmental impact statement; ETTP = East Tennessee Technology Park; FONSI = Finding of No Significant Impact; HALEU = High-Assay Low-Enriched Uranium;

Name	Description	Location(s) [b]	Status	Source Document(s)

HAOM = H Area Old Manufacturing Facility; HFIR = High-Flux Isotope Reactor; HLW = high-level radioactive waste; IFDP = Integrated Facility Disposition Project; INL = Idaho National Laboratory; INTEC = Idaho Nuclear Technology and Engineering Center; LLW = low-level radioactive waste; MFC = Materials and Fuels Complex; MFFF = Mixed Oxide Fuel Fabrication Facility; MTHM = metric tons of heavy metal; NEPA = National Environmental Policy Act; NNPP = Naval Nuclear Propulsion Program; NNSA = National Nuclear Security Administration; NOI = notice of intent; NRC = U.S. Nuclear Regulatory Commission; NRF = Naval Reactor Facility; NSTR = National Security Test Range; ORNL = Oak Ridge National Laboratory; ORR = Oak Ridge Reservation; ORSTP = Oak Ridge Science and Technology Project; REDC = Radiochemical Engineering Development Center; ROD = Record of Decision; RRTR = Radiological Response Training Range; RWMC = Radioactive Waste Management Complex; SA = Supplement Analysis; SNF = spent nuclear fuel; SRS = Savannah River Site; TAN = Test Area North; TCR = Transformational Challenge Reactor; TREAT = Transient Reactor Test Facility; TRU = transuranic; UAMPS = Utah Associated Municipal Power Systems; TVA = Tennessee Valley Authority; WIPP = Waste Isolation Pilot Plant.

[a] In this VTR EIS, reasonably foreseeable actions are generally understood to be those that have been identified in a NEPA document or are from another environmental impact analysis that is available and for which the effects can be meaningfully evaluated. These include actions unrelated to DOE. Applicable actions within the boundaries of the DOE sites (i.e., the INL Site, ORR, and SRS) were considered regardless of their locations. Actions outside the DOE site boundaries were examined if they were within about 10 miles of the specific locations at the DOE sites (i.e., MFC at the INL Site, Melton Valley Site at ORNL, and K Area at SRS) and might contribute to cumulative effects.

[b] Indicates locations analyzed in the alternatives evaluated in the referenced source document. Only those locations that are analyzed in this EIS (i.e., INL, ORR or ORNL, and SRS) are listed; other locations are indicated as "other sites."

[c] A pit is the central core of a nuclear weapon that principally contains plutonium or enriched uranium.

Maintenance and repair of buildings and infrastructure (e.g., utilities and roads) at DOE sites are ongoing processes. Therefore, maintenance and repair activities at the INL Site, ORR, and SRS could contribute to cumulative impacts. However, most of these activities would be of limited size and of short duration and are generally covered by one of the categorical exclusions in the DOE NEPA Implementing Procedures (10 CFR Part 1021, Appendix B). Therefore, they would be unlikely to substantially contribute to cumulative impacts and are not evaluated further in this EIS.

5.3 Idaho National Laboratory

5.3.1 Land Use and Aesthetics

Land Use – Cumulative impacts on land use at the INL Site are presented in **Table 5–2**. Cumulative actions could occupy 48,500 to 48,700 acres of land, would be generally compatible with existing land use plans and allowable uses and would not affect offsite land uses. Existing activities at the primary facility areas at the INL Site currently occupy about 11,400 acres. Utility right-of-way corridors and public roadways at the INL Site represent a combined land use commitment of about 34,000 acres. Many of the other present and reasonably foreseeable future actions identified in Table 5–1 and included in Table 5–2 would occur in industrial or otherwise developed areas at the INL Site (e.g., ATR, MFC, and NRF) and would result in minor or no new land disturbance.

Table 5–2. Cumulative Land Use Impacts at Idaho National Laboratory

Activity		***Land Use Commitment (acres)*** [a]
Past, Present, and Reasonably Foreseeable Future Actions		
Existing Site Activities [b]	Developed Areas	11,400 [c]
	Utility Rights-of-Way and Public Roads	34,000
Plutonium-238 Production for Radioisotope Power Systems (DOE 2000b:2-92)		10-66 [d]
Disposal of GTCC LLW and GTCC-Like Waste (DOE 2016a:2-22)		50-110 [d]
Expanding Capabilities at the Power Grid Test Bed (DOE 2019a:10)		400
Expand Capabilities at NSTR and RRTR (DOE 2019h:13)		460
Recapitalization of Infrastructure Supporting Naval SNF Handling (DOE 2016b:2-24)		50-150 [d]
DOE Idaho Spent Fuel Facility (NRC 2004:2-10)		18
Idaho HLW and Facilities Disposition (DOE 2002a:3-51)		22
UAMPS Small Modular Reactors (DOE-ID 2016:1)		up to 2,000
Subtotal – Baseline Plus Other DOE Actions		**48,400–48,600**
VTR	INL VTR Alternative	100 [e]
	INL Reactor Fuel Production Options	0
Subtotal for VTR		**100**
Total [f]		**48,500-48,700**
Site Capacity		569,600 [b, g]

GTCC = greater-than-Class C; HLW = high-level radioactive waste; LLW = low-level radioactive waste; NSTR = National Security Test Range; RRTR = Radiological Response Training Range; SNF = spent nuclear fuel; UAMPS = Utah Associated Municipal Power Systems.

[a] Acreages include areas cleared or used for construction staging areas in addition to operational areas.
[b] From Chapter 3, Section 3.1.1.1
[c] Represents developed areas at primary facility areas located within an about 230,000 acre central core of the INL Site. A 45,000-acre security and safety buffer surrounds the developed area.
[d] Includes the minimum and maximum values from various alternatives of the proposed actions.
[e] From Chapter 2, Section 2.4
[f] Total rounded to three significant figures.
[g] Majority of this land is undeveloped.

Within the boundaries of the INL Site, the cumulative land use of 48,500 to 48,700 acres would involve about 8.5 percent of the 569,600 acres that comprise the INL Site. Activities evaluated in this EIS for the maximum INL VTR Alternative (including the INL Reactor Fuel Production Options) would disturb 100 acres, or about 0.2 percent of the 45,400 acres of currently developed land at the INL Site and about 0.02 percent of the 569,600 acres of land available at the INL Site. Therefore, the land used for construction and operation of the VTR and associated facilities at the INL Site would not substantially contribute to cumulative land use impacts.

Aesthetics – Several of the actions identified in Table 5–1 involve the alteration of existing ground conditions or the construction of new facilities at the INL Site with the potential to change the overall visual character of areas within the viewshed (see **Table 5–3**). For many of the actions identified in Table 5–3, construction activities would create short-term visual impacts, but would not be out of character for an industrial site or would not be visible from public areas outside the INL Site. The information in Table 5–3 indicates that because of the geographic separation between the various activities, location of many of the activities in industrial areas, and the nature of the activities, there would be little cumulative impacts on aesthetics at the INL Site. Only one of the activities listed in Table 5–3 (Sample Preparation Laboratory) involves the construction of a new facility at MFC, which once completed, would be consistent with the industrialized character of the area. Because construction of the VTR and associated facilities would disturb only 100 acres located adjacent to industrial areas at MFC and geographically separated from most of the other activities at the INL Site, the Proposed Action would not substantially contribute to cumulative aesthetics impacts at the INL Site.

Table 5–3. Reasonably Foreseeable Actions with the Potential to Affect Aesthetics at Idaho National Laboratory

Activity	*Location*	*Acres*	*Potential Visual Resources/Aesthetic Impact as Assessed in NEPA document*
Plutonium-238 Production for Radioisotope Power Systems (DOE 2000b:2-91)	ATR	10-66 [a]	If alternatives involving construction were chosen, a site-specific evaluation of visual resources would be conducted before site selection. This could result in reclassification under BLM guidelines.
Disposal of GTCC LLW and GTCC-Like Waste (DOE 2016a:2-22)	Near ATR	50-110 [a]	Under one alternative, 12 vault structures would be constructed; each would be 36 feet wide, 310 feet long, and 26 feet tall.
Sample Preparation Laboratory (DOE 2019b:3)	MFC	0.7	This laboratory will be a three story, slab-on-grade, masonry block structure with steel. The first floor will be reinforced, cast-in-place concrete; second and third floors will be steel deck with reinforced concrete.
Expanding Capabilities at the Power Grid Test Bed (DOE 2019a:26)	CFA to MTR	400	The proposed overhead power line traverses areas of the INL Site that are, in general, out of view of public roads and public vantage points. The Proposed Action uses dark poles to reduce contrast with natural surroundings.
Expand Capabilities at NSTR and RRTR (DOE 2019h:42)	NTSR RRTR	460	Implementing the Proposed Action would not degrade the visual character or quality of the INL Site or its surroundings.
Recapitalization of Infrastructure Supporting Naval SNF Handling (DOE 2016b:2-53)	NRF	150	There would be no impact on visual/scenic resources from landscape contrast since the new facility would be consistent with the current visual character of NRF.
DOE Idaho Spent Fuel Facility (NRC 2004:2-13)	INTEC	18	Because of its smaller scale compared to adjacent INTEC facilities, construction and operation of the proposed facility would not cause significant visual impacts on the BLM Class IV rating for INTEC.
Idaho HLW and Facilities Disposition (DOE 2002a:3-54; 5-18)	Adjacent to INTEC	22	There would be negligible change in the visual setting. From U.S. 20, the nearest public access, the new facility would blend in with the rolling topography of the area and would not be visible.

ATR = Advanced Test Reactor; BLM = Bureau of Land Management; CFA = Central Facilities Area; GTCC = greater-than-Class C; HLW = high-level radioactive waste; INTEC = Idaho Nuclear Technology and Engineering Center; LLW = low-level radioactive waste; NRF = Naval Reactors Facility; NSTR = National Security Test Range; RRTR = Radiological Response Training Range

[a] Includes the minimum and maximum values from various alternatives of the proposed actions.

5.3.2 Geology and Soils

As described in Section 5.3.1, Table 5–2, cumulative land disturbance at the INL Site could total 48,500 to 48,700 acres, or about 8.5 percent of the total land area at the INL Site of 569,600 acres. The amount of land disturbed under the maximum INL VTR Alternative (including the INL Reactor Fuel Production Options) would be 100 acres or 0.2 percent of the total amount of land disturbed. When land is disturbed, the native soil structure is destroyed. Based on the information presented in Section 5.3.1, the amount of soil disturbed under the maximum INL VTR Alternative, would be a small percentage of the total soil disturbed at the INL Site and would not substantially contribute to cumulative impacts.

As shown in **Table 5–4**, cumulative geologic and soils materials used for the construction projects at the INL Site could total 1,230,000 cubic yards. The amount of geologic and soils materials used under the maximum INL VTR Alternative would be 112,000 cubic yards or about 9 percent of the total amount of geologic and soils materials that would be used by other activities at the INL Site.

In an EA prepared to address the impacts of developing new sources of silt and clay to support INL activities, DOE identified a need for 4,600,000 cubic yards of silt and clay material over a period of 10 years (DOE 2002a:5-215). The 112,000 cubic yards of geologic and soils materials used under the maximum INL VTR Alternative would be about 2.4 percent of the total geologic and soils materials anticipated to be needed at the INL Site as described in the EA.

Table 5–4. Cumulative Geology and Soils Impacts at Idaho National Laboratory

Activity [a]		***Geologic and Soils Materials (cubic yards)***
Past, Present, and Reasonably Foreseeable Future Actions		
Existing Site Activities		NP [b]
GTCC LLW Disposal (DOE 2016a:5-49)		664,000
Sample Preparation Lab (DOE 2019b:1)		480
Multipurpose Haul Road (DOE 2010c:32)		80,600
Power Grid Test Bed (DOE 2019a:3)		163,000
Naval SNF Handling (DOE 2016b:4-28)		209,000
	Subtotal – Baseline Plus Other Actions	**1,117,000**
VTR [c]	INL VTR Alternative	112,000
	INL Reactor Fuel Production Options	little or no use of geologic and soil materials
Subtotal for VTR [d]		**112,000**
Total [e]		**1,230,000**

GTCC = greater-than-Class C; LLW = low-level radioactive waste; NP = not provided; SNF = spent nuclear fuel.

[a] Activities are from Table 5–1. Only those activities with available estimates of geologic and soil materials use are listed.

[b] The amount of geologic and soils material used by existing site development is unknown.

[c] Impact indicator values are from Chapter 4, Section 4.2.1.

[d] Total is a range that includes the minimum and maximum values from the VTR EIS alternatives. Total may not equal the sum of the contributions due to rounding.

[e] Total rounded to three significant figures.

5.3.3 Water Resources

As described in Chapter 4, Section 4.3.1.2, no effluent would be discharged directly to natural surface water bodies, and no surface water would be used during implementation of the maximum INL VTR Alternative (including the INL Reactor Fuel Production Options). Therefore, the Proposed Action would not contribute to cumulative impacts on surface water at the INL Site.

As described in Chapter 4, Section 4.3.2.2, no effluent would be discharged directly to groundwater during implementation of the maximum INL VTR Alternative. Therefore, the Proposed Action would not contribute to cumulative impacts on groundwater quality at the INL Site.

Groundwater use during construction of the projects listed in Table 5–1 generally would be for short durations, would involve relatively small quantities of water, and would occur at different times. The staggering of construction activities helps to ensure that the cumulative groundwater use during construction of all present and reasonably foreseeable projects would not substantially add to cumulative impacts on groundwater at the INL Site.

Past and present INL operations use groundwater as the water supply source. The Federal Reserved Water Right for the INL Site allows a maximum water consumption of 11.4 billion gallons per year from the Snake River Plain Aquifer (SRPA). **Table 5–5** lists the cumulative annual groundwater withdrawals expected from operation of the past, present, and reasonably foreseeable future actions at the INL Site. The totals presented in Table 5–5 represent about 872 million gallons per year, or about 7.6 percent of the Federal Reserved Water Right for the INL Site. Compared to the 755 million gallons withdrawn in 2019, the INL VTR Alternative with the Reactor Fuel Production Options represents an estimated 1 percent increase in groundwater use, and a negligible contribution to cumulative impacts on groundwater. However, these withdrawals would contribute to the declining SRPA water table elevation and could eventually impact water availability to other INL Site facilities or to downstream users. As shown in Table 5–5, the groundwater withdrawn to support the maximum INL VTR Alternative (including the INL Reactor Fuel Production Options), would be a very small percentage of annual cumulative groundwater use. Therefore, the groundwater use for this alternative would not substantially contribute to cumulative impacts at the INL Site.

As discussed in Chapter 4, Section 4.3, the anticipated volume of wastewater discharged to the MFC Industrial Waste Pond or active sewage lagoons under the maximum INL VTR Alternative (including the INL Reactor Fuel Production Options) would represent about 12 percent of the permitted limit of 17 million gallons per year. Another 2.4 million gallons per year of sanitary wastewater would be generated during operations, but sanitary wastewater is not regulated under the industrial wastewater reuse permit and would not contribute to the permitted limit of 17 million gallons per year. As the other past, present, and reasonably foreseeable future actions presented in Table 5–5 would be located across the INL Site and would discharge wastewater to different discharge points, there would be little or no cumulative impact of these discharges. As all activities would comply with permit limitations, no adverse cumulative effect from wastewater discharges would be anticipated.

Table 5–5. Cumulative Groundwater Withdrawals During Operation of Past, Present, and Reasonably Foreseeable Actions at Idaho National Laboratory

Activity		*Groundwater Withdrawal (gallons per year)*
Past, Present, and Reasonably Foreseeable Future Actions [a]		
Existing Site Activities [b]		755,000,000
Recapitalization of Infrastructure Supporting Naval SNF Handling (DOE 2016b:5-9)		3,600,000
DOE Idaho Spent Fuel Facilities/Independent SNF Storage Installation (DOE 2016g:5-9)		450,000
Idaho High-Level Waste and Facilities Disposition (DOE 2002a:5-89)		104,000,000
Disposal of GTCC LLW and GTCC-Like Waste (DOE 2016a:5-92, 5 94)		1,400,000
Subtotal – Baseline Plus Other Actions		**865,000,000**
VTR [c]	INL VTR Alternative	4,400,000
	INL Reactor Fuel Production Options	2,400,000
Subtotal for VTR		**6,800,000**
Total [d]		**872,000,000**
INL's Reserved Water Right [b]		11,400,000,000

GTCC = greater-than-Class C; LLW = low-level radioactive waste; SNF = spent nuclear fuel.

[a] Activities are from Table 5–1. Only those activities with available estimates of groundwater use are listed.

[b] Existing groundwater use and INL's Federal Reserved Water Right are from Chapter 3, Section 3.1.3.4.

[c] Impact indicator values are from Chapter 4, Section 4.3.2.2.

[d] Total rounded to three significant figures.

5.3.4 Air Quality

The region surrounding the INL Site is currently in compliance with all State and national ambient air quality standards. The air quality cumulative impacts analysis estimates the potential for emissions from the maximum INL VTR Alternative (including the INL Reactor Fuel Production Options), in combination with emissions from other past, present, and reasonably foreseeable future actions, to exceed an ambient air quality standard. Radiological emissions are discussed in Section 5.3.10.

As described in Chapter 4, Sections 4.4.1.1 and 4.4.4.1 of this VTR EIS, construction activities from the maximum INL VTR Alternative (including the INL Reactor Fuel Production Options) would generate emissions. Emissions would be from the use of fossil fuel-powered equipment and trucks, workers' commuter vehicles, and fugitive dust (PM_{10}/$PM_{2.5}$) due to the operation of equipment on exposed soil. Estimated peak annual construction emissions from these combined activities would remain well below indicator thresholds of significance (see Tables 4–5 and 4–9). The intermittent operation of construction emission sources over an area of 100 acres would result in dispersed concentrations of air pollutants adjacent to construction activities. The transport of construction emissions from MFC to the nearest INL Site boundary (about 3 miles) would produce additional dispersion and would result in inconsequential concentrations of air pollutants beyond the INL Site property boundary. Therefore, in combination with emissions from other past, present, and reasonably foreseeable future actions, the minor increase in offsite air pollutant concentrations produced from construction of the VTR and associated facilities would not result in air pollutant concentrations that would exceed the State and national ambient air quality standards. Emissions from construction activities related to the maximum INL VTR Alternative (including the INL Reactor Fuel Production Options) would not substantially contribute to cumulative air quality impacts.

Emissions from construction trucks transporting materials, equipment, and wastes, and from workers' commuter vehicles, would produce low concentrations of air pollutants along public roadways. These low concentrations are primarily because of the intermittent use of vehicles and equipment and their low emission rates. Because these air pollutant concentrations would be low, offsite on-road construction vehicle activities from the maximum INL VTR Alternative (including the INL Reactor Fuel Production Options) would not substantially contribute to cumulative air quality impacts.

As described in Chapter 4, Sections 4.4.1.2 and 4.4.4.2, operations activities from the maximum INL VTR Alternative (including the INL Reactor Fuel Production Options) would generate emissions. Emissions would be from intermittent use of two diesel-powered backup electrical generators, intermittent use of propane-fired heaters for the VTR sodium heat exchanger system during maintenance activities, diesel-powered trucks that deliver material and transport wastes, and workers' commuter vehicles. Review of the data in Tables 4–6 and 4–10 shows that the combined activities would produce minor amounts of air emissions. Transport of these emissions to the INL Site boundary would produce negligible ambient air pollutant concentrations at offsite locations. Therefore, the minor increase in offsite air pollutant concentrations produced from operations, in combination with emissions from other past, present, and reasonably foreseeable future actions, would result in air pollutant concentrations that would not exceed the State and national ambient air quality standards. Emissions from operations activities related to the maximum INL VTR Alternative (including the INL Reactor Fuel Production Options) would not substantially contribute to cumulative air quality impacts.

5.3.5 Ecological Resources

For the cumulative impacts analysis, the ROI for ecological resources expands to include the proposed project area and nearby areas that could potentially be affected under the INL VTR Alternative (including the INL Reactor Fuel Production Options) when combined with other past, present, and reasonably foreseeable future actions. Table 5–2 is a tabulation of cumulative land disturbance at the INL Site.

Cumulative disturbance to ecological resources could total 48,523 to 48,742 acres, or 8.5 percent of the total 570,000 acres of land area at the INL Site.

Cumulative impacts on ecological resources could occur with the Proposed Action when combined with other past, present, and reasonably foreseeable future actions, including temporary and permanent disturbance, and degradation or loss of animals and habitats from land-clearing activities. The disturbance or displacement of wildlife due to an increase in noise and human activity at the construction site (behavioral avoidance) and the fragmentation of remaining habitats resulting from project developments are also potential cumulative impacts. Also included are the increases in human-wildlife encounters and collisions between wildlife and motor vehicles from wildlife displaced from their habitat by construction activities and possibly made more susceptible to predation and intra-species competition and less able to obtain adequate food and cover.

Vegetation removal activities at the INL Site would increase the amount of habitat loss and could lead to habitat degradation. Direct impacts could include permanent and temporary impacts on wildlife due to an increase in noise and human activity near construction activities and the loss of habitat from land-clearing activities that could result in habitat fragmentation. Construction activities could also result in potential increases in collisions between wildlife and motor vehicles. Indirect impacts would also include an increased potential for the spread of invasive species due to soil disturbance (creating open habitat for invasive species establishment). It is anticipated that impacts on vegetation, wildlife, and special status species from the activities listed in Table 5–2 would be similar to those for the Proposed Action as described in Chapter 4, Section 4.5.

Operational and administrative controls (as described in Section 4.5) will be evaluated and implemented, if warranted, for the Proposed Action and other actions to reduce the potential for adverse effects to wildlife (including migratory birds and special status species) and their habitats. These controls may include daily and seasonal timing of project activities, reduced speed limits, ultrasonic warning whistles, encouraging animals not to use the road, and preemptive awareness programs for construction crews. Administrative controls would include the posting of speed limit signs and creating exclusion areas for sensitive species (such as snake hibernacula and the pygmy rabbit burrow area). Increased vehicle activity within the proposed project area could potentially increase the risk for wildlife strikes by vehicles.

Additionally, construction, land clearing, and vegetation removal activities would be controlled to preclude damage to active bird nests. Following the Migratory Bird Treaty Act permit guidance, performance of migratory bird nesting surveys would occur before any ground disturbance or vegetation removal. Other preventive measures, such as buffer areas or stopping work, would prevent nest abandonment until nestlings have fledged, thus minimizing cumulative impacts.

Vegetation subject to clearing could support foraging, nesting, and other behaviors for mammals, birds (including migratory birds and Birds of Conservation Concern [BCC]), amphibians, and reptiles. Land clearing would cause disturbances in the landscape resulting in new habitat edges, potentially disrupting wildlife ecosystem processes and habitats. The cumulative impacts to sagebrush habitat could be substantial given the extent of habitat affected. The DOE "no net loss of sagebrush habitat" policy (to mitigate loss of sagebrush, monitor sagebrush disturbance, and planting an area equal to that disturbed or removed in areas that are beneficial to greater sage-grouse under the *CCA for Greater Sage-grouse* on the INL Site [DOE-ID & USFWS 2014]), would confer protection of this sensitive ecological resource. To verify compliance with this DOE-ID policy, annual monitoring and summary reporting of sagebrush restoration efforts at the INL Site would continue to be conducted (DOE-ID 2019a). Revegetation of temporary disturbance areas would occur in accordance with annual INL Revegetation Assessment program practices (INL/EXT-19-56726). Invasive species management would continue to be implemented for all projects. Infrastructure and traffic could impose dispersal barriers to most non-flying terrestrial animals.

Cumulative impacts on ecological resources would not be substantial because ground disturbance and land clearing for the Proposed Action and other past, present, and reasonably foreseeable future actions would occur at different locations and times, and appropriate mitigations (such as sagebrush replacement, invasive species management, and the INL Revegetation Assessment program) would be enforced. Revegetation would occur in accordance with annual INL Revegetation Assessment program practices (INL/EXT-19-56726).

5.3.6 Cultural and Paleontological Resources

Damage to the nature, integrity, and spatial context of cultural resources can have a cumulative impact if the initial act is compounded by other similar losses or impacts. The alteration or damage to cultural resources may incrementally impact resources in and around the INL Site.

As described in Section 3.1.6, there are no significant cultural or paleontological resources in the area of potential effect (APE) for proposed VTR construction at the INL Site. Therefore, cumulative impacts on cultural resources within the ROI would be negligible because the proposed new construction is consistent with the historic industrial character of the area and will not diminish the integrity of setting of any historic property within the MFC facility.

5.3.7 Infrastructure

Table 5–6 lists the estimated annual cumulative infrastructure requirements from operations at the INL Site for electricity and water. Projected cumulative site activities would annually require 468,000 to 471,000 megawatt-hours of electricity, which is below the total site-wide capacity of 481,800 megawatt-hours. Cumulative water usage would be about 872 million gallons of water per year, which is well within the site-wide capacity of 11.4 billion gallons per year. Operation of the VTR and associated facilities at the INL Site would use about 6.8 million gallons of water per year, which represents a fraction of cumulative infrastructure use and an even smaller fraction of total site capacity. Electricity use would be about 170,000 megawatt-hours of electricity per year, which represents about one third of current site capacity. When evaluating other site activities, total electric use would be about 10,800 to 13,800 megawatt-hours per year below site capacity. As discussed in Section 4.7.1, several options are under consideration for upgrades to the current electrical system at the INL Site to handle additional loads potentially resulting from VTR operations.

Table 5–6. Annual Cumulative Infrastructure Impacts from Operations at Idaho National Laboratory

Activity		***Electricity Consumption (megawatt-hours per year)***	***Water Usage (gallons per year)***
Past, Present, and Reasonably Foreseeable Future Actions			
Existing Site Activities		186,255 [a]	755,000,000 [a]
Plutonium-238 Production for Radioisotope Power Systems (DOE 2000b:4-317)		negligible	440,000
Disposal of GTCC LLW and GTCC-Like Waste (DOE 2016a:5-92, 5-94)		5,050	1,400,000
Recapitalization of Infrastructure Supporting Naval SNF Handling (DOE 2016b:5-9)		105,000	3,600,000
DOE Idaho Spent Fuel Facility (NRC 2004:2-11)		Not reported	450,000
Idaho HLW and Facilities Disposition (DOE 2002a:5-222))		1,800–5,000 [b]	104,000,000
Subtotal – Baseline Plus Other DOE Actions		**298,000–301,000**	**865,000,000**
VTR	INL VTR Alternative	150,000 [c]	4,400,000 [c]
	INL Reactor Fuel Production Options	20,000 [c]	2,400,000 [c]
Subtotal for VTR		170,000	**6,800,000**

Activity	Electricity Consumption (megawatt-hours per year)	Water Usage (gallons per year)
Total [d]	**468,000–471,000**	**872,000,000**
Total Site-wide Capacity	481,800 [a]	11,400,000,000[a]

GTCC = greater-than-Class C; HLW = high-level radioactive waste; LLW = low-level radioactive waste; SNF = spent nuclear fuel.
[a] From Chapter 3, Section 3.1.7.
[b] Total is a range that includes the minimum and maximum values from various alternatives of Proposed Action.
[c] From Chapter 4, Section 4.7.
[d] Total is rounded to three significant figures.

The Utah Associated Municipal Power Systems (UAMPS) Small Modular Reactors project would have the potential to create additional electrical power capacity to the region. The project would site up to 12 small modular reactors at the INL Site, rated at 50 to 60 megawatts each. Therefore, this project could add up to 600 to 720 megawatts of additional electrical capacity. UAMPS plans to commence site preparation in 2021, with construction commencing in 2023, and commercial operations beginning with one reactor coming online in 2026 and the remainder in 2027 (NuScale 2019).

5.3.8 Noise

The analysis of cumulative noise impacts considers perceptible increases in ambient noise levels and increases of excessive ground-borne vibration to persons or property in the ROI. The ROI for noise extends 0.5 miles from the edge of the construction area. As discussed in Chapter 3, Section 3.1.8.3, the closest noise-sensitive receptor is a dual home and farm about 5.0 miles from the VTR site and about 1.9 miles from U.S. Highway 20, which is expected to be the primary noise source for this location. As a result, the cumulative impacts analysis examines the onsite noise-sensitive receptors to include workers present onsite and within 0.5 miles from the edge of the construction area. Most existing and planned projects at the INL Site listed in Table 5–1 would occur at different locations and at different times and would not contribute to cumulative noise effects in combination with the proposed VTR activities.

Most of the potential impacts from noise are short-term and are related to the construction phase of the project, including noise from construction equipment and vehicles. Examples of construction noise levels are given in Chapter 4, Section 4.8.2.1 and include measurements at 50 feet of 80 decibels (A-weighted) (dBA) from excavators, 85 dBA from tractors and bulldozers, and 89 dBA from graders. Although construction noise could be moderately loud, the temporary and intermittent nature of the construction activities would not result in long-term cumulative impacts. As discussed in Section 4.8.2.1, noise levels fluctuate depending on the type, number, and duration of use of heavy equipment for construction activities. They also differ by the type of activity, distance to noise-sensitive uses, existing topography and vegetation conditions to diminish the sound, and ambient noise levels. Additionally, construction activities are generally limited to daylight hours in conformance with Federal, State, and local codes and ordinances, and manufacturer-prescribed safety procedures and industry practices.

During operation, cumulative impacts include the potential for perceptible increases in ambient noise levels for sensitive receptors (e.g., the INL Site workers). For some projects listed in Table 5–1, operations could cumulatively increase noise due to facility operations, range activities, and additional vehicle trips.

As noted above, the closest sensitive receptor to the VTR site is a dual home and farm that is about 5.0 miles away. Given the large distance, cumulative noise from construction or operation of projects at MFC and others within the INL Site would be indistinguishable from typical background at the closest offsite noise-sensitive receptor. See Section 4.8.2.1 for additional information about potential noise levels at the closest offsite receptor.

5.3.9 Waste Management

The assessment of the waste management cumulative impacts at the INL Site includes the INL VTR Alternative and reactor fuel production options and other reasonably foreseeable actions that result in the generation, treatment as required, and disposal of LLW, MLLW, and transuranic (TRU) waste. **Table 5–7** summarizes the estimated cumulative annual generation rates of these wastes. Additional reasonably foreseeable actions are identified in Section 5.2, Table 5–1. As noted in Table 5–1, some of these activities are ongoing, and the waste generated by these activities are included in the existing site activities' waste generation rates for the INL Site. For some of the activities identified as proposed, there is no waste generation information currently available. For some activities, waste generation was described as "small quantities" or was less than 20 cubic meters. Therefore, these other DOE actions were covered as a group and the annual LLW, MLLW, and TRU waste generation rates are characterized as "small quantities" in Table 5–7 below.

Table 5–7. Cumulative Average Annual Waste Generation at the Idaho National Laboratory Site in Cubic Meters

Activity		***LLW***	***MLLW***	***TRU Waste***
Past, Present, and Reasonably Foreseeable Future Actions				
Existing Site Activities [a]		8,600	4,600	1,100
Other DOE actions		Small Quantities	Small Quantities	Small Quantities
Subtotal – Baseline Plus Other DOE Actions		8,600	4,600	1,100
VTR	INL VTR Alternative [a]	540	38	0.89
	INL Feedstock Preparation/Fuel Fabrication [b]	170[c] /170[d]	2[c, e] /2[d, e]	200[c] /200[d]
Subtotal for VTR		540 - 880	38 - 42	0.89 - 400
Total		9,100 - 9,500	4,600	1,500

LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; TRU = transuranic waste.
[a] Source: Section 4.9.1.2, Table 4-34. INL VTR Alternative wastes are average annual generation rates based on a 60-year operation cycle.
[b] Source: Section 4.9.3.1.1, Table 4-36. Wastes are average annual generation rates based on a 60-year operation cycle.
[c] These quantities are estimates and could be different depending on the process for the feedstock.
[d] These quantities are fuel fabrication with no feedstock preparation.
[e] These quantities are included in the LLW quantities.
Note: All numbers are rounded to two significant figures. Due to rounding, sums and products may not equal those calculated from table entries.

The characteristics of the newly generated wastes are estimated to be similar to the wastes currently generated by existing activities. As described in Chapter 4, Section 4.9.1.2, the waste management infrastructure at the INL Site was developed to support the quantities of waste generated. Therefore, cumulative waste generation would be within site capacities. There are existing offsite DOE and commercial waste management facilities with sufficient capacities for the treatment and disposal needs of the relatively small volumes of LLW and MLLW generated by the Proposed Action. Consequently, substantial cumulative impacts on offsite LLW and MLLW treatment and disposal facilities would not be expected.

The Waste Isolation Pilot Plant (WIPP) facility is the only permanent disposal option for TRU waste generated by atomic energy defense activities as required by the WIPP Land Withdrawal Act (LWA; Pub. L. 102-579). The LWA specifies a total TRU waste disposal volume capacity limit of 6.2 million cubic feet (175,564 cubic meters).

The Annual TRU Waste Inventory Report (ATWIR) serves as a current estimate of the TRU waste inventory for potential disposal at the WIPP facility and documents the TRU waste that may be considered in future Compliance Recertification Applications submitted to the U.S. Environmental Protection Agency (EPA).

The ATWIR estimates are also used for technical analyses, strategic planning and National Environmental Policy Act (NEPA) analyses. The TRU Waste Inventory Profile Reports (Appendices A and B of the ATWIR) reflect the information reported by the TRU waste generator/storage sites. The TRU waste inventory estimates in the ATWIR have inherent uncertainties and therefore the inventory estimates change annually. The TRU waste inventory estimates typically change due to factors, such as: updates or revisions to site treatment plans, waste minimization activities, packaging adjustments, and technical and planning changes. As of the data collection cutoff date for the 2019 ATWIR, approximately 67,400 cubic meters of TRU waste were disposed at the WIPP facility (DOE-CFO 2019).

The maximum total TRU waste estimated to potentially be generated over the life of the alternatives and options evaluated in this EIS is 24,000 cubic meters. The maximum TRU waste volume estimates in this document represent TRU waste volume estimates and not the volume of the overpack disposal container(s). In addition, other proposed actions since publication of the current ATWIR[2] could change the TRU waste inventory for potential disposal at the WIPP facility.[3] These actions will be incorporated, as appropriate, into future ATWIR TRU waste inventory estimates.

TRU waste volume estimates such as those provided in NEPA documents, cannot be used to determine compliance with the WIPP LWA total TRU waste disposal volume capacity limit. The TRU waste estimates in the ATWIR change annually. Determining compliance with the WIPP LWA disposal capacity limit is determined by proven and audited procedures and processes implemented for the WIPP facility by the Carlsbad Field Office. The Carlsbad Field Office monitors and tracks the actual defense-related TRU waste volume emplaced at the WIPP facility to ensure compliance with the WIPP LWA and will take action as appropriate in a timely and appropriate manner to ensure needs of the DOE complex are met.

Any GTCC-like waste (e.g., non-defense TRU waste not eligible for disposal at the WIPP facility) generated from the Proposed Action would be stored at the generator site in accordance with applicable requirements until a disposal capability is available.

5.3.10 Human Health – Normal Operations

Cumulative impacts on public health and safety from radiological emissions could result from activities at the INL Site and potentially from other activities within the INL Site ROI (50 miles from the INL Site boundary). The actions listed in Table 5–1 were reviewed to identify potential worker and public health impact. **Table 5–8** shows information on the potential impacts from the present INL Site operations (from Chapter 3, Section 3.1.10.1 of this VTR EIS), reasonably foreseeable future actions, and the Proposed Action. This table includes those actions identified in Table 5–1 that could contribute to both worker and public (population and maximally exposed individual [MEI]) doses and potential latent cancer fatalities (LCFs). Only those activities that have identified radiological impacts with available estimates of radiation exposure are listed. Some of the actions identified in Table 5–1 would be expected to have radiological impacts, but estimates were not available. At the INL Site, these actions stem from the DOE Naval Nuclear Propulsion Program (NNPP)'s recapitalization of infrastructure supporting fuel examination capabilities, the Department of Defense's construction and demonstration of a Prototype Advanced Mobile Nuclear Reactor, the Oklo Aurora reactor project, and UAMPS Small Modular Reactors (carbon free power project).

[2] The latest ATWIR can be found at: https://wipp.energy.gov/national-tru-program-documents.asp.

[3] Examples include the *Final Supplement Analysis of the 2008 Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory for Plutonium Operations* (DOE 2020g) and the *Final Environmental Impact Statement for Plutonium Pit Production at the Savannah River Site in South Carolina,* DOE/EIS-0541 (DOE 2020a), https://www.energy.gov/nepa/downloads/doeeis-0541-draft-environmental-impact-statement.

Table 5–8. Annual Cumulative Population Health Effects of Exposure to Radiation from Normal Operations at Idaho National Laboratory

Activity		*Workforce*		*Population within 50 Miles*		*MEI*	
		Dose (person-rem)	*Annual LCF* [a]	*Dose (person-rem)*	*Annual LCF* [a]	*Dose (millirem)*	*Annual LCF Risk* [a]
Past, Present, and Reasonably Foreseeable Future Actions							
Existing Site Activities (baseline) [b]		94	0.06	0.044	5×10^{-6}	0.026	2×10^{-8}
RPS Infrastructure [c]		12	0.005	3.9×10^{-6}	6.8×10^{-8}	2.6×10^{-7}	1.3×10^{-13}
HALEU Fuel Production [d]		NC	NC	NC	NC	1.6	1×10^{-6}
Radiological Response Training Range (North Test Range) [e]		NC	NC	NC	NC	0.048	3×10^{-8}
Radiological Response Training Range (South Test Range) [e]		NC	NC	NC	NC	0.00034	2×10^{-10}
National Security Test Range [e]		NC	NC	NC	NC	0.04	2×10^{-8}
Recapitalization of Infrastructure Supporting Naval SNF Handling [f]		0	0	0.023	1×10^{-5}	0.0006	4×10^{-10}
Idaho Spent Fuel Facility [g]		NC	NC	NC	NC	0.000063	4×10^{-11}
Remote Handled LLW Disposal Facility [h]		0.5	0.0003	(h)	(h)	(h)	(h)
Integrated Waste Treatment Unit (ICP/EXT-05-01116) [e]		NC	NC	NC	NC	0.075	4×10^{-8}
Subtotal – Baseline Plus Other Actions		**110**	**0.06**	**0.067**	$\mathbf{4\times10^{-5}}$	**1.8**	$\mathbf{1\times10^{-6}}$
INL VTR	INL VTR Alternative	42 [i]	0.03	0.044	3×10^{-5}	0.0068	4×10^{-9}
	Feedstock Preparation Option	19 [i]	0.01	0.012	7×10^{-6}	0.0012	7×10^{-10}
	Fuel Fabrication Option	**110**	**0.07**	0.0053	3×10^{-6}	0.0016	1×10^{-9}
Subtotal for VTR		**230**	**220**	**0.1**	$\mathbf{4\times10^{-5}}$	**0.0096**	$\mathbf{6\times10^{-9}}$
Total		**340**	**0.2**	**0.13**	$\mathbf{8\times10^{-5}}$	**1.8**	$\mathbf{1\times10^{-6}}$

HALEU = high-assay low-enriched uranium; LCF = latent cancer fatality; LLW = low-level radioactive waste; MEI = maximally exposed individual; NC = not calculated; NNPP = Naval Nuclear Propulsion Program; RPS = Radioisotope Power System; SNF = spent nuclear fuel; UAMPS = Utah Associated Municipal Power Systems.

[a] LCFs are calculated using a conversion factor of 0.0006 LCFs per rem or person-rem (DOE 2003). The annual LCFs for the analyzed population represent the number of LCFs calculated by multiplying the listed doses by the risk conversion factor; no population LCFs are expected from any individual activity or from all combined activities. The annual MEI LCF risk represents the calculated risk of an LCF to an individual.

[b] From Chapter 3, Section 3.3.10.1 of this EIS. Worker population dose is the average for 2014 to 2018. Population dose is the highest from the last 3 years of operation.

[c] Impacts from the alternative with the highest impacts in the *Final PEIS for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the FFTF* (DOE 2000b:Table 4-169).

[d] Maximum dose calculated for alternatives in the *Environmental Assessment for Use of DOE-Owned High-Assay Low-Enriched Uranium Stored at Idaho National Laboratory* (DOE 2019b:Table 8). The environmental assessment did not calculate a population dose or a collective worker dose (dose to an individual collocated worker was calculated [maximum of 48 millirem per year]).

[e] *Final Environmental Assessment for Expanding Capabilities at the National Security Test Range and the Radiological Response Training Range at Idaho National Laboratory* (DOE 2019h:Table 35). The environmental assessment did not calculate a population dose nor include an assessment of worker dose.

[f] Impacts from *Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling* (DOE 2016b: Section 4.10.2, Tables 5.2-3, 5.2-4). Changes in the number of workers are limited to construction workers, who are not expected to receive doses above background levels.

[g] Impacts from the *Environmental Impact Statement for the Proposed Idaho Spent Fuel Facility at the Idaho National Engineering and Environmental Laboratory in Butte county, Idaho* (NRC 2004:Table 4-5) and are identified as less than the quantity shown. The EIS did not calculate a population dose and gave only a maximum individual worker dose.

[h] Worker impacts are from the transportation of wastes. Public impacts from transportation of selected waste to an offsite disposal site (0.48 person-rem and an LCF of 0.003) would not be limited to the ROI. The *Environmental Assessment for the Replacement Capability for Disposal of Remote-Handled Low-Level Radioactive Waste Generated at the Department of*

	Workforce		***Population within 50 Miles***		***MEI***	
Activity	***Dose (person-rem)***	***Annual LCF*** [a]	***Dose (person-rem)***	***Annual LCF*** [a]	***Dose (millirem)***	***Annual LCF Risk*** [a]

Energy's Idaho Site (DOE 2011a, 2011f) indicates the impacts from low-level waste storage occur thousands of years from now. The environmental assessment did not include an estimate of an MEI dose or LCF risk.

[l] Total worker dose for VTR is higher than listed. However, some of the dose would replace worker dose from existing activities and would not result in an increase in cumulative worker dose.

The cumulative offsite population dose would be 0.13 person-rem per year with no expected LCFs (calculated value of 8 x 10^{-5}). Operations of the VTR and associated facilities at the INL Site, including fuel preparation and fabrication, would result in a total population dose of 0.061 person-rem per year with no expected LCFs (calculated value of 4 x 10^{-5}). The total dose and LCFs from the Proposed Action would be 45 percent of the cumulative dose and LCFs. While this is a significant portion of the cumulative impact, the absolute value is low. For that reason, the additional population dose from operations of the VTR and associated facilities would not substantially contribute to human health impacts at the INL Site.

The cumulative MEI dose from activities on the INL Site would be 1.8 millirem per year with an associated LCF risk of 1 x 10^{-6}. This cumulative MEI dose is lower than the DOE limit of 100 millirem per year from all pathways (DOE Order 458.1 [DOE 2011b]), and the EPA individual dose limit of 10 millirem per year from airborne radionuclides (40 CFR Part 61 subpart H [54 FR 51695]). This dose conservatively assumes the same person would be the MEI for all activities at the INL Site. This is unlikely because the activities occur at different locations at the INL Site, each potentially with an MEI located at different offsite locations. Operation of the VTR and associated facilities, including feedstock preparation and fabrication, at the INL Site, would result in a total MEI dose of 0.0096 millirem per year with an associated LCF risk of 6 x 10^{-9}. The total MEI dose and LCFs from the Proposed Action would be 0.05 percent of the cumulative MEI dose and LCFs and therefore, would not substantially contribute to cumulative human health impacts at the INL Site.

The cumulative worker dose would be 220 person-rem per year with no expected LCFs (calculated value of 0.1). Operation of the VTR and associated facilities, including feedstock preparation and fuel fabrication, at the INL Site, would result in a total worker dose of 110 person-rem per year with no expected LCFs (calculated value of 0.07). The total worker dose and LCFs from the Proposed Action would be 51 percent of the cumulative dose and LCFs. The Proposed Action could result in 4 worker LCFs from 60 years of VTR operation. Much of the worker dose estimate is the result of conservatively using 750 millirem per year (the INL administrative dose limit is 700 millirem) as the estimate for some worker doses resulting from fuel fabrication. The flowchart and equipment for this activity are, at best, in the early stages of design. 10 CFR 835 requires DOE "to develop and implement plans and measures to maintain occupational radiation exposures as low as is reasonably achievable" (ALARA). DOE-STD-1098-2017, DOE Standard Radiological Control (DOE 2017f) identifies an effective ALARA process as including implementation of both engineered and administrative controls to control worker dose. All equipment and operations would be designed and implemented following this principle. Therefore, needed worker protection could be incorporated into the final design potentially reducing worker doses.

5.3.11 Traffic

As described in Chapter 4, Section 4.13.1, the impacts on traffic from construction and operation of facilities under the maximum INL VTR Alternative (including the INL Reactor Fuel Fabrication Options) are anticipated to be negligible to minor. Impacts on traffic from this alternative would not substantially contribute to cumulative traffic impacts and are not discussed further.

5.3.12 Socioeconomics

The ROI for cumulative socioeconomic impacts includes the seven Idaho counties near the INL Site: Bannock, Bingham, Bonneville, Butte, Clark, Jefferson, and Madison counties. As shown in **Table 5–9**, cumulative employment at the INL Site from present and reasonably foreseeable future actions could reach a peak of about 7,990 persons. This is about 5.1 percent of the 157,400 people employed in the INL Site ROI in 2018. These values are conservative estimates of short-term future employment at the INL Site. Some of the employment would occur at different times and it may not be appropriate to total these values. The employment totals from existing site activities include existing onsite employment (directly employed and contractor staff) and potential future employees based on activities identified in Table 5–1 and carried over to Table 5–9.

Table 5–9. Cumulative Employment at Idaho National Laboratory

Activity		***Direct Construction Employment (number of personnel in peak year***	***Direct Operations Employment (first year of operation)***
Past, Present, and Reasonably Foreseeable Future Actions [a]			
Existing Site Activities [b]		Not Applicable	6,840
Recapitalization of Infrastructure Supporting Naval SNF Handling (DOE 2016b:4-123–4-128)		360 direct 450 indirect	60 direct 110 indirect
Disposal of GTCC LLW and GTCC-like Waste (DOE 2016a:7-58, 2018d)		62–145	38–51
Expanding Capabilities at the Power Grid Test Bed (DOE 2019a:8, 11)		20	30
Use of DOE-Owned HALEU (DOE 2019b)		No staffing levels given (assume negligible)	
UAMPS Small Modular Reactors (DOE-ID 2016; NuScale 2019; UAMPS 2019:37, 40; Idaho Policy Institute 2019)		2,000 direct 1,360 indirect	360 direct 307 indirect
DOE Idaho Spent Fuel Facility/Independent SNF Storage Installation (NRC 2004:4-16)		250	60
Subtotal – Baseline Plus Other Actions		**2,690–2,780**	**7,390–7,400**
VTR [c]	INL VTR Alternative	1,310 peak, 650 average	218
	INL Fuel Fabrication Option	18 peak, 6 average	70 (230) [e]
	INL Feedstock Preparation Option	18 peak, 6 average	300
Subtotal for VTR		**1,350 peak**	**588 (818)[e]**
Total (Direct labor) [f]		**4,030–4,120**	**7,980–7,990**
ROI Labor Force (2018) [d]		**157,398**	

EIS = environmental impact statement; GTCC = greater-than-Class C; HALEU = High-Assay Low-Enriched Uranium; HLW = high-level radioactive waste; INL = Idaho National Laboratory; LLW = low-level radioactive waste; NNPP = Naval Nuclear Propulsion Program; ROI = region of influence; SNF = spent nuclear fuel; UAMPS = Utah Associated Municipal Power Systems; VTR = Versatile Test Reactor.

[a] Activities are from Table 5–1. Only those activities with available estimates of employment are listed. The following proposed projects in 2019 have no workforce estimates available and were excluded: Sample Test Laboratory, Expanding Capabilities at the Power Grid Test Bed.

[b] Employment from existing site activities is from Chapter 3, Section 3.1.14.

[c] Impacts of the VTR Alternative/Option are from Chapter 4, Section 4.14.1.

[d] ROI Labor Force is from Chapter 3, Section 3.1.14.

[e] Fuel fabrication would employ 70 new workers but an additional 230 workers would be drawn from the existing workforce at the INL Site, which would result in a total of 588 new workers and 818 workers total.

[f] Total rounded to three significant figures.

As identified in Table 5–1, it is assumed that no new workforce would be added to support ongoing projects at the INL Site, based on the NEPA documentation that was completed before 2019. These projects are ongoing and are presumably captured in the current onsite employment totals. These ongoing INL Site projects include:

- Plutonium-238 Production for Radioisotope Power Systems (DOE 2000b, 2013a)
- Treatment and Management of Sodium-Bonded SNF (DOE 2000a)
- Resumption of Transient Testing of Nuclear Fuels and Materials (DOE 2014b)
- Multi-Purpose Haul Road (DOE 2010c, 2010d)
- Idaho HLW and Facilities Disposition (DOE 2002a, 2005d)
- New Remote-Handled LLW Disposal Facility (DOE 2011a, 2011f)

It is assumed that the projects identified in Table 5–1 with NEPA documentation dated on or after 2019 may not yet be complete and operational at this writing. Therefore, these activities could require an additional onsite workforce. This cumulative employment is captured in Table 5–9.

Activities proposed under the maximum INL VTR Alternative (including the INL Reactor Fuel Production Options) could produce direct employment for up to about 1,340 construction workers during the 51-month construction period, nearly 32 percent of the 4,120 cumulative workforce related to construction activities at the INL Site. The 588 operations staff under the maximum INL VTR Alternative (including the INL Reactor Fuel Production Options) would be about 7.4 percent of the 7,990 cumulative workforce related to annual operations at the INL Site. By comparison, about 157,400 people were employed in the INL Site ROI in 2018. In addition to the direct jobs, INL estimates that for every INL Site job, another 1.71 jobs (indirect jobs) are created in other industries (INL 2020b), as described in Chapter 4, Section 4.14.1.

Any migration of workers into the ROI is expected to be small when compared to the projected population of the ROI. Furthermore, any in-migration would be within the historical trends of population growth within the ROI. Due to the low potential for in-migration and changes to the ROI population, impacts on the availability of housing and community services under the Proposed Action are expected to be small. The overall contribution to cumulative socioeconomic impacts (e.g., housing, schools, and community services) from the Proposed Action on the ROI is also expected to be small. The increase in jobs and income levels would be considered a small and beneficial impact on the local and regional economies.

However, it is also important to mention the proposed UAMPS Small Modular Reactors project, which would be located at the INL Site within the socioeconomic impacts ROI. It is a relatively large project with a potentially overlapping construction period with the VTR project. Both adverse and beneficial socioeconomic impacts are anticipated from construction of the UAMPS. The UAMPS project is expected to require large construction and operations workforces – larger than the VTR project (see Table 5–9). One economic impact study estimates the construction workforce for the UAMPS project at 2,000 workers (annually), over a 4-year construction period and a permanent operations workforce of an additional 360 people (Idaho Policy Institute 2019). The combined labor requirements of the two projects, especially during construction, could require a potentially large in-migrating workforce (both projects would require special skill sets), many of whom would bring families. This would result in an increase in the local population. In addition to workers hired directly for project construction or operation, the in-migrating workforce could also include workers required to fill new indirect jobs created by the two projects. This population influx could put additional demands on existing housing supply and local community services (e.g., schools, fire and police, and hospitals). Potential cumulative impacts of both projects would range from small to moderate adverse impacts, at least in the short term, depending on the total number of new employees who move into the area and the existing capacity of local resources and services to accommodate them. Moderate beneficial socioeconomic impacts also would occur due to the increase in income and spending in the local and regional communities and associated tax revenue. Over the longer term, increased tax revenues could be used to offset increased strains on housing and community services by funding enhancements to appropriate services and facilities.

Although project details related to the recently proposed Department of Defense Prototype Advanced Mobile Nuclear Reactor have not yet been identified (including its final location at ORNL or the INL Site) the Notice of Intent implies that it would be constructed and operated within existing facilities and infrastructure and would not have significant labor requirements (85 FR 12273). If this is true, then any adverse socioeconomic impacts from this activity would be expected to be small, and its contribution to potential cumulative impacts at the INL Site would also be small.

5.3.13 Environmental Justice

The analysis in Chapter 4, Section 4.15, indicates no high and adverse human health and environmental impacts on any population within the ROI because of the Combined INL VTR Alternative and the INL Reactor Fuel Production Options. Impacts on minority and low-income populations would be comparable to those on the population as a whole and would be negligible. Because the doses from the Proposed Action at the INL Site would be small and there would be no disproportionate high and adverse impacts on minority and low-income populations, the Proposed Action would not substantially contribute to cumulative environmental justice impacts at the INL Site.

5.4 Oak Ridge National Laboratory

5.4.1 Land Use and Aesthetics

Land Use – Cumulative impacts on land use at ORR are presented in **Table 5–10**. Cumulative actions could occupy 12,250 to 12,450 acres of land, would be generally compatible with existing land use plans and allowable uses, and would not affect offsite land uses. Existing activities at the primary facility areas at ORR currently occupy about 11,600 acres. Many of the other present and reasonably foreseeable future actions identified in Table 5–1 and included in Table 5–10 would occur in industrial or otherwise well-developed areas at ORR (e.g., Y-12, ORNL) and would result in minor or no new land disturbance. One future action, the transfer of property to develop a general aviation airport at ETTP, would result in a net loss of 170 acres of ORR property.

Table 5–10. Cumulative Land Use Impacts at the Oak Ridge Reservation

Activity	*Land Use Commitment (acres)*[a]
Past, Present, and Reasonably Foreseeable Future Actions	
Existing Site Activities	11,600 [b, c]
ORNL Modernization Initiative (DOE 2008b:2-4)	22 [d]
U-233 Material Downblending and Disposition (DOE 2010e:2-3)	2
Environmental Management Disposal Facility (DOE 2017a:7-16)	53–135 [e]
Plutonium-238 Production for Radioisotope Power Systems (DOE 2000b:2-92)	10–66 [e]
NNSA Complex Transformation (DOE 2008a:3-22, 3-41, 3-51)	475
Ongoing and Future Operations at Y-12 (DOE 2016e:39)	75
Y-12 Emergency Operations Center Project (DOE 2015d:4-3)	2
Property Transfer to Develop a General Aviation Airport at ETTP (DOE 2016d:2-1)	-170 [f]
Stable Isotope Production and Research Center (DOE-ORNL 2020b:2)	1
Second Target Station at the Spallation Neutron Source (DOE-ORNL 2020a)	9
Subtotal – Baseline Plus Other DOE Actions	**12,100–12,300**
ORNL VTR Alternative	150 [g]
Total	**12,250–12,450**
Site Capacity	32,867 [c]

ETTP = East Tennessee Technology Park; NNSA = National Nuclear Security Administration; ORNL = Oak Ridge National Laboratory.

[a] Acreages include areas cleared or used for construction staging areas in addition to operational areas.

Activity	Land Use Commitment (acres)[a]

[b] DOE classifies land use on ORR into five categories: Institutional/Research, Industrial, Mixed Industrial, Institutional/Environmental Laboratory, and Mixed Research/Future Initiatives.
[c] From Chapter 3, Section 3.2.1.
[d] New construction is a combination of disturbed, previously disturbed, and undisturbed areas at ORR.
[e] This figure includes the minimum and maximum values from various alternatives of the proposed actions.
[f] DOE currently plans to transfer the property to the Metropolitan Knoxville Airport Authority using the GSA "Public Benefit Conveyance" process.
[g] From Chapter 2, Section 2.5.

Within the boundaries of ORR, the cumulative land use of 12,250 to 12,450 acres would involve about 37 to 38 percent of the 32,867 acres that comprise ORR. Activities evaluated in this EIS for the ORNL VTR Alternative would disturb a maximum of 150 acres, or about 1.2 percent of the 12,250 to 12,450 acres of developed land at ORR and about 0.5 percent of the 32,867 acres of land available at ORR. Therefore, the land used for construction and operation of the VTR and associated facilities at ORNL would not substantially contribute to cumulative land use impacts.

Proposed by the Tennessee Valley Authority, the Clinch River Small Modular Reactors Project has the potential to impact land use in proximity to ORR. Development at the Clinch River Nuclear Site, adjacent to ORR, would result in moderate land use impacts. This is due to the conversion of substantial areas of undeveloped naturally vegetated land to a developed condition and the long-term dedication of a 935-acre tract of federally owned land to an industrial setting that would have otherwise been available for other industrial or urban uses. This change in land use would not destabilize land resources in the region because the changes would take place in an area where energy generation and development projects are common and would not be incompatible with existing land uses. Nor would these changes substantially interfere with anticipated regional growth (NRC 2019:4-9).

Aesthetics – Several of the actions identified in Table 5–1 involve the alteration of existing ground conditions or the construction of new facilities at ORNL with the potential to change the overall visual character of areas within the viewshed (**Table 5–11**). For many of the actions identified in Table 5–11, construction activities would create short-term visual impacts, but would not be out of character for an industrial site and would not be visible from public areas outside ORR. The information in Table 5–11 indicates that because of the geographic separation between the various activities, valley and ridge topography, predominantly forested landscape, location of many of the activities in industrial areas, and the nature of the activities, there would be little cumulative impacts on aesthetics at ORR. Only three of these actions involve the construction of new facilities at ORNL, which once completed, would be consistent with the industrialized character of the area. Because construction of the VTR and associated facilities would disturb only 150 acres and would be geographically and topographically separated from most of the other activities at ORR, the Proposed Action would not substantially contribute to cumulative aesthetics impacts at ORR.

Table 5–11. Reasonably Foreseeable Actions at the Oak Ridge Reservation with Potential to Affect Aesthetics

Activity	*Location*	*Acres*	*Potential Visual Resources/Aesthetic Impact as Assessed in NEPA Document*
ORNL Modernization Initiative (DOE 2008b:4-2)	ORNL – Bethel Valley, Melton Valley	22	Demolition and construction would change the current visual landscape. Architectural consistency would be created within Bethel Valley and Melton Valley, to the extent practicable, to ensure blending of construction with existing structures.
U-233 Material Downblending and Disposition (DOE 2010e:3-22)	ORNL	2	Minor impacts during construction are expected. No impacts on visual resources in modifications incorporated into existing systems are likely.

Activity	Location	Acres	Potential Visual Resources/Aesthetic Impact as Assessed in NEPA Document
Environmental Management Disposal Facility (DOE 2017a:7-32)	Multiple	135	The proposed facility would be visible from Bear Creek Road, western parts of Y-12, Chestnut Ridge, and Pine Ridge. Because Bear Creek Road is not a public thoroughfare and Chestnut Ridge and Pine Ridge are restricted access, there would be no short-term visual impacts from public viewpoints.
Plutonium-238 Production for Radioisotope Power Systems (DOE 2000b:2-91)	ORNL	66	If alternatives involving construction were chosen, a site-specific evaluation of visual resources would be conducted before site selection. This could result in reclassification under BLM guidelines.
NNSA Complex Transformation (DOE 2008a:5-317, 5-318)	Y-12	475	Short-term construction impacts are expected. Y-12 would remain a highly developed area with an industrial appearance, and no change to the VRM classification would be expected.
Ongoing and Future Operations at Y-12 (DOE 2016e:39)	Y-12	75	Y-12 would remain a highly developed area with an industrial appearance, and there would be no change to the VRM Class IV, which is used to describe a highly developed area.
Y-12 Emergency Operations Center Project (DOE 2015d:4-26)	Y-12	2	This one-story structure would not impact Y-12's visual character. Y-12 would remain a highly developed area with an industrial appearance, and no change to the VRM classification would be expected.
Stable Isotope Production and Research Center (DOE-ORNL 2020b:2)	ORNL	1	No visual resources impact analysis. The proposed facility would be located in a highly developed industrial area.
Second Target Station at the Spallation Neutron Source (DOE 1999a:5-47)	ORNL	9	The station is not visible to the public. Startup of the Proposed Action at the Spallation Neutron Source at ORNL would have minimal effects on visual resources.

BLM = Bureau of Land Management; VRM = Visual Resource Management.

[a] Includes the minimum and maximum values from various alternatives of the proposed actions.

5.4.2 Geology and Soils

As described in Section 5.4.1, Table 5–10, cumulative land disturbance at ORR could total 12,250 to 12,450 acres, or about 38 percent of the total land area at ORR of 32,867 acres. The maximum amount of land disturbed under the ORNL VTR Alternative is 150 acres or 1.2 percent of the total amount of land disturbed. When land is disturbed, the native soil structure is destroyed. Based on the information presented in Section 5.4.1, the maximum amount of soil disturbed under the ORNL VTR Alternative would be a small percentage of the total soil disturbed at ORR and would not substantially contribute to cumulative impacts.

As shown in **Table 5–12**, cumulative geologic and soils materials used for construction projects at ORR could total 1,450,000 cubic yards. The maximum amount of geologic and soils materials used under the ORNL VTR Alternative would be 187,000 cubic yards or about 13 percent of the total amount of geologic and soils materials that would be used by these other activities at ORR.

Table 5–12. Cumulative Geology and Soils Impacts at the Oak Ridge Reservation

Activity [a]	*Geologic and Soils Materials (cubic yards)*
Past, Present, and Reasonably Foreseeable Future Actions	
Existing Site Activities	Unknown [b]
Environmental Management Disposal Facility (DOE 2017a:2-12)	839,000
Ongoing and Future Operations at Y-12 (DOE 2011c:3-18)	5,000
Second Target Station at Spallation Neutron Source (DOE-ORNL 2020a:4)	430,000
Subtotal – Baseline Plus Other Actions	**1,274,000**
ORNL VTR Alternative [c]	187,000
Total [d]	**1,460,000**

Activity [a]	Geologic and Soils Materials (cubic yards)

[a] Activities are from Table 5–1. Only those activities with available estimates of geologic and soil materials use are listed.
[b] The amount of geologic and soils material used by existing site development is unknown.
[c] Impact indicator value is from Chapter 4, Section 4.2.2.
[d] Total rounded to three significant figures.

5.4.3 Water Resources

As described in Chapter 4, Section 4.3.2, no effluent would be discharged directly to groundwater, and no groundwater would be withdrawn during operation of the ORNL VTR Alternative, except shallow groundwater withdrawn during dewatering. Excavation activities in the project construction phase could encounter groundwater due to the water table's depth of about 5 to 20 feet below grade in Melton Valley. Dewatering would temporarily discharge uncontaminated groundwater through outfalls to surface water. Because of the short duration and localized extent of this activity, dewatering would not be expected to substantially contribute to cumulative water resources impacts at ORR. Therefore, the Proposed Action would not substantially contribute to cumulative groundwater impacts at ORR.

Construction activities associated with building structures or modifying existing buildings could adversely affect surface waters. Potential impacts could include increased sedimentation from clearing activities, ground disturbance, and increased vehicle and human traffic. Increased vehicle use near surface waters during construction phases of a project could also impact water quality through accidental releases of petroleum, oil, lubricants, or stormwater runoff introducing such contaminants to surface water resources. Long-term and permanent cumulative impacts from construction could include the placement of fill in surface waters or wetlands. Table 5–10 shows the total amount of land disturbed by the other activities at ORR, and Section 5.4.1 summarizes the cumulative land use effects of the ORNL VTR Alternative, which could in turn indirectly affect surface water resources, including those from which drinking water is drawn. The construction phases for the other activities listed in Table 5–1 generally would occur at different times, at different locations, and be of short duration. This would reduce the overall cumulative effect of these construction activities on surface water quality.

This staggering of construction activities helps ensure that cumulative surface water use during construction of all present and reasonably foreseeable projects would not substantially add to cumulative impacts on surface water at ORNL.

As discussed in Chapter 4, Section 4.3.1.3, potable water for ORR is supplied by the Clinch River and treated at the Oak Ridge Water Treatment Plant. **Table 5–13** summarizes the volume of surface water required by existing onsite activities combined with the estimated water requirements of the ORNL VTR Alternative and information from the operation phase of other past, present, and reasonably foreseeable actions across ORR. The cumulative surface water requirements would represent about 36 percent of the Oak Ridge Water Treatment Plant's capacity and about 0.4 percent of the 1 trillion gallons per year (4,400 cubic feet per second) average annual flow of the Clinch River at Melton Hill Dam (DOE 1996c:2-10). Water use under the ORNL VTR Alternative would be less than 0.1 percent of the cumulative surface water use for ORR and would not substantially contribute to cumulative impacts on surface water availability.

As described in Chapter 4, Section 4.3.1.3, no contaminated effluent would be discharged directly to surface water during operation of the ORNL VTR Alternative. Therefore, the Proposed Action would not contribute to cumulative impacts on surface water quality during operations at ORR.

Table 5–13. Cumulative Surface Water Use During Operation of Past, Present, and Reasonably Foreseeable Actions at Oak Ridge Reservation

Activity	*Surface Water Use (gallons per year)*
Past, Present, and Reasonably Foreseeable Future Actions [a]	
Existing Site Activities	3,754,000,000
U-233 Material Downblending and Disposition Project (DOE 2010e:3-3)	1,100,000
NNSA Complex Transformation (DOE 2008a:5-320, 5-334)	404,000,000
Ongoing and Future Operations at Y-12 (DOE 2016e:33, 41)	105,000,000
Subtotal – Baseline Plus Other Actions	**4,264,000,000**
ORNL VTR Alternative [b]	4,400,000
Total [c]	**4,270,000,000**
Capacity of Oak Ridge Water Treatment Plant	11,700,000,000

ORNL = Oak Ridge National Laboratory.

[a] Activities are from Table 5–1. Only those activities with available estimates of surface water use are listed.

[b] Impact indicator value is from Chapter 4, Section 4.3.1.3.

[c] Total rounded to three significant figures.

5.4.4 Air Quality

The region surrounding ORNL currently is in compliance with all State and national ambient air quality standards. The air quality cumulative impacts analysis estimates the potential for emissions from the ORNL VTR Alternative, in combination with emissions from other past, present, and reasonably foreseeable future actions, to exceed an ambient air quality standard. Radiological emissions are discussed in Section 5.4.10.

As described in Chapter 4 Section 4.4.2.1 of this VTR EIS, construction activities from the ORNL VTR Alternative would generate emissions. Emissions would be from the use of fossil fuel-powered equipment and trucks, workers' commuter vehicles, and fugitive dust (particulate matter) due to the operation of equipment on exposed soil. The data in Table 4–7 show that peak annual emissions from construction of the VTR facilities would be well below the annual indicator thresholds. The intermittent operation of construction emission sources over an area of 150 acres would result in dispersed concentrations of air pollutants adjacent to construction activities. The transport of any construction emissions from the VTR site to the nearest ORR boundary (about 0.5 miles) would produce additional dispersion and would result in inconsequential concentrations of air pollutants beyond the ORR property boundary. Therefore, in combination with emissions from other past, present, and reasonably foreseeable future actions, the minor increase in offsite air pollutant concentrations produced from construction of the VTR and associated facilities would not result in air pollutant concentrations that would exceed the State and national ambient air quality standards. Emissions from construction activities related to the ORNL VTR Alternative would not substantially contribute to cumulative air quality impacts.

Emissions from construction trucks transporting materials, equipment, and wastes, and from workers' commuter vehicles, would produce low concentrations of air pollutants along public roadways. These low concentrations are primarily because of the intermittent use of vehicles and equipment and their low emission rates. Because these air pollutant concentrations would be low, offsite on-road construction vehicle activities from the ORNL VTR Alternative would not substantially contribute to cumulative air quality impacts.

As described in Chapter 4, Section 4.4.2.2, operational activities from the ORNL VTR Alternative would generate emissions from intermittent use of diesel-powered backup electrical generators, intermittent use of propane-fired heaters for the VTR sodium heat exchanger system during maintenance activities, diesel-powered trucks that deliver material and transport wastes, and workers' commuter vehicles. The data in Table 4–8 show that operation of the ORNL VTR Alternative would produce minor amounts of air emissions. In addition, the PTE for the generator units based on 500 hours of operation would produce insignificant emissions (less than 5 tons per year for criteria pollutants and less than 1,000 pounds per year for an individual HAP), as defined in Chapter 1200-03-09 of the Tennessee Air Pollution Control Regulations. Transport of these emissions to the ORR boundary would produce negligible ambient air pollutant concentrations at offsite locations. Therefore, the minor increase in offsite air pollutant concentrations produced from operations, in combination with emissions from other past, present, and reasonably foreseeable future actions, would result in air pollutant concentrations that would not exceed the State and national ambient air quality standards. Emissions from operations activities related to the ORNL VTR Alternative would not substantially contribute to cumulative air quality impacts.

5.4.5 Ecological Resources

For the cumulative impacts analysis, the ROI for ecological resources expands to include the proposed project area and nearby areas that could potentially be affected under the ORNL VTR Alternative when combined with other past, present, and reasonably foreseeable future actions. Table 5–10 in Section 5.4.1, is a tabulation of cumulative land disturbance at ORNL. Cumulative impacts to ecological resources at ORNL could total 12,269 to 12,407 acres or about 37 percent of the total land area at ORNL of 33,259 acres.

Cumulative impacts on ecological resources could occur including temporary and permanent disturbance and degradation or loss of habitat from land-clearing activities. The disturbance or displacement of wildlife due to an increase in noise and human activity near construction activities (behavior avoidance), and the fragmentation of remaining habitats resulting from project developments are also potential cumulative impacts. Also included are the increases in human-wildlife encounters and collisions between wildlife and motor vehicles from wildlife displaced from their habitat by construction activities and possibly made more susceptible to predation and intra-species competition and less able to obtain adequate food and cover.

Cumulative activities could increase the amount of overall habitat loss from vegetation removal and could potentially lead to habitat degradation. Direct impacts could include permanent and temporary impacts on wildlife due to an increase in noise and human activity near construction activities and the loss of habitat from land-clearing activities that could result in habitat fragmentation. Construction activities could also result in potential increases in collisions between wildlife and motor vehicles. Indirect impacts would include an increased potential for the spread of invasive species due to soil disturbance (creating open habitat for invasive species establishment). It is anticipated that impacts on vegetation, wildlife, and special status species from the activities listed in Table 5–1 would be similar to those for the Proposed Action as described in Chapter 4, Section 4.5.

Operational and administrative controls (as described in Section 4.5) will be evaluated and implemented, if warranted, for the ORNL VTR Alternative and other actions to reduce the potential for adverse impacts to wildlife (including migratory birds and special status species) and their habitats. Increased vehicle activity during operations could potentially increase the risk for wildlife strikes by vehicles. Operational and administrative controls include daily and seasonal timing of project activities, posting of signs with reduced speed limits, ultrasonic warning whistles, encouraging animals to not use the road or construction area, and preemptive awareness programs for construction crews.

Trees and other vegetation subject to clearing could support foraging, nesting, and other behaviors for mammals, birds (including migratory birds and BCC), amphibians, and reptiles. Land clearing would cause disturbances in the landscape resulting in new habitat edges, potentially disrupting wildlife ecosystem processes and habitats. Any habitat loss could adversely affect individual animals. For less mobile species, such as amphibians and insects, there is the potential for cumulative impacts to affect local populations.

Cumulative land disturbance accounts for about 37 to 38 percent of the land area at ORNL and would be substantial given the extent of habitat affected. Various special and sensitive natural resource areas (i.e., NA, RA, and HA) recognized in the Research Park could be impacted, as well as long-term research opportunities and on-going studies that have occurred within these unique habitats. Species monitoring and management for the area would be administered through the *Wildlife Management Plan for the Oak Ridge Reservation* (ORNL 2020e), and coordinated amongst the ORNL Natural Resources Program, Hemlock Conservation Partnership, and regulatory agencies (e.g., USFWS, USACE, TDEC, and the Tennessee Wildlife Resources Agency [TWRA]), which would confer the continued protection of any sensitive ecological resources. Invasive species management would continue to be implemented through the *Invasive Plant Management Plan for the Oak Ridge Reservation* (ORNL 2017).

Cumulative impacts on ecological resources could be substantial given the total amount of land subject to ground disturbance and land clearing on ORNL. However, the Proposed Action and other past, present, and reasonably foreseeable future actions would occur at different locations and times. Appropriate mitigations (such as wetland mitigation) would be enforced. Land-clearing activities would temporarily and permanently affect vegetation. However, these impacts would generally be evaluated as minor due to the availability of forested-hardwood habitats within the ORNL and intermountain regions of Appalachia. The loss of habitat associated with the Proposed Action would account for less than 1 percent (0.6 percent) of the 24,000 acres of forested-hardwood habitat and less than 1 percent of the 4,100 acres of interior forest available within the ORNL, and thus would represent a small portion of the cumulative impacts on ecological resources at ORNL. However, ongoing assessments of ORNL's ecological resources suggest that in-kind mitigation (i.e., protection or enhancement of ecologically similar resources) could be required due to impacts and may entail greater acreage than available elsewhere on ORNL (ORNL 2020d).

It is anticipated that up to 37 hemlock trees would be disturbed under the Proposed Action. In Tennessee, hemlock trees are voluntarily protected as part of the Hemlock Conservation Partnership (TWRF 2018). Invasive species management would continue to be applied through the Invasive Plant Management Program.

Under the Proposed Action and other actions, species-specific surveys would need to occur to determine an accurate measure of the severity of effects to special status species. DOE would be required to consult with the USFWS Tennessee Ecological Services Field Office under Section 7 Interagency Cooperation regarding potential impacts on federally listed species protected under the ESA. Additionally, DOE would be required to consult with TWRA and TDEC regarding State-listed species of special concern. TWRA conducts wildlife management activities on the ORR through an agreement with DOE. The ORNL Natural Resources Management Program also has ORR wildlife management responsibilities under a DOE assigned task. Mitigation for Federal and State-listed species, aquatic features (including wetlands, seeps, and active springs) and sensitive habitats may also be required. DOE will be required to consult with the USFWS about the potential impacts to migratory birds from the Proposed Action and other actions. In accordance with the USFWS Mitigation Policy, DOE would be required to evaluate ways to avoid or minimize any such impacts (DOE 1999b:6-11, 6-12). Potential impacts to aquatic resources would require wetland delineations (USACE 1987), stream evaluations (TDEC 2019b), and hydrologic determinations of currently unclassified channels and wet weather conveyances (TDEC 2020a). Any potential Exceptional Tennessee Waters will require additional assessment using the Tennessee Rapid Assessment Method, as required by the TDEC. Evaluation of aquatic resources at proposed mitigation sites might also be required to assess adequate mitigation actions (TDEC 2015, 2019b). A Section 404 wetland permit from USACE would be required before any construction work in jurisdictional streams. Compensatory mitigation would be required for any unavoidable impacts resulting from the Proposed Action and other actions.

5.4.6 Cultural and Paleontological Resources

Damage to the nature, integrity, and spatial context of cultural resources can have a cumulative impact if the initial act is compounded by other similar losses or impacts. The alteration or damage to cultural resources may incrementally impact resources in and around ORNL.

As described in Chapter 3, Section 3.2.6, there are no significant cultural resources in the APE for the Proposed Action at ORNL. Therefore, cumulative impacts on cultural resources within the ROI would be negligible because of the lack of important cultural resources within the APE and due to the necessity of following the Section 106 process for all activities.

5.4.7 Infrastructure

Table 5–14 lists the estimated annual cumulative infrastructure requirements from operations at ORR for electricity and water. Projected cumulative site activities would annually require about 1,440,000 to 1,520,000 megawatt-hours of electricity, which is well within the total site-wide capacity of 13,880,000 megawatt-hours. Cumulative water usage would be about 4,270 million gallons of water, which is well within the site-wide capacity of 11,715 million gallons per year. Operation of the VTR and associated facilities at ORNL would use about 180,000 megawatt-hours of electricity and about 4.4 million gallons of water per year, which represents a fraction of cumulative infrastructure use and an even smaller fraction of total site capacity. Therefore, operation of the VTR and associated facilities at ORNL would not substantially contribute to cumulative infrastructure impacts.

While there is adequate capacity for electric needs at ORR, two offsite projects could have an impact on the availability of electricity in the region. Bull Run Fossil Plant, located on Bull Run Creek near Oak Ridge, has a summer net capability of 865 megawatts and generates about 6 billion kilowatt-hours of electricity a year, enough to supply 400,000 homes. After a detailed review that included public input, TVA approved the retirement of the Bull Run Fossil Plant by December 2023 (TVA 2020a).

In December 2019, TVA obtained approval for an early site permit from the U.S. Nuclear Regulatory Commission to potentially construct and operate small modular reactors on the 935-acre Clinch River Nuclear Site, adjacent and southwest of ORR. The facility would be capable of producing up to 800 megawatts. However, there is an extended timetable for facility construction, as TVA will have up to 20 years, with a possibility of an extension, to make a decision to pursue the construction of the reactors (TVA 2019).

Table 5–14. Annual Cumulative Infrastructure Impacts from Operations at the Oak Ridge Reservation

Activity	*Electricity Consumption (megawatt-hours per year)*	*Water Usage (gallons per year)*
Past, Present, and Reasonably Foreseeable Future Actions		
Existing Site Activities	726,000	3,754,000,000
U-233 Material Downblending and Disposition Project (DOE 2010e:3-3)	Not available	1,100,000
NNSA Complex Transformation (DOE 2008a:5-320, 5-334)	268,000	404,000,000
Ongoing and Future Operations at Y-12 (DOE 2016e:33, 41)	270,000–350,000 [a]	105,000,000
Subtotal – Baseline Plus Other DOE Actions	**1,260,000–1,340,000**	**4,264,000,000**
ORNL VTR Alternative	180,000 [b]	4,400,000 [b]
Total [c]	**1,440,000–1,520,000**	**4,270,000,000**
Total Site-wide Capacity	13,880,000	11,700,000,000

NNSA = National Nuclear Security Administration; ORNL = Oak Ridge National Laboratory.

[a] Total is a range that includes the minimum and maximum values from various alternatives of Proposed Action.

[b] From Chapter 4, Section 4.7.2.

[c] Total is rounded to three significant figures.

5.4.8 Noise

The analysis of cumulative noise impacts evaluates perceptible increases in ambient noise levels and increases of excessive ground-borne vibration to persons or property in the ROI. The ROI for noise extends 0.5 miles from the edge of the construction area. As discussed in Chapter 3, Section 3.2.8.3, the closest offsite receptors include residential homes more than 1.25 miles to the east and across the Clinch River in Knox County. As a result, the cumulative impacts analysis considers the onsite noise-sensitive receptors to include ORNL workers present onsite and within 0.5 mile from the edge of the construction area. Most existing and planned projects at ORR listed in Table 5–1 would occur at different locations and at different times and would not contribute to cumulative noise effects in combination with the proposed VTR activities.

Most of the potential impacts from noise would be short-term and aligned with the construction phase of a project, including construction equipment and vehicles. Examples of construction noise levels (given in Chapter 4, Section 4.8.2.1) include measurements at 50 feet of 80 dBA from excavators, 85 dBA from tractors and bulldozers, and 89 dBA from graders. Although construction noise can be moderately loud, the temporary and intermittent nature of the construction activities would not result in long-term cumulative impacts. As discussed in Section 4.8.3.1, noise levels fluctuate depending on the type, number, and duration of use of heavy equipment for construction activities, and differ by the type of activity, distance to noise-sensitive receptors, existing site conditions (topography and vegetation to diminish the sound), and ambient noise levels. Additionally, construction activities are generally limited to daylight hours in conformance with Federal, State, and local codes and ordinances, and manufacturer-prescribed safety procedures and industry practices. Most of the reasonably foreseeable future actions listed in Table 5–1 would not occur at the same location and at the same time as the proposed project. However, if they did overlap, there would be a short-term cumulative impact on onsite receptors (e.g., ORNL workers) due to increased noise during construction activities.

During operation, cumulative impacts include the potential for perceptible increases in ambient noise levels at sensitive receptors (e.g., ORNL workers). For some projects listed in Table 5–1, operations could cumulatively increase noise due to facility operations and additional vehicle trips.

The closest offsite receptors include residential homes more than 1.25 miles to the east and across the Clinch River in Knox County. Given the large distance, cumulative noise from construction or operation of projects at ORNL and other locations within ORR would be indistinguishable from background at the closest offsite noise-sensitive receptors. See Section 4.8.3 for additional information about potential noise levels at the closest offsite receptor.

5.4.9 Waste Management

The assessment of the waste management cumulative impacts at ORR includes the ORNL VTR Alternative and other reasonably foreseeable actions that result in the generation, treatment as required, and disposal of LLW, MLLW, and TRU waste. **Table 5–15** summarizes the estimated cumulative annual generation rates of these wastes. Additional reasonably foreseeable actions are identified in Section 5.2, Table 5–1. As noted in Table 5–1, some of these activities are ongoing and the waste generated by these activities are included in the existing site activities' waste generation rates for ORR. For some of the activities identified as proposed, there is no waste generation information currently available. For some activities, waste generation was described as "small quantities." Therefore, these other DOE actions were covered as a group and the LLW, MLLW, and TRU waste annual generation rates characterized as "small quantities" in Table 5–15 below.

Table 5–15. Cumulative Average Annual Waste Generation Rates at the Oak Ridge Reservation in Cubic Meters

Activity	*LLW*	*MLLW*	*TRU Waste*
Past, Present, and Reasonably Foreseeable Future Actions			
Existing Site Activities [a]	81,000	700	140
Other DOE Actions	Small Quantities	Small Quantities	Small Quantities
Subtotal – Baseline Plus Other DOE Actions	81,000	700	140
ORNL VTR Alternative [a]	540	38	0.89
Subtotal for VTR	540	38	0.89
Total	82,000	740	140

LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; TRU = transuranic waste.

[a] Source: Section 4.9.2.2, Table 4-35. ORNL VTR Alternative wastes are average annual generation rates based on a 60-year operation cycle.

Note: All numbers are rounded to two significant figures. Due to rounding, sums and products may not equal those calculated from table entries.

The characteristics of the newly generated wastes are estimated to be similar to the wastes currently generated by existing activities. As described in Chapter 4, Section 4.9.2.2, the waste management infrastructure at ORR was developed to support the quantities of waste generated. Therefore, cumulative waste generation would be within site capacities. There are existing offsite DOE and commercial waste management facilities with sufficient total capacities for the treatment and disposal needs of the relatively small volumes of LLW and MLLW wastes generated by the Proposed Action. Therefore, substantial cumulative impacts on offsite LLW and MLLW treatment and disposal facilities would not be expected. See Section 5.3.9 for a discussion of the impacts of TRU waste disposal at the WIPP facility.

5.4.10 Human Health – Normal Operations

Cumulative impacts on public health and safety from radiological emissions could result from activities at ORR and potentially from other activities within the ORR ROI (50 miles from the ORR boundary) that could impact worker and public health. The actions identified in Table 5–1 were reviewed to identify those that could have a worker and public health impact. **Table 5–16** shows information on the potential impacts of the present ORR operations (from Chapter 3, Section 3.2.10.1 of this VTR EIS), reasonably foreseeable future actions, and the Proposed Action. This table includes those actions identified in Table 5–1 that could contribute to worker and the public (population and MEI) dose and potential LCFs. Only those activities that have identified radiological impacts with available estimates of radiation exposure are listed. Some of the actions identified in Table 5–1 would be expected to have radiological impacts, but estimates were not available. At ORR, these actions are the Stable Isotope Production and Research Center, the Transformational Challenge Reactor, the Oak Ridge Integrated Facility Disposition Project, and the Construction and Demonstration of a Department of Defense Prototype Advanced Mobile Nuclear Reactor.

The cumulative offsite population dose would be 94 person-rem per year with no expected LCFs (calculated value of 0.06). Operation of the VTR and associated facilities at ORR would result in a total population dose of 0.58 person-rem per year with no expected LCFs (calculated value of 0.0004). The total dose and LCFs from the Proposed Action would be less than 1 percent of the cumulative dose and LCFs and, for that reason, would not substantially contribute to cumulative human health impacts at ORR.

Table 5–16. Annual Cumulative Population Health Effects of Exposure to Radiation from Normal Operations at the Oak Ridge Reservation

Activity	*Workforce*		*Population within 50 Miles*		*MEI*	
	Dose (person-rem	*Annual LCF* [a]	*Dose (person-rem)*	*Annual LCF* [a]	*Dose (millirem)*	*Annual LCF Risk* [a]
Past, Present, and Reasonably Foreseeable Future Actions						
Existing Site Activities (baseline) [b]	72	0.04	12	0.007	2.4	1×10^{-6}
RPS Infrastructure [c]	12	0.005	8.8×10^{-5}	4.6×10^{-8}	1.9×10^{-6}	9.4×10^{-13}
U-233 Downblending and Disposition [d]	NC	NC	NC	NC	0.3	2×10^{-7}
Future Y-12 Operations [e]	NA	NA	-0.5	-0.0004	-0.06	-4×10^{-8}
Second Target Station at the Spallation Neutron Source [f]	0.018	1×10^{-5}	10	0.006	1.1	7×10^{-7}
Subtotal – Baseline Plus Other Actions	**84**	**0.05**	**22**	**0.01**	**3.7**	$\mathbf{2\times10^{-6}}$
ORNL VTR Alternative	44	0.03	0.58	0.0004	0.031	2×10^{-8}
Total for Oak Ridge Reservation	**130**	**0.08**	**222**	**0.01**	**3.8**	$\mathbf{2\times10^{-6}}$
Clinch River Site for Small Modular Reactors [g]	–	–	68	0.04	11	7×10^{-6}
Watts Bar Nuclear Facility [h]	–	–	3.8	0.002	5.8	3×10^{-6}
Total for Region of Influence	**–**	**–**	**94**	**0.06**	**--**	**--**

LCF = latent cancer fatality; MEI = maximally exposed individual; NA = not applicable; NC = not calculated; NNSA = National Nuclear Security Administration; ORNL = Oak Ridge National Laboratory; RPS = Radioisotope Power System; Y-12 = Y-12 National Security Complex; U-233 = uranium-233.

[a] LCFs are calculated using a conversion factor of 0.0006 LCFs per rem or person-rem (DOE 2003). The annual LCFs for the analyzed population represent the number of LCFs calculated by multiplying the listed doses by the risk conversion factor; no population LCFs are expected from any individual activity or from all combined activities. The annual MEI LCF risk represents the calculated risk of an LCF to an individual.

[b] From Chapter 3, Section 3.2.10.1 of this EIS. Worker dose is the average for 2014 to 2017.

[c] Impacts from the alternative with the highest impacts in *Final PEIS for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the* FFTF (DOE 2000b:Table 4-165).

[d] From the *Environmental Assessment for U-233 Material Downblending and Disposition Project at the Oak Ridge National Laboratory, Oak Ridge, Tennessee* (DOE 2010e:3-28).

[e] The *Final Site-Wide Environmental Impact Statement for the Y-12 National Security Complex* shows a reduction in the MEI and offsite population doses from enactment of any of the action alternatives. The reduction is due to the closure of a uranium facility, reduced quantities of material being processed, and expected safety improvements associated with operation of the new facility. The values listed in this table are the reductions in doses from current operations identified for the capability-sized uranium processing facility. (A supplement analysis for the site-wide EIS examined a new Proposed Action (a combination of facility upgrades and new facilities) that would have similar impacts as the capability-sized uranium processing facility alternative from the Site-Wide EIS (DOE 2016e:Table 4-1). Worker doses from this action are for Y-12 workers and are not applicable to the ORNL workforce.

[f] Impacts are the difference between the 1-megawatt (one target station) and 4-megawatts (two target stations) options identified in the *Final Environmental Impact Statement Construction and Operation of the Spallation Neutron Source* (DOE 1999a:Table 5.2.9.2.1-1; DOE-ORNL 2020a). Worker doses are to uninvolved workers, and no impact was identified for involved workers.

[g] Values are for a site with 4 modular reactors from the *Environmental Impact Statement for an Early Site Permit (ESP) at the Clinch River Nuclear Site* (NRC 2019:Table 5-8, Section 5.9.3.2, pg 5-61). The EIS states that the impacts from radiation exposure to the operations workforce would be small. Additionally, the Clinch River Nuclear Site workforce is separate from that at ORR. Therefore, worker impacts are not presented.

[h] From the Watts Bar, Units 1 and 2, 2018 Annual Radioactive Effluent Release Report ML19120A075 30 April 2019 (Watts Bar 2019:Tables 6A to D, 7A to D, 8A). The Watts Bars' workforce is separate from that at ORR, so worker impacts are not presented here.

The cumulative MEI dose for activities at ORR would be 3.8 millirem per year with an LCF risk of 2×10^{-6}. This cumulative MEI dose is lower than the DOE limit of 100 millirem per year from all pathways (DOE Order 458.1 [DOE 2011b]). It is also lower than the EPA individual dose limit of 10 millirem per year from airborne radionuclides (40 CFR Part 61 subpart H [54 FR 51695]). The MEI dose conservatively assumes the same person would be the MEI for all activities at ORR but does not include doses from the Watts Bar Nuclear Facility and Clinch River Site for Small Modular Reactors. It is unlikely the same person would be the MEI for all these activities because the activities occur at different locations, each with an MEI located at different offsite locations. Operation of the VTR and associated facilities at ORR would result in a total MEI dose of 0.031 millirem per year with an LCF risk of 2 x 10^{-8}. The total MEI dose and LCFs from the Proposed Action would be about 1 percent of the cumulative MEI dose and LCFs. Therefore the cumulative MEI dose for VTR activities would not substantially contribute to cumulative human health impacts at ORR.

The cumulative worker dose would be 130 person-rem per year with no expected LCFs (calculated value of 0.08). Operation of the VTR and associated facilities at ORR would result in a total worker dose of 44 person-rem per year with no expected LCFs (calculated value of 0.03). The total worker dose and LCFs from the Proposed Action would be 34 percent of the cumulative dose and LCFs. This could result in 2 worker LCFs from 60 years of VTR operation. 10 CFR 835 requires DOE "to develop and implement plans and measures to maintain occupational radiation exposures as low as is reasonably achievable" (ALARA). DOE-STD-1098-2017, DOE Standard Radiological Control (DOE 2017f) identifies an effective ALARA process as including implementation of both engineered and administrative controls to control worker dose. All equipment and operations would be designed and implemented following this principle. Therefore, needed worker protection could be incorporated into the final design potentially reducing worker doses.

5.4.11 Traffic

As described in Chapter 4, Section 4.13.2, the impacts on traffic from construction and operation of facilities under the ORNL VTR Alternative are anticipated to be negligible to minor. As such, impacts to traffic from this alternative would not substantially contribute to cumulative traffic impacts. Therefore, they are not discussed further.

5.4.12 Socioeconomics

The ROI for cumulative impacts on socioeconomics includes the four-county area near ORNL: Anderson, Knox, Loudon, and Roane counties in Tennessee. As shown in **Table 5–17**, cumulative employment at ORR from past, present, and reasonably foreseeable future actions could reach a peak of about 15,200 persons. This peak is about 4.7 percent of the 320,327 people employed in the ORR ROI, including ORNL, in 2019. These values are conservative estimates of short-term future employment at ORR. Some of the employment would occur at different times and it may not be appropriate to total these values. The employment totals from existing site activities include existing onsite employment (directly employed and contractor staff) and potential future employees based on activities identified in Table 5–1 and carried over to Table 5–17.

Table 5–17. Cumulative Employment at the Oak Ridge Reservation

Activity	*Direct Construction Employment (number of personnel in peak year)*	*Direct Operations Employment (first year of operation)*
Past, Present, and Reasonably Foreseeable Future Actions [a]		
Existing site Activities [b]	Not Applicable	14,300
Environmental Management Disposal Facility (DOE 2017a:7-36, 7-47)	Specific numbers not included but construction workforce would be small, occur in stages, and result in minimal worker influx	Specific numbers not included but operation workforce would be small, occur in stages, and result in minimal worker influx
Transformational Challenge Reactor (DOE-ORNL 2020c)	No staffing estimates available; however, assumed to be minimal given small reactor size, short operating period, and location within existing building	

Activity	Direct Construction Employment (number of personnel in peak year)	Direct Operations Employment (first year of operation)
Construction of a Second Target Station for the Spallation Neutron Source (DOE 1999a:3-14, 3-26)	480 (peak) 166 (full-time annual)	180 (visiting scientists not included)
ORR Subtotal – Baseline Plus Other Actions	**480 (peak)**	**14,500**
ORNL VTR Alternative [c]	1,598	300
ORR Subtotal	**2,078**	**14,800**
Offsite Projects		
Property Transfer for General Aviation Airport at ETTP (DOE 2016d, 2016h)	Not Applicable	5
Bull Run Fossil Plant (Huotari 2019)	Not Provided	-100 to -125
Clinch River Site for Small Modular Reactors (NRC 2019:4-49, 5-30)	3,300 (peak)	500
Total [d]	**5,380**	**15,200**
ROI Labor Force (2018) [e]	**320,327**	

ETTP = East Tennessee Technology Park; ORNL = Oak Ridge National Laboratory; ORR = Oak Ridge Reservation; ROI = region of influence; VTR = Versatile Test Reactor.

[a] Activities are from Table 5–1. Only those activities with available estimates of employment are listed.

[b] Employment from existing site activities is from Chapter 3, Section 3.2.14.

[c] The impacts of the ORNL VTR Alternative are from Chapter 4, Section 4.14.2.

[d] Total rounded to three significant figures.

[e] ROI Labor Force is from Chapter 3, Section 3.2.14.

As identified in Table 5–1, it is assumed that no new workforce would be added to support ongoing projects at ORR, based on the NEPA documentation that was completed before 2019. These projects are ongoing and are presumably captured in the current onsite employment totals. Existing offsite projects or facilities also were reviewed to determine whether any change in existing employment levels was expected in the future. No change was identified for any facility except the Bull Run Fossil Plant and the Clinch River Site for Small Modular Reactor. Ongoing onsite projects that would not be expected to contribute to cumulative socioeconomic impacts at ORNL include:

- Plutonium-238 Production for Radioisotope Power Systems (DOE 2000b, DOE 2013a)
- National Nuclear Security Administration Complex Transformation (DOE 2008a)
- ORNL Modernization Initiative (DOE 2008d)
- Oak Ridge Science and Technology Project (DOE 2008c, 2008e)
- U-233 Material Downblending and Disposition Project (DOE 2010e)
- Oak Ridge Integrated Facility Disposition (DOE 2011c)
- Ongoing and Future Operations at Y-12 (DOE 2011c, 2016e)
- Y-2 Emergency Operations Center Project (DOE 2015b, 2015d)

Ongoing offsite projects that would not be expected to contribute to cumulative socioeconomic impacts at ORNL include:

- Energy*Solutions* Bear Creek Processing Facility (ES 2020)
- Centrus Energy Corporation (Centrus 2020)
- TVA Kingston Fossil Plant (TVA 2020c, 2020d)
- Manufacturing Sciences Corporation (MSC) (MSC 2020)
- TOXCO Inc. Materials Management Center (TOXCO 2020)

Activities proposed under the ORNL VTR Alternative could produce direct employment of up to a peak of 1,590 construction workers during the 51-month construction period, or 30 percent of the 5,380 cumulative workforce (peak) related to construction activities. The 300 operations staff under the ORNL VTR Alternative would be about 2 percent of the 15,200 cumulative workforce related to operations. By comparison, about 320,327 people were employed in the ORR ROI in 2019. In addition to the direct jobs, DOE estimates that for every job within the ORNL, another 1.73 jobs (indirect jobs) are created in other industries (DOE 2018g), as described in Chapter 4, Section 4.14.2.

Any migration of workers into the ROI is expected to be small when compared to the projected population of the ROI. Furthermore, any in-migration would be within the historical trends of population growth within the ROI. Due to the low potential for in-migration and changes to the ROI population, impacts on the availability of housing and community services under the Proposed Action are expected to be small. The overall contribution to cumulative socioeconomic impacts (e.g., housing, schools, and community services) from the Proposed Action on the ROI is expected to be small. The increase in jobs and income levels would be considered a small and beneficial impact on the local and regional economies.

It is also important to mention the proposed Clinch River Small Modular Reactors project, which would be located within the socioeconomic impacts ROI. It is a relatively large project with a potentially overlapping construction period with the VTR project. Both adverse and beneficial socioeconomic impacts are anticipated from construction of the Clinch River Small Modular Reactors. The Clinch River Small Modular Reactors are expected to require a large construction and operations workforce. The workforce, in fact, would be larger than that of the VTR project (see Table 5–17). The Early Site Permit EIS for the Clinch River Small Modular Reactors (NRC 2019) estimates the construction workforce at 3,300 workers (peak) over a 72-month construction period and a permanent operations workforce of 500 (NRC 2019). It further estimates that 1,365 construction workers would migrate into the ROI with their families, resulting in a population increase of 3,453. Of these workers, 250 operations workers would migrate into the ROI with their families, resulting in a population increase of 633 (NRC 2019). The combined labor requirements of the two projects, especially during construction, could require a potentially large in-migrating workforce (both projects would require special skill sets), many of whom would bring families. In addition to workers hired directly for project construction or operation, the in-migrating workforce could also include workers required to fill new indirect jobs created by the two projects. This population influx could put additional demands on existing housing supply and local community services (e.g., schools, fire and police, hospitals). Potential cumulative impacts of both projects could be small to moderate and adverse, at least in the short term, depending on the total number of new employees that move into the area and the existing capacity of local resources and services to accommodate them. Moderate beneficial socioeconomic impacts also would occur due to the increase in income and spending in the local and regional communities and associated tax revenue. Over the longer term, increased tax revenues also could be used to offset increased strains on housing and community services by funding enhancements to appropriate services and facilities. Another positive outcome would be that the additional jobs created by the 2 nuclear projects would help reduce the local adverse socioeconomic effects from the planned closing of the Bull Run Fossil Plant and loss of 100 to 125 workers in 2023.

Although project details related to the recently proposed Department of Defense Prototype Advanced Mobile Nuclear Reactor have not yet been identified, including its final location (ORNL or the INL Site), the Notice of Intent implies that it would be constructed and operated within existing facilities and infrastructure and not have significant labor requirements (85 FR 12274). If this is true, then any adverse socioeconomic impacts from this activity would be expected to be small, and its contribution to potential cumulative impacts at ORNL would be small.

5.4.13 Environmental Justice

Similar to the INL Site, the analysis in Chapter 4, Section 4.15, indicates no high and adverse human health and environmental impacts on any population within the ROI because of the ORNL VTR Alternative. Impacts on minority and low-income populations would be comparable to those on the population as a whole and would be negligible. Similarly, there would be no high and adverse impacts for a subsistence exposure scenario. Because the doses from the Proposed Action at ORNL would be small and there would be no disproportionate high and adverse impacts on minority and low-income populations, the Proposed Action would not substantially contribute to cumulative environmental justice impacts at ORNL.

5.5 Savannah River Site

As described in Appendix B, Section B.5.4.2, modification and operation of K Area facilities[4] for Reactor Fuel Production for the VTR would occur largely within existing buildings with no new land disturbance. Therefore, as described in Chapter 4, impacts on land use and aesthetics, geology and soils, ecological resources, cultural and paleontological resources, and noise, would be minimal and would not contribute to cumulative impacts. Therefore, these resource areas are not discussed further.

5.5.1 Water Resources

As described in Appendix B, Section B.5.4.2, modification and operation of K Area facilities for Reactor Fuel Production for the VTR would occur within existing buildings with no new land disturbance and no effluent discharged directly to surface water or groundwater. Therefore, as described in Chapter 4, Section 4.3.3.2, impacts on surface water and groundwater quality would be minimal and would not contribute to cumulative impacts.

As described in Chapter 4, Section 4.3.3.2, no surface water would be used during modification and operation of the SRS Reactor Fuel Production Options. Therefore, the Proposed Action would not contribute to cumulative impacts from surface water use at SRS.

Groundwater use during construction of the projects listed in Table 5–1 generally would be for short durations, would be for relatively small quantities of water, and would occur at different times. This staggering of construction activities helps ensure that cumulative groundwater use during construction of all present and reasonably foreseeable projects would not substantially add to cumulative impacts on groundwater at SRS.

Table 5–18 includes the cumulative annual groundwater withdrawals expected from operation of the past, present, and reasonably foreseeable future actions at the SRS. The totals presented in Table 5–18 represent a potential maximum of about 623 million gallons per year, or about 21 percent of the total site-wide capacity. Compared to the baseline of 320 million gallons, the projects listed in Table 5–5 represent an increase of about 10 percent in the portion of the total site-wide capacity used, or a minor cumulative impact on groundwater.

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[4] As described in Chapter 2, Section 2.6.3, similar impacts would be expected if Reactor Fuel Production activities were to be constructed and operated in L Area.

Table 5–18. Cumulative Groundwater Withdrawals During Operation of Past, Present, and Reasonably Foreseeable Actions at Savannah River Site

Activity	*Water Usage (gallons per year)*
Past, Present, and Reasonably Foreseeable Future Actions [a]	
Existing Site Activities	320,000,000 [a]
NNSA Complex Transformation (DOE 2008a:5-245, 5-261, 6-12)	80,500,000
Disposal of GTCC LLW and GTCC-Like Waste (DOE 2016a:5-92, 5-94)	1,400,000
Surplus Plutonium Disposition (DOE 2015a:2-42, 4-129)	25,000,000–57,000,000 [b]
Acceptance and Disposition of SNF from Germany (DOE 2017d:4-73, 4-90)	37,000,000–89,000,000 [b]
H-Canyon Processing of SNF (DOE 2000c:2-50, 5-11)	55,700,000
Plutonium Pit Production (DOE 2020a:5-7)	12,100,000–13,300,000 [b]
HLW Salt Processing Facility (DOE 2001:5-14)	3,200,000
Subtotal – Baseline Plus Other DOE Actions	**534,900,000–620,100,000**
SRS Reactor Fuel Production Options	2,900,000 [c]
Total [d]	**538,000,000–623,000,000**
Site-wide Capacity	2,950,000,000 [a]

GTCC = greater-than-Class C; HLW = high-level radioactive waste; LLW = low-level radioactive waste; NNSA = National Nuclear Security Administration; SNF = spent nuclear fuel.

[a] From Chapter 3, Section 3.3.7.

[b] Total is a range that includes the minimum and maximum values from various alternatives of Proposed Action.

[c] From Chapter 4, Section 4.7.4.2 and Appendix B, Table B-44 (SRS Fuel Fabrication Operational Resource Requirements).

[d] Total rounded to three significant figures.

5.5.2 Air Quality

The region surrounding SRS is currently in compliance with all State and national ambient air quality standards. The air quality cumulative impacts analysis estimates the potential for emissions from the proposed SRS Reactor Fuel Production Options, in combination with emissions from other past, present, and reasonably foreseeable future actions, to exceed an ambient air quality standard. Radiological emissions are discussed in Section 5.5.4.

As described in Chapter 4, Section 4.4.3.2 of this VTR EIS, construction activities from the SRS Reactor Fuel Production Options would generate emissions. Emissions would be from the use of fossil fuel-powered equipment, trucks, and workers' commuter vehicles. Estimated peak annual construction activities would result in minimal emissions that would be well below annual indicator thresholds of significance (see Table 4–11). The intermittent operation of construction emission sources would result in dispersed concentrations of air pollutants adjacent to construction activities. The movement of any construction emissions from the K-reactor building to the nearest SRS boundary (about 5.5 miles) would produce additional dispersion and would result in minor concentrations of air pollutants beyond the SRS property boundary. Therefore, the slight increase in offsite air pollutant concentrations produced from construction of the fuel fabrication facility, in combination with emissions from other past, present, and reasonably foreseeable future actions, would result in air pollutant concentrations that would not exceed the State and national ambient air quality standards. Emissions from construction activities related to the SRS Reactor Fuel Production Options would not substantially contribute to cumulative air quality impacts.

As described in Chapter 4, Section 4.4.3.2 of this VTR EIS, operational activities from the SRS Reactor Fuel Production Options would generate emissions. These emissions would be from intermittent use of a diesel-powered backup electrical generator, diesel-powered trucks that deliver materials and haul off wastes, and workers' commuter vehicles. Review of the data in Table 4–12 shows that proposed operations would produce minor amounts of air emissions. Transport of these emissions to the SRS boundary would produce negligible ambient air pollutant concentrations at offsite locations. Therefore, the minor increase in offsite air pollutant concentrations produced from operations, in combination with emissions from other past, present, and reasonably foreseeable future actions, would result in air pollutant concentrations that would not exceed the State and national ambient air quality standards. Emissions from operations activities related to the SRS Reactor Fuel Production Options would not substantially contribute to cumulative air quality impacts.

5.5.3 Infrastructure

Table 5–19 shows the estimated annual cumulative infrastructure requirements from operations at SRS for electricity and water. Projected cumulative site activities would annually require about 858,000 to 1,010,000 megawatt-hours of electricity, which is well within the total site-wide capacity of 4,400,000 megawatt-hours. Cumulative water usage would range from about 538 million to 623 million gallons of water, which is well within the site-wide capacity of 2,950 million gallons per year. Operation of the reactor fuel production capability at SRS would use about 20,000 megawatt-hours of electricity and 2.9 million gallons of water per year, which represents a fraction of the cumulative infrastructure use and an even smaller fraction of total site capacity. Therefore, operation of the reactor fuel production capability at SRS would not substantially contribute to cumulative infrastructure impacts.

While there is adequate capacity for electric needs at SRS, construction of Unit 3 (expected to be online in November 2021) and Unit 4 (expected to be online in November 2022) of the Vogtle Electric Generating Plant, located about 6.5 miles from K Area, would generate 6,800 megawatts of additional capacity to the area. Once complete, the 2 new Westinghouse AP1000 reactors will produce enough energy to power 500,000 homes and businesses (Georgia Power 2018).

Table 5–19. Annual Cumulative Infrastructure Impacts from Operations at Savannah River Site

Activity	*Electricity Consumption (megawatt-hours per year)*	*Water Usage (gallons per year)*
Past, Present, and Reasonably Foreseeable Future Actions		
Existing Site Activities	310,000 [a]	320,000,000 [a]
NNSA Complex Transformation (DOE 2008a:5-245, 5-261, 6-12)	268,000	80,500,000
Disposal of GTCC LLW and GTCC-Like Waste (DOE 2016a:5-92, 5-94)	5,050	1,400,000
Surplus Plutonium Disposition (DOE 2015a:2-42, 4-129)	170,000–310,000 [b]	25,000,000–57,000,000 [b]
Acceptance and Disposition of SNF from Germany (DOE 2017d:4-73, 4-90)	15,000–27,000 [b]	37,000,000–89,000,000 [b]
H-Canyon Processing of SNF (DOE 2000c:2-50, 5-11)	15,800	55,700,000
Plutonium Pit Production (DOE 2020a:5-7)	30,000	12,100,000–13,300,000 [b]
HLW Salt Processing Facility (DOE 2001:5-14)	24,000	3,200,000
Subtotal – Baseline Plus Other DOE Actions	**838,000–990,000**	**534,900,000–620,100,000**
SRS Reactor Fuel Production Options	20,000 [c]	2,900,000 [c]
Total [d]	**858,000–1,010,000**	**538,000,000–623,000,000**
Total Site-wide Capacity	**4,400,000 [a]**	**2,950,000,000 [a]**

GTCC = greater-than-Class C; HLW = high-level radioactive waste; LLW = low-level radioactive waste; NNSA = National Nuclear Security Administration; SNF = spent nuclear fuel.

[a] From Chapter 3, Section 3.3.7.

[b] Total is a range that includes the minimum and maximum values from various alternatives of Proposed Action.

[c] From Chapter 4, Section 4.7.3.2 and Appendix B, Table B-44 (SRS Fuel Fabrication Operational Resource Requirements).

[d] Total rounded to three significant figures.

5.5.4 Waste Management

The assessment of the waste management cumulative impacts at SRS includes the reactor fuel production options and other reasonably foreseeable actions that result in the generation, treatment as required, and disposal of LLW, MLLW, and TRU waste. **Table 5–20** summarizes of the estimated cumulative annual generation rates of these wastes. Additional reasonably foreseeable actions are identified in Section 5.2, Table 5–1. As noted in Table 5–1, some of these activities are ongoing and the waste generated by these activities are included in the existing site activities' waste generation rates for SRS. For some of the activities identified as proposed, there is no waste generation information currently available. For those that had information available, they are included in Table 5–20 below.

The characteristics of the newly generated wastes are estimated to be similar to the wastes currently generated by existing activities. As described in Chapter 4, Section 4.9.3.2, the waste management infrastructure at SRS was developed to support the quantities of waste generated. Therefore, cumulative waste generation would be within site capacities. There are existing offsite DOE and commercial waste management facilities with sufficient total capacities for the treatment and disposal needs of the relatively small volumes of LLW and MLLW wastes generated by the Proposed Action. Therefore, substantial cumulative impacts on offsite LLW and MLLW treatment and disposal facilities would not be expected. See Section 5.3.9 for a discussion of the impacts of TRU waste disposal on the WIPP facility.

Table 5–20. Cumulative Average Annual Waste Generation Rates at Savannah River Site in Cubic Meters

Activity	*LLW*	*MLLW*	*TRU Waste*
Past, Present, and Reasonably Foreseeable Future Actions			
Existing Site Activities [a]	5,300	55	11
Other DOE Actions Evaluated in the Surplus Plutonium Disposition SEIS [b]	1,800	97	200
Surplus Plutonium Disposition [b]	1,070	30	170 – 710
SRS Pit Production [c]	1,700 – 2,200	7.6 – 11	460 – 670
Subtotal – Baseline Plus Other DOE Actions	9,900 – 10,400	190	840 – 1,600
SRS Feedstock Preparation/Fuel Fabrication [a]	170 [d] /170 [e]	2 [d, g] /2 [e, f]	200 [d]/200 [e]
Subtotal – Feedstock Preparation and Fuel Fabrication	170 – 340	2 – 4	200 – 400
Total	10,100 – 10,800	190	1,040 – 2,000

LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; TRU = transuranic waste.
[a] Source: Section 4.9.3.2.1, Table 4-37. SRS Reactor Fuel Production Option wastes are average annual generation rates based on a 60-year operation cycle.
[b] Source: SPD SEIS (DOE 2015a: Table 4-43 alternatives with the greatest potential impacts).
[c] Source: Final SRS Pit Production EIS (DOE 2020a).
[d] These quantities are estimates and could be different depending on the process for the feedstock.
[e] These quantities are fuel fabrication with no feedstock preparation.
[f] These quantities are included in the LLW quantities.
Note: All numbers are rounded to two significant figures. Due to rounding, sums and products may not equal those calculated from table entries.

5.5.5 Human Health – Normal Operations

Cumulative impacts on public health and safety from radiological emissions could result from activities at SRS and potentially from other activities within the SRS ROI (50-mile radius from the SRS boundary) that could impact worker and public health. The activities identified in Table 5–1 were reviewed to identify those that could have a worker and public health impact. **Table 5–21** gives information on the potential impacts from the present SRS operations (from Chapter 3, Section 3.3.10.1 of this VTR EIS), reasonably foreseeable future actions, and the Proposed Action. This table includes those actions identified in Table 5–1 that could contribute to worker and the public (population and MEI) dose and potential LCFs.

Only those activities that have identified radiological impacts with available estimates of radiation exposure are listed. Some of the actions identified in Table 5–1 would be expected to have radiological impacts, but estimates were not available. At SRS, this activity is the Tritium Finishing Facility.

Table 5–21. Annual Cumulative Population Health Effects of Exposure to Radiation From Normal Operations at Savannah River Site

Activity		Workforce		Population within 50 Miles		MEI	
		Dose (person-rem)	Annual LCF [a]	Dose (person-rem)	Annual LCF [a]	Dose (millirem)	Annual LCF Risk [a]
Past, Present, and Reasonably Foreseeable Future Actions							
Existing Site activities (baseline) [b]		75	0.04	6.0	0.004	0.27	2×10^{-7}
Surplus Plutonium Disposition [c]		620	0.4	1.0	0.0006	0.01	6×10^{-9}
HLW Salt Processing [d]		6.5	0.004	18	0.01	0.31	2×10^{-7}
Acceptance and Disposition of SNF from Germany [e]		41	0.02	2.3 to 7.8	0.001 to 0.005	0.029 to 0.12	2×10^{-8} to 7×10^{-8}
Mark-18A Target Processing [f]		–	0.002	–	2.2×10^{-5}	0.11	7×10^{-8}
Pit Production [g]		178 to 200	0.11 to 0.12	3.3×10^{-5} to 5.2×10^{-5}	1.9×10^{-8} to 3.1×10^{-8}	5.0×10^{-7} to 8.0×10^{-7}	3×10^{-13} to 4.8×10^{-13}
Subtotal – Baseline Plus Other Actions		**920 to 940**	**0.5**	**27 to 33**	**0.02**	**0.82**	$\mathbf{5\times10^{-7}}$
SRS VTR	Feedstock Preparation Option	51	0.03	0.0.42	2×10^{-5}	0.0015	1×10^{-9}
	Fuel Fabrication Option	51	0.03	0.020	1×10^{-5}	0.00071	4×10^{-10}
Subtotal for VTR		**102**	**0.06**	**0.062**	$\mathbf{4\times10^{-5}}$	**0.0022**	$\mathbf{1\times10^{-9}}$
Total for Savannah River Site		**1,020 to 1,040**	**0.6**	**27 to 33**	**0.02**	**0.73 to 0.82**	$\mathbf{4\times10^{-7}}$ **to** $\mathbf{5\times10^{-7}}$
Plant Vogtle [h]		–	–	1.8	0.001	2.4	1×10^{-6}
Total for Region of Influence		–	–	**29 to 35**	**0.02**	--	--

HLW = high-level radioactive waste; LCF = latent cancer fatality; MEI = maximally exposed individual; NA = not available; NRC = U.S. Nuclear Regulatory Commission; SNF = spent nuclear fuel; WIPP = Waste Isolation Pilot Plant.

[a] LCFs are calculated using a conversion factor of 0.0006 LCFs per rem or person-rem (DOE 2003). The annual LCFs for the analyzed population represent the number of LCFs calculated by multiplying the listed doses by the risk conversion factor. No population LCFs are expected from any individual activity or from all combined activities. The annual MEI LCF risk represents the calculated risk of an LCF to an individual.

[b] From Chapter 3, Section 3.3.10.1 of this EIS. Worker dose is the average for 2014 to 2018.

[c] Impacts from the Preferred Alternative (the WIPP Alternative) for the disposal of non-pit plutonium from SPD Supplemental EIS (DOE 2015a:Chapter 4, Tables 4-38, 4-39). A preferred option for the pit plutonium has not been identified. The WIPP Alternative public impacts are the largest among all of the alternatives evaluated; immobilization to Defense Waste Processing Facility impacts are largest for workers.

[d] Interim waste salt processing is being performed, pending startup of the facility. Impacts are those associated with operation of the new facility (DOE 2001:Table 4-12).

[e] A disposition process at SRS has not been selected. Values represent the range of impacts identified in the *Final Environmental Assessment for the Acceptance and Disposition of Spent Nuclear Fuel Containing U.S.-Origin Highly Enriched Uranium from the Federal Republic of Germany* (DOE 2017d:Tables 4-31, 4-32).

[f] The *Supplement Analysis of the Mark-18A Target Material Recovery Program at the Savannah River Site* identifies a total MEI dose of 0.109 from fission products added to a caustic waste stream. The Supplement Analysis does not identify a population dose or a worker dose, but states operational impacts would be within current site impacts (DOE 2016f:pg 18).

[g] Range of impacts identified for action alternatives in the *Final Environmental Impact Statement for Plutonium Pit Production at the Savannah River Site in South Carolin*a (DOE 2020a [DOE/EIS-0541]:Tables 5-5 and 5-6).

[h] Impacts identified in the *Final EIS for Plutonium Pit Production* (DOE 2020a:Table 5-5). The Vogtle workforce is separate from that at SRS, and thus, worker impacts are not presented.

The cumulative offsite population dose would be up to 35 person-rem per year with no expected LCFs (calculated value of 0.02). Operation of the VTR feedstock preparation and fuel fabrication facilities at SRS would result in a total population dose of 0.062 person-rem per year with no expected LCFs (calculated value of 4 x 10^{-5}). The total dose and LCFs from the Proposed Action would be about 0.2 percent of the cumulative dose and LCFs and so would not substantially contribute to cumulative human health impacts at SRS.

The cumulative MEI dose from SRS activities would be up to 0.82 millirem per year with an associated LCF risk of 5×10^{-7}. This cumulative MEI dose is lower than the DOE limit of 100 millirem per year from all pathways (DOE Order 458.1 [DOE 2011b]), and the EPA individual dose limit of 10 millirem per year from airborne radionuclides (40 CFR Part 61, Subpart H). This dose conservatively assumes the same person would be the MEI for all activities at SRS, but does not include activities not on SRS (Vogtle Plant). It is unlikely that the same person would be the MEI for SRS and Vogtle activities because the activities would occur at different locations, each with an MEI located at different offsite locations. Operation of the VTR fuel preparation and fabrication facilities at SRS would result in a total MEI dose of 0.0022 millirem per year with an associated LCF risk of 1 x 10^{-9}. The total MEI dose and LCFs from the Proposed Action would be about 0.03 percent of the cumulative MEI dose and LCFs and therefore, would not substantially contribute to cumulative human health impacts at SRS.

The cumulative worker dose would be up to about 1,000 person-rem per year with 1 expected LCF (calculated value of 0.6). Operation of the VTR fuel preparation and fuel fabrication capabilities at SRS would result in a total worker dose of 102 person-rem per year with no expected LCFs (calculated value of 0.06). The total worker dose and LCFs from the Proposed Action would be 10 percent of the cumulative dose and LCFs. Cumulative worker dose, consequently, would not substantially contribute to cumulative human health impacts at SRS. This could result in 4 worker LCFs from 60 years of VTR operation. 10 CFR 835 requires DOE "to develop and implement plans and measures to maintain occupational radiation exposures as low as is reasonably achievable" (ALARA). DOE-STD-1098-2017, DOE Standard Radiological Control (DOE 2017f) identifies an effective ALARA process as including implementation of both engineered and administrative controls to control worker dose. All equipment and operations would be designed and implemented following this principle. Therefore, needed worker protection could be incorporated into the final design potentially reducing worker doses.

5.5.6 Traffic

As described in Chapter 4, Section 4.13.3, the impacts on traffic from construction and operation of facilities under the SRS reactor fuel options are anticipated to be negligible to minor. As such, impacts to traffic from this alternative would not substantially contribute to cumulative traffic impacts. Therefore, they are not discussed further.

5.5.7 Socioeconomics

The ROI for cumulative impacts on socioeconomics includes the four-county area near SRS: Aiken and Barnwell counties, South Carolina; and Columbia and Richmond counties, Georgia. As shown in **Table 5–22**, cumulative employment at SRS from past, present, and reasonably foreseeable future actions could reach a peak of about 15,600 persons. This peak is about 6.4 percent of the 243,863 people employed in the SRS ROI in 2019. These values are conservatively high estimates of short-term future employment at SRS. Some of the employment would occur at different times and it may not be appropriate to total these values. The employment totals from existing site activities include existing onsite employment (directly employed and contractor staff) and potential future employees based on proposed projects identified in Table 5–1 and carried over to Table 5–22.

Table 5–22. Total Cumulative Employment at Savannah River Site

Activity	*Direct Construction Employment (number of personnel in peak year)*	*Direct Operations Employment (first year of operation)*
Past, Present, and Reasonably Foreseeable Future Actions [a]		
Existing Site Activities	Not Applicable	11,100 [b]
Disposal of GTCC LLW and GTCC-Like Waste (DOE 2016a:9-69, 2018d)	62-145	38-51
Surplus Plutonium Disposition Program (DOE 2015a:4-39, 4-40; SRNS 2020)	741	1,680
SNF from Germany Containing U.S.-Origin Highly Enriched Uranium (DOE 2017d:4-54, 4-55; 2017e)	201	150
Tritium Finishing Facility (NNSA 2020)	Not Provided	Not Provided
Pit Production (DOE 2020a:4-38)	1,800 peak	1,830-2,015
SRS Subtotal – Baseline Plus Other Actions	**2,890**	**15,000**
SRS Fuel Fabrication Option [c]	**120**	**300**
SRS Feedstock Preparation Option	**120**	**300**
Subtotal for VTR	**240**	**600**
SRS Total	**3,130**	**15,600**
Offsite Projects		
Vogtle Generating Plant (NRC 2008; Bloomberg 2019; Georgia Power 2018; Southern Nuclear 2020)	4,300	812
Total [d]	**7,430**	**16,400**
ROI Labor Force (2018)[e]	**243,863**	

GTCC = greater-than-Class C; LLW = low-level radioactive waste; ROI = region of influence; SNF = spent nuclear fuel; SRS = Savannah River Site; VTR = Versatile Test Reactor.

[a] Activities are from Table 5–1. Only those activities with available estimates of employment are listed. The proposed Commercial Disposal of Defense Waste Processing Facility Recycle Wastewater Project did not include workforce estimates (DOE 2020e).

[b] Employment from existing site activities is from Chapter 3, Section 3.3.14.

[c] The impacts of the SRS VTR Alternative are from Chapter 4, Section 4.14.3.

[d] Total rounded to three significant figures.

[e] ROI Labor Force is from Chapter 3, Section 3.3.14.

It is assumed that no new workforce would be added to support ongoing projects at SRS identified in Table 5–1, at least those where the NEPA documentation was completed on or before 2019. These projects are ongoing and are presumably captured in the current onsite employment totals. Existing offsite projects or facilities also were reviewed to determine whether any change in existing employment was expected in the future. No change was identified for any identified offsite facility. The ongoing onsite SRS projects, which would not be expected to contribute to cumulative socioeconomic impacts at SRS, include:

- National Nuclear Security Administration Complex Transformation (DOE 2008a)
- SRS HLW Salt Processing Facility (DOE 2001)
- H-Canyon Processing of Target Residue Material (DOE 2015e, SRNS 2020)
- H-Canyon Processing of SNF (DOE 2000c, 2013b; SRNS 2020)
- Mark-18A Target Material Recovery Program (DOE 2016f)
- Use of SRS Lands for Military Training (DOE 2011g, 2011h, 2012b)

The ongoing nearby offsite projects, which would not be expected to contribute to cumulative socioeconomic impacts at SRS, include:

- American Zinc Recycling LLC (AZR 2020a, 2020b)
- Energy*Solutions* LLW Disposal Facility (DOE 2015a; SRNS 2020)

Activities proposed under the SRS Reactor Fuel Production Options could produce direct employment of up to a peak of 240 construction workers during the 3-year construction period, or 3.2 percent of the 7,430 cumulative workforce (peak) related to construction activities. The operations staff would number 600 and represent about 3.7 percent of the 16,400 cumulative workforce related to operations. By comparison, about 243,863 people were employed in the SRS ROI in 2019. In addition, DOE estimates that for every direct job, another 2.5 indirect jobs are created in other industries, based on a 2011 Economic Impact Study (Noah et al. 2011) and as described in Chapter 4, Section 4.14.3.

Given the locally available labor supply, very few, if any, construction and operations workers would be expected to in-migrate to the ROI to support reactor fuel production activities. Due to the relatively small workforce and low potential for any in-migration, impacts on the availability of housing and community services under the Proposed Action are expected to be small. The overall contribution to cumulative socioeconomic resource impacts from the Proposed Action on the ROI (e.g., housing, schools, and community services) is expected to be small during construction and negligible during operation. The overall increase in employment and income levels within the ROI would be evaluated as a beneficial impact on the local and regional economies.

While the employment requirements of the Proposed Action at SRS are very small, the total estimated operations workforce from all other actions (including the existing workforce at SRS) represents about 6.4 percent of the available workforce in the SRS ROI in 2018. The increased employment could affect conditions in the ROI. In particular, the larger-scale proposed projects include the processing of non-pit plutonium, the production of plutonium pits at SRS, and the ongoing expansion of the Vogtle Nuclear Generating Plant in nearby Burke County, Georgia. DOE anticipates that the majority of the construction workforce for the plutonium pits would be local and require only a small in-migrating workforce (DOE 2020a). Operations of all these other proposed projects would overlap with reactor fuel activities at SRS under the proposed VTR project. Even though the new Units 3 and 4 at the Vogtle plant are located outside the ROI in Burke County, they could affect conditions in Richmond and Columbia counties in Georgia, which are within the SRS ROI.

Both adverse and beneficial socioeconomic impacts are anticipated from these projects. The potential adverse impacts on the local community services are expected to be minimal, given the small number of in-migrating workers (and their families) projected for the SRS ROI from the various projects compared to the existing population and labor force in the SRS ROI. Moderate beneficial socioeconomic impacts would occur due to the increase in income and spending in the local and regional communities and associated tax revenue. In addition, in the event a larger-than-expected in-migrating workforce originating from the various projects entered the ROI and affected existing community services, the effects would be short-term. Over the longer term, the increased income and tax revenues generated by the projects could be used to offset any increased strains on local housing or community services by funding enhancements to appropriate supplies and markets.

5.5.8 Environmental Justice

Similar to the INL Site, the analysis in Chapter 4, Section 4.15, indicates no high and adverse human health and environmental impacts on any population within the ROI because of the SRS Reactor Fuel Production Options. Impacts on minority and low-income populations would be comparable to those on the general population as a whole and would be negligible. Because the doses from the Proposed Action at SRS would be small and there would be no disproportionate high and adverse impacts on minority and low-income populations, the Proposed Action would not substantially contribute to cumulative environmental justice impacts at SRS.

5.6 Transportation

The assessment of cumulative transportation impacts for past, present, and reasonably foreseeable future actions concentrates on offsite transportation throughout the nation[5] that would result in potential radiation exposure to the transportation workers and the general population. Cumulative radiological impacts from transportation are estimated using the dose to the workers and the general population, because dose can be directly related to LCFs using a cancer risk coefficient.

The comprehensive transportation cumulative impacts analysis that is presented in the Yucca Mountain EIS (DOE 2002e, 2008d), and updated in the *Surplus Plutonium Disposition (SPD) Supplemental EIS* (DOE 2015a) Section 4.5.3.7, is incorporated in, and forms the basis for, this VTR EIS analysis. The analysis included historical shipments, reasonably foreseeable future actions, and general radioactive materials transportation that was not related to any particular action. The timeframe of the SPD Supplemental EIS transportation impacts analysis began in 1943 and extended to 2073. The timeframe for this VTR EIS analysis is for 63 years beyond the 2028 start of VTR operation, which extends the cumulative impact period beyond 2090.

Table 5–23 shows estimated cumulative impacts on transportation workers and the general population based on the cumulative impacts estimated in the SPD Supplemental EIS (DOE 2015a) and additional past, present, and reasonably foreseeable future actions, including transportation activities analyzed in this VTR EIS. When combined with past, present, and reasonably foreseeable future nation-wide transportation, the cumulative transportation worker dose was estimated to be about 430,000 person-rem (about 258 LCFs). The cumulative general population dose was estimated to be about 441,000 person-rem (about 265 LCFs). For the INL VTR and the ORNL VTR Alternatives evaluated in this EIS, doses to transportation workers and the general population would be less than 2,120 and 2,025 person-rem, respectively. Therefore, worker and population doses from the Proposed Action would be less than 0.5 percent of the cumulative worker and population doses and would not substantially contribute to cumulative transportation impacts.

The total number of LCFs (among the workers and the general population) estimated to result from radioactive material transportation over the period between 1943 and 2090 is about 525, or an average of about 4 LCFs per year. Over this same period (148 years), about 88 million people are projected to die from cancer, based on National Center for Health Statistics data. The annual number of cancer deaths in the United States in 2017 was about 599,000 (CDC 2019), with about 3 percent fluctuation in the number of cancer fatalities from 1 year to the next, over the previous 10 years (2008 through 2017), and a mean of 584,000 cancer fatalities per year. The transportation-related LCFs would be 0.0006 percent of the total annual number of LCFs. As a result, this number is indistinguishable from the natural fluctuation in the total annual death rate from cancer.

[5] An assessment of potential cumulative impacts of DOE shipments of radioactive material across the global commons is presented in Appendix F, Section F.7. This includes incident-free marine transport of up to 34 metric tons of plutonium from Europe to the United States. The cumulative transportation worker dose was estimated to be about 134 to 135 person-rem with no LCFs expected (calculated value of 0.08). There would be no dose to the general public.

Table 5–23. Cumulative Transportation-Related Radiological Doses and Latent Cancer Fatalities

Category	Worker Dose (person-rem)	General Population Dose (person-rem)
Historical [a]	49	25
Past, Present, and Reasonably Foreseeable Future Actions (DOE) [a, b]	29,600	36,700
Additional Reasonably Foreseeable Future Actions (DOE)		
Permanent Disposal or Interim Storage of Spent Nuclear Fuel [c]	5,600–5,900	1,100–1,200
Disposal of Greater-Than-Class C LLW [d]	180	68
Disposition of Depleted Uranium Oxide Conversion Product [l]	145–276	217–723
SRS Pit Production [m]	581–901	334–455
Surplus Plutonium Disposition [n]	230–650	150–580
WIPP Transuranic Waste Disposal Supplemental Analysis [e]	492	383
Production of Tritium in a Commercial Light Water Reactor [f]	25–60	2.7–12
Liquid Highly Enriched Uranium Shipments from Canada [g]	17	10
Santa Susana Field Laboratory Remediation [h]	3.0	0.89
Acceptance and Disposition of Spent Nuclear Fuel from the Federal Republic of Germany [i]	0.12–10.9	0.54–4.7
Sister Rod Shipments [j]	0.27	0.75
Total Past, Present, and Reasonably Foreseeable Future Actions (DOE)	**36,900–38,100**	**38,900–40,100**
Past, Present, and Reasonably Foreseeable Future Actions (non-DOE) [a]	5,380	61,300
General Radioactive Materials Transportation [a]	384,000	338,000
Transportation Impacts in this VTR EIS [k]		
INL VTR Alternative	624–1,920	699–1,780
ORNL VTR Alternative	832–2,120	945–2,020
Total [o]	**427,000–430,000**	**439,000–441,000**
Total LCFs [p]	256–258	263–265

LCF = latent cancer fatalities; LLW = low-level radioactive waste; WIPP = Waste Isolation Pilot Plant.

[a] DOE 2015a:Table 4-48, p. 4-136 and 4-137. Historical shipments are shipments that occurred in the past.

[b] DOE 2015a:Table 4-48, p. 4-136 and 4-137. Excludes transportation doses from the greater-than-Class C LLW EIS (DOE/EIS-0375) and DUF6 conversion at Paducah and Portsmouth EISs (DOE/EIS-0359 and DOE/EIS-0360).

[c] DOE 2008d:Table 8-14, p. 8-44. For the purposes of the transportation cumulative impacts analysis, DOE evaluated the Yucca Mountain, Nevada, repository site as a surrogate destination for an interim storage facility or a permanent repository.

[d] DOE 2016a:Table 4.3.9-1, p. 4-68 and 4-69, DOE 2018d:3-20.

[e] DOE 2009:Table 2, p. 5.

[f] DOE 2016b:Table F-12, p. F-17. Calculated from LCFs.

[g] DOE 2013b:A-11. Calculated from LCFs.

[h] DOE 2018f:Table H-9, p. H-31.

[i] DOE 2017d:Table 4-28, p. 4-68.

[j] DOE 2015f:Table 3-1, p. 24. Calculated from LCFs.

[k] From Section E.8 (Table E-6) of Appendix E or Section 4.12 and adjusted for the 63 years of operations in this VTR EIS. Range includes INL and SRS Reactor Fuel Production Options.

[l] DOE 2020b:Table 4-51, p 4-93. The highest impacts for rail and truck shipments.

[m] DOE 2020a:Table 5-7, for 50 to 80 pits per year with 50 years of operation.

[n] DOE 2015a:Table E-20 in Appendix E. Impacts are conservative because a decision on disposition of the 34 metric tons of surplus plutonium has not been made. The impacts of transportation of surplus pit plutonium from the Pantex Plant to LANL or SRS for disassembly and conversion are a fraction of the total impacts presented here.

[o] Total values are rounded to three significant figures. (Note: the lower end of the range totals includes the lowest value from the VTR alternatives; the upper end of the range includes the highest value.) Total rounded to three significant figures.

[p] Total LCFs are calculated assuming 0.0006 latent cancer fatalities per person-rem of exposure (DOE 2003).

5.7 Global Commons

5.7.1 Ozone Depletion

Construction and operation activities would use materials and equipment that would comply with applicable ozone-depleting substances (ODSs) laws and regulations. DOE works to reduce its use of ODSs complex-wide, based on Federal directives and DOE Order 436.1, Departmental Sustainability (DOE 2011e). The VTR Alternative is not expected to use substantial quantities of ODSs as regulated under 40 CFR Part 82, "Protection of Stratospheric Ozone." Emissions of ODSs would be very small and would represent a negligible contribution to the destruction of the Earth's protective ozone layer.

5.7.2 Climate Change

Greenhouse gases (GHGs) are gases that trap heat in the atmosphere by absorbing infrared radiation. The accumulation of GHGs in the atmosphere regulates the Earth's temperature. GHG emissions occur from natural processes and human activities. The most common GHGs emitted from natural processes and human activities include carbon dioxide, methane, and nitrous oxide. The main source of GHGs from human activities is the combustion of fossil fuels, such as natural gas, crude oil (including gasoline, diesel fuel, and heating oil), and coal (USGCRP 2018).

Atmospheric levels of GHGs and their resulting effects on climate change are due to innumerable sources of GHGs across the globe. The direct environmental effect of GHG emissions is a general increase in global temperatures, which indirectly causes numerous environmental and social effects. Therefore, the ROI for potential GHG impacts is global. These cumulative global impacts would be manifested as impacts on resources and ecosystems in the United States, including Idaho, Tennessee, and South Carolina.

Predictions of long-term environmental impacts due to increased atmospheric GHGs include sea-level rise, changing weather patterns (e.g., increases in severity of storms and droughts), changes in local and regional ecosystems (e.g., potential loss of species), and a substantial reduction in winter snowpack (IPCC 2014; USGCRP 2018). The Northwest region that encompasses Idaho is at risk from an increase in flooding, drought, and heat waves; compromises to water supplies and hydropower; and an increase in wild fires. The region risks damage to aquatic and terrestrial ecosystems, an increase in the incidence of infectious diseases and other human health problems, and stresses to agricultural productivity (USGCRP 2018). The Southeast region that encompasses both ORR and SRS would experience an increase in extreme rainfall events, which would increase flood risks in low-lying regions, and an increase in heat and vector-borne diseases in urban areas. The Southeast is also at risk from more frequent extreme heat episodes and changing seasonal climates, which would increase exposure-linked health impacts and economic vulnerabilities in the agricultural, timber, and manufacturing sectors (USGCRP 2018).

Table 5–24 shows estimates of GHG emissions that would occur from construction and operation of the VTR and associated facilities at the INL Site, ORNL, and SRS. Emissions from construction and operations would occur over a period of up to 65 years and would imperceptibly add to U.S. and global GHG emissions, which were estimated to be 6.7 billion metric tons and 36.6 billion metric tons of CO_2e in 2018, respectively (EPA 2019e; Global Carbon Project 2019). Therefore, GHGs emitted from the proposed actions at the INL Site, ORR, and SRS would be a negligible percentage of U.S. and global GHG emissions and would not substantially contribute to future climate change.

Table 5–24. Greenhouse Gas Emissions from Construction and Operation of the Versatile Test Reactor and Associated Facilities at Idaho National Laboratory, Oak Ridge National Laboratory, and Savannah River Site

Activity	*Alternatives/Options (metric tons of CO_2e)*		
	INL VTR Alternative, Including the Maximum Reactor Fuel Production Option	*ORNL VTR Alternative*	*SRS Reactor Fuel Production Options*
Construction – Total Emissions over 5 Years	18,039	23,055	696
Operations – Annual Emissions/Total Emissions over 60 Years	769 / 46,862	1,222 / 74,009	980 / 58,782
Total Emissions over 65 Years [a]	65,000	97,000	59,000

CO_2e = carbon dioxide equivalent.

[a] Rounded to two significant figures.

Source: Air Quality/GHG Calculation Package version 1.