TECHNICAL REPORT

Supporting Information for the Environmental Impact Statement for Department of Energy Activities in Support of Commercial Production of High-Assay Low-Enriched Uranium (HALEU)

November 2023

Prepared by
Leidos, Inc.
for
U.S. Department of Energy
Office of Nuclear Energy

This page left blank intentionally.

CONTENTS

List of Figures

List of Tables

Acronyms, Abbreviations

<	greater than
<	less than
AADT	annual average daily traffic
ACO	American Centrifuge Operating, LLC (a Centrus company)
ACP	American Centrifuge Plant
ADU	ammonium diuranate
AEGL	acute exposure guideline level
AHF	anhydrous hydrogen fluoride
ALARA	as low as reasonably achievable
ANR	advanced nuclear reactor
ANSI	American National Standards Institute
APE	area of potential effects
ATSDR	Agency for Toxic Substances and Disease Registry
AUC	ammonium uranyl carbonate
B_2O_3	boron oxide
BF_3	boron trifluoride
BMPs	best management practices
BWXT	BWX Technologies, Inc.
°C	degrees Celsius
CAA	Clean Air Act
CAAPP	Clean Air Act Permit Program
CAB	controlled area boundary
CaF_2	calcium fluoride
CCR	criticality control rod
CCS	criticality control system
CCV	Cask Containment Vessel
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
Ci	curies
Ci/g	curies per gram
CWA	Clean Water Act
DAQ	Division of Air Quality
dB	decibels
dBA	A-weighted decibels
DEQ	Department of Environmental Quality
DOE	U.S. Department of Energy
DU	depleted uranium
DUF_4	depleted uranium tetrafluoride
DUF_6	depleted uranium hexafluoride
DUO_2	depleted uranium dioxide
EA	Environmental Assessment
EIS	Environmental Impact Statement
ELUC	environmental land use control
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
ESA	Endangered Species Act
°F	degrees Fahrenheit
FBP	Fluor-BWXT Portsmouth
FEP	fluorine extraction process
FFF	Fuel Fabrication Facility
FMB	Feed Materials Building
FMO	Fuel Manufacturing Operation
ft^2	square feet
ft^3	cubic feet
FTEs	full-time equivalents
gal	gallons
GE	General Electric
GEIS	Generic Environmental Impact Statement
GHGs	greenhouse gases
GLE	Global Laser Enrichment, LLC
GNF-A	Global Nuclear Fuel – Americas
H_2SO_4	sulfuric acid
ha	hectares
HALEU	high-assay low-enriched uranium
HAPs	hazardous air pollutants
HF	hydrogen fluoride
HMDSO	hexamethyldisiloxane
HTGR	high-temperature gas-cooled
I-	Interstate
IDR	Integrated Dry Route
IEPA	Illinois Environmental Protection Agency
IIFP	International Isotopes Fluorine Products, Inc.
IPaC	Information for Planning and Consultation
IROFS	items relied on for safety
ISA	integrated safety analysis
ISR	in-situ recovery
kg	kilograms
km	kilometers
kV	kilovolt
L	liters
LAR	license amendment request
lbs	pounds
LCF	latent cancer fatality
L_{dn}	day-night average sound level

LES Louisiana Energy Services
LEU low-enriched uranium
LLW low-level radioactive wastes
LOS level of service
LSA low specific activity
LWR light water reactor
m meters
m^3 cubic meters
µCi microcuries
MCS Mid-America Conversion Services
MEI maximally exposed individual
mg milligrams
$\mu g/m^3$ micrograms per cubic meter
mg/m^3 milligrams per cubic meter
MLLW mixed low-level radioactive wastes
mrem millirem
mrem/hr millirem per hour
MSR molten salt reactors
MT metric tons
MTS methyltrichlorosilane
MT/yr metric ton per year
MWe megawatts electric
NAAQS National Ambient Air Quality Standards
NEF National Enrichment Facility
NEPA National Environmental Policy Act
NESHAP National Emission Standards for Hazardous Air Pollutants
NFS Nuclear Fuel Services, Inc.
NH_3 ammonia
NHPA National Historic Preservation Act
NM- New Mexico Highway
NO_2 nitrogen dioxide
NPDES National Pollutant Discharge Elimination System
NRC U.S. Nuclear Regulatory Commission
NRHP National Register of Historic Places
O_2 oxygen
OSHA Occupational Safety and Health Administration
pCi/L picocuries per liter
PEL permissible exposure limit
$PM_{2.5}$ particulate matter less than or equal to 2.5 microns in diameter
PM_{10} particulate matter less than or equal to 10 microns in diameter
PNM Public Service Company of New Mexico
PPE Plant Parameter Envelope
ppm parts per million
PSP protective structural package
ROI region of influence
SBMs Separations Building Modules
SCDHEC South Carolina Department of Health and Environmental Control
SHPO State Historic Preservation Officer
SiF_4 silicon tetrafluoride
SILEX separation of isotopes by laser excitation
SiO_2 silicon dioxide
SNF spent nuclear fuel
SNM special nuclear material
SPE Site Parameter Envelope
SR State Route
ST short tons
SWUs separative work units
SWU/yr separative work unit per year
SX solvent extraction
TRISO TRi-structural ISOtropic
TRISO-X TRISO fuel developed by X-energy
U-234 uranium-234
U-235 uranium-235
U-238 uranium-238
UF_4 uranium tetrafluoride
UF_6 uranium hexafluoride
ULP Uranium Leasing Program
UN uranyl nitrate
U_3O_8 triuranium octoxide
UO_2 uranium dioxide
UO_2F_2 uranyl fluoride
US- U.S. Route
U.S. United States
U.S.C. United States Code
USCB U.S. Census Bureau
USFWS U.S. Fish and Wildlife Service
USNC Ultra Safe Nuclear Corporation
UUSA Urenco USA
WCS Waste Control Specialists
WE Westinghouse Electric
yd^3 cubic yards

Preface

The *Environmental Impact Statement for Department of Energy Activities in Support of Commercial Production of High-Assay Low-Enriched Uranium (HALEU)* (the "HALEU EIS") presents the potential environmental consequences of the Proposed Action[1] (i.e., the impacts from HALEU production, storage, and transportation activities) and discusses the potential impacts of HALEU fuel fabrication, use in reactors, and the resulting spent nuclear fuel management. This Technical Report documents the review of existing National Environmental Policy Act (NEPA) documentation for constructing and operating uranium fuel cycle facilities.

To determine what the potential environmental consequences of the Proposed Action might be, the Leidos Team analyzed the best available information (i.e., existing environmental analysis documentation) prepared in accordance with NEPA, for the construction and operation of facilities that currently conduct or are capable of conducting activities that would be similar to those expected to occur under the Proposed Action. Those existing and planned facilities are approved to operate under existing U.S. Nuclear Regulatory Commission (NRC) licenses, Agreement State licenses, U.S. Department of Interior permits, and/or applicable Federal, state, and local permits and approvals. NEPA evaluations for those facilities were previously performed and considered under their licensing, permitting, and approval action decisions.

Decisions on the specific location of facilities is not being made in the HALEU EIS. HALEU procurement contracts with the U.S. Department of Energy (DOE), which will support the Proposed Action, will only address the acquisition of HALEU and related services. The locations where companies choose to site their facilities would be subject to further environmental analysis under the relevant regulatory authority.

Therefore, DOE contracted with the Leidos Team (see the List of Preparers) to carefully review the existing NEPA documentation, from the perspective of the Proposed Action activities, and document that review and analytical results in this Technical Report.

[1] The Proposed Action is to acquire, through procurement from commercial sources, HALEU enriched to at least 19.75 and less than 20 weight percent U-235 over a 10-year period of performance, and to facilitate the establishment of commercial HALEU fuel production. The Proposed Action implements Section 2001(a)(2)(D)(v) of the Energy Act of 2020 for the acquisition of HALEU produced by a commercial entity using enrichment technology and making it available for commercial use or demonstration projects.

This page intentionally left blank.

1 Uranium Mining and Milling

1.1 Description of the Activity

1.1.1 General Description

The production of high-assay low-enriched uranium (HALEU) starts with taking uranium ore from the ground and then purifying and processing it through a series of steps. Uranium recovery focuses on extracting natural uranium ore from the earth and concentrating (or milling) that ore. These recovery operations produce a product, called "yellowcake," which is then transported to a succession of fuel cycle facilities where the yellowcake is converted into fuel (NRC, 2020a).

To produce 25 metric tons per year (MT/yr) of HALEU, approximately 1,300 metric tons (MT) of yellowcake (uranium oxide [U_3O_8]) would need to be produced. The 1,300 MT of yellowcake would fill about 1,480 55-gallon (gal) drums. If all uranium was mined through conventional methods, and assuming an ore composition of 0.1%, this would correspond to 1.3 million MT/yr of uranium-bearing ore needing to be mined. To achieve a total production goal of 150 MT of HALEU, approximately 7,800 MT of yellowcake and 7.8 million MT of uranium-bearing ore would need to be mined.[2]

1.1.2 Description of the Process

This HALEU Environmental Impact Statement (EIS) considers two uranium extraction methods: (1) in-situ recovery (ISR) mining, which is the predominant extraction method currently used in the United States for uranium recovery, and (2) conventional mining, which includes open-pit and underground mining. For the purposes of the Technical Report, the Leidos Team considered construction and operation of existing uranium mines (existing permitted mining locations). Extrapolation of impacts to new mining locations is addressed in the EIS (see Section 1.1.3, *Potential Facilities*, regarding potential facilities).

ISR facilities recover uranium from low-grade ores where other mining and milling methods may be too expensive or environmentally disruptive. For ISR, the uranium ore is oxidized from insoluble tetravalent uranium to highly soluble hexavalent uranium (U_3O_8) underground before being pumped to the surface for further processing. In the ISR uranium extraction process, wells are drilled into rock formations containing uranium ore. Water, usually fortified with oxygen and sodium bicarbonate, is injected into the wells to oxidize uranium in the rock so that it dissolves in the groundwater. The plume of the uranium-bearing solution is controlled by strategically placed wells that pump water in and out of the formation. The uranium-bearing solution is pumped to a central processing plant, which uses ion exchange to extract the uranium ions from the liquid and subsequently produces yellowcake. Waste from this process is specific in nature (e.g., filters, piping), is relatively small in volume, and can be disposed of in a tailings pile at a conventional mill site or at a licensed disposal facility. Liquid wastes are generally disposed of in permitted deep disposal wells, evaporation pads, spray irrigation, or treated and discharged to surface water. Unlike in conventional mining, mine tailings are not generated at ISR facilities. Monitoring and

[2] These quantities are associated with one enrichment contract resulting from the DOE Draft Request for Proposals (RFP) for HALEU enrichment services (DOE, 2023a). The Draft Enrichment RFP requests enrichment services of up to 145 MT of HALEU per contract. The analysis assumes this equates to about 25 MT per year for 6 years of enrichment facility operation. Multiple contracts, each of up to 145 MT of HALEU, may be awarded for a total of 290 MT of HALEU. The corresponding values associated with this quantity would be an assumed annual production of 50 MT requiring 2,600 MT of yellowcake or 2.6 million MT of uranium-bearing ore annually for a total of 15,000 MT of yellowcake and 15 million MT of uranium-bearing ore.

restoration of groundwater is important to protect public health and the environment and is an important focus of the U.S. Nuclear Regulatory Commission (NRC) (NRC, 2020a). ISR mining uses the following process, as illustrated in Figure 1-1 (NRC, 2021a):

1) A solution called lixiviant (typically containing water mixed with oxygen and/or hydrogen peroxide, as well as sodium carbonate or carbon dioxide) is injected through a series of wells into the ore body to oxidize and dissolve the uranium.
2) The lixiviant is then collected in a series of recovery wells, through which it is pumped to a processing plant where the uranium is extracted from the solution through an ion-exchange process.
3) The uranium extract is then further purified, concentrated, and dried to produce a material, which is called "yellowcake" because of its yellowish color.
4) Finally, the yellowcake is packed in 55-gal drums to be transported to a uranium conversion facility, where it is processed through the stages of the nuclear fuel cycle to produce fuel for use in nuclear power reactors.

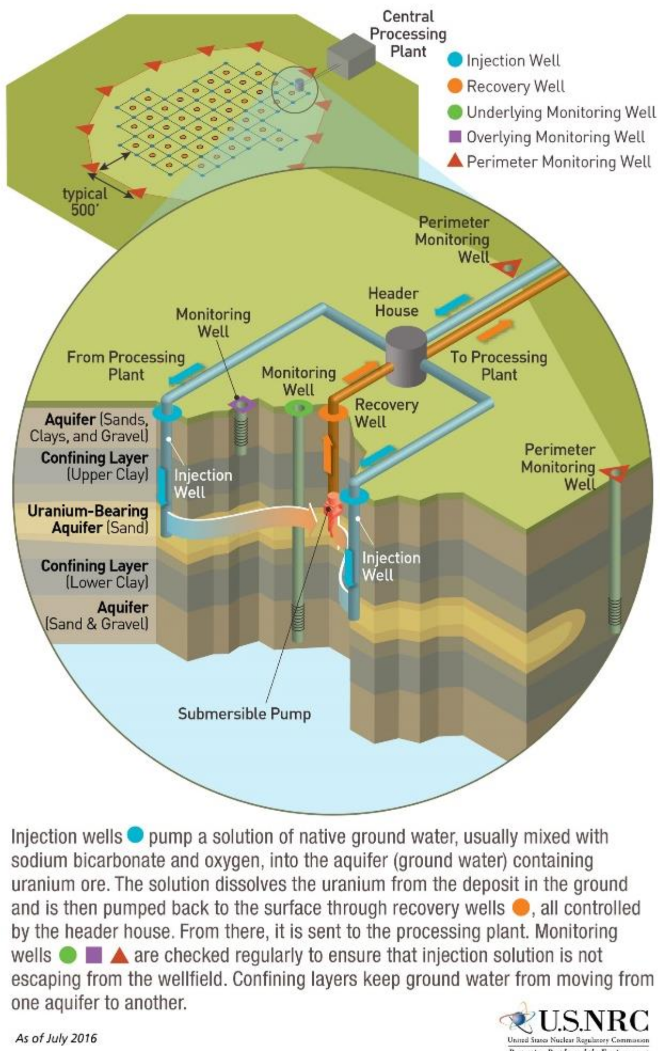


Figure 1-1. ISR Mining Process

NRC-licensed flow rates typically range from approximately 15,100 to 34,000 liters per minute (4,000 to 9,000 gal per minute). Licensed maximum limits on annual uranium production range from approximately 860,000 to 2.5 million kilograms (kg) per year (1.9 million to 5.5 million pounds [lbs] per year) of yellowcake.

Uranium purification and extraction involves the following steps.

Elution: The "regeneration" phase for ISR resin is called "elution," and the saltwater used to regenerate the resin is called "eluent." Just as for a home water softener, highly concentrated saltwater brine is used for regeneration. In the case of ISR however, some sodium bicarbonate-carbonate solution (baking soda and club soda) is mixed with the brine. This brine water is then pumped over the resin, and a reverse ion exchange occurs, just as it does in a home water softener during the regenerating phase. The elution process causes uranium to be concentrated in the saltwater brine or "eluent" in the form of uranyl carbonate. For a home water softener, the brine is used only once and then is sent down the drain, but in the ISR process, the eluent is recycled and reused after the uranium is precipitated from it (Uranium Producers of America, 2014).

Precipitation, Drying, and Packaging: In the precipitation and drying circuit, the eluant is typically acidified using hydrochloric or sulfuric acid (H_2SO_4) to destroy the uranyl carbonate complex. Hydrogen peroxide is then added to precipitate the uranium as uranyl peroxide. Sodium hydroxide or ammonia (NH_3) is also normally added at this stage to neutralize the acid remaining in the eluate. The eluant is typically recycled. Water left over from these processes may be reused in the eluant circuit or may be disposed of as byproduct material. After the precipitation process, the resulting slurry is sent to a thickener where it is settled, washed, filtered, and dewatered. This thickened slurry may be transported off-site to a uranium processing plant to produce yellowcake (U_3O_8). For on-site processing, the slurry is next dried in the yellowcake dryer (either a multihearth dryer or vacuum dryer). Because of the high temperatures involved in multihearth dryers, any organic contaminants in the yellowcake (e.g., grease from bearings) will be completely burned and will exit the system with the dryer off-gas. The off-gas discharge from the dryer is scrubbed with a high-intensity venturi scrubber that is 95% to 99% efficient at removing uranium particulates before they are released into the atmosphere. Solutions from the scrubber are normally returned to the precipitation circuit and are processed to recover any uranium particulates. As a result, the stack discharge normally contains only water vapor and quantities of uranium fines that are maintained below regulatory limits. Newer ISR facilities usually use vacuum yellowcake dryers. In a vacuum dryer the heating system is isolated from the yellowcake so that no radioactive materials are entrained in the heating system or its exhaust. The drying chamber that contains the yellowcake slurry is under vacuum. Therefore, any potential leak would cause air to flow into the chamber. Moisture in the yellowcake is the only source of vapor. Emissions from the drying chamber are normally treated in two ways. First, vapor passes through a bag filter to remove yellowcake particulates with an efficiency exceeding 99%. Any captured particulates are returned to the drying chamber. Second, any water vapor exiting the drying chamber is cooled and condensed. The dried product (yellowcake) is removed from the bottom of the dryer and packaged in drums for shipping off-site (Uranium Producers of America, 2014).

Decommissioning: ISR licensees are required to decommission well fields when those wells are no longer producing uranium. Decommissioning of the well fields includes restoration of the groundwater to meet NRC requirements. ISR facilities and conventional mills must be decommissioned at the end of operations. Licensees are required to remove contaminated structures, decontaminate soil, stabilize sites, and safely dispose of radioactive waste. These steps must be completed to the NRC's satisfaction before a license is terminated in accordance with established requirements. In all circumstances, the NRC terminates a license for uranium recovery only after it is determined that the site has been remediated and stabilized in accordance with the applicable requirements. After license termination, conventional mill or heap leach[3] facilities are transferred to the Federal government or a state government. The NRC continues to regulate these sites during the long-term care period (NRC, 2020a).

Regulatory Authority: The NRC becomes involved in uranium recovery operations when the ore is processed and physically or chemically altered. For that reason, the NRC regulates ISR facilities as well as uranium mills and the disposal of liquid and solid wastes from uranium recovery operations (including mill tailings). The NRC does not regulate conventional uranium mining in which the ore is not altered (NRC, 2020a).

The NRC has a well-established and comprehensive regulatory framework for ensuring that uranium recovery facilities are appropriately licensed, operated, monitored, and decommissioned to protect public health and safety. The NRC conducts comprehensive safety and environmental reviews on every new application for a uranium recovery facility. The safety review scrutinizes the applicant's qualifications, design safety, operational programs, and site safety to ensure that the facility will meet NRC requirements. NRC standards conform to standards promulgated by the U.S. Environmental Protection Agency (EPA). The NRC also performs an environmental review to fulfill its obligation under the National Environmental Policy Act (NEPA). The NRC developed the *Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities* (NRC, 2009a), a Generic Environmental Impact Statement (GEIS) for ISR operations in the western United States (referred to as the "ISR GEIS") that analyzes environmental impacts common to these facilities. For each new application, the NRC prepares a Supplemental EIS to review impacts specific to that site (NRC, 2020a).

By issuing or amending a current license, the NRC authorizes the licensee to construct and operate (with specified conditions) a uranium recovery facility, expand an existing facility, or restart an existing facility at a specific site, in accordance with established laws and regulations. A uranium recovery license is valid for 10 years and can be renewed in 10-year increments (NRC, 2020a).

The public and other stakeholders are provided multiple opportunities to participate in the regulatory process. This process may include participating in public meetings, requesting an adjudicatory hearing on the issuance of a license, amendment, or renewal, and commenting on the EIS and other documents. Opportunities for public involvement are typically announced by the NRC in a *Federal Register* notice or public meeting notice on the NRC website. The NRC also has a strategy for outreach and communication with Indian Tribes potentially affected by uranium recovery sites (NRC, 2020a).

After issuing a license for a new uranium recovery facility, the NRC focuses its regulatory actions on protecting the health and safety of the public and the environment. The NRC provides continued oversight of the operations through periodic licensing reviews, inspections, assessment, and enforcement. Inspections of uranium recovery facilities licensed by the NRC are essential to ensure that operations are conducted in compliance with applicable regulatory requirements. Inspection frequencies range from several times a year (for operating facilities) to once every two years (for facilities in standby mode or decommissioning). The NRC inspections focus on those areas that are most important to safety and

[3] Heap leach is a method for extracting uranium from ore placed in piles or heaps on top of liners. The liners prevent uranium and other chemicals from moving into the ground. H_2SO_4 is dripped onto the heap and dissolves uranium as it moves through the ore. Uranium solution drains into collection basins, where it is piped to a processing plant. At the plant, uranium is extracted, concentrated, and dried to form yellowcake. This method is no longer used for uranium extraction in the United States (NRC, 2020d).

security, using objective measures of performance to capture the most accurate data possible. In general, these inspections address a variety of topics, including management organization and controls, radiation protection, chemical processes, radioactive waste management, emergency preparedness, fire safety, environmental protection including groundwater protection, and on-site construction (NRC, 2020a).

Conventional mining refers to the removal of uranium ore from deep underground shafts or shallow open pits. Conventional mining activities are conducted in the following three phases: (1) exploration; (2) mining development and operations; and (3) reclamation.

Exploration: The exploration phase is considered a pre-production activity. This phase is typically conducted in a relatively short period of time (i.e., several weeks); however, it can occur annually over the course of several years. It involves planning, obtaining access to the tracts, constructing temporary roads as required, and performing exploratory drilling. Exploration holes are drilled to determine the exact location and grade of uranium ore present. A temporary access road is typically prepared to give a drill truck, a pipe truck, and a water truck access to the location identified for exploration. Such temporary roads are generally less than 20 feet (6.1 meters [m]) in width. During the exploration phase, surface disturbance would be limited to the minimum area required to obtain a grade and provide for the safe transportation of drilling equipment and personnel. The surface area disturbance would typically include the removal of vegetation and the leveling of high points in the rights-of-way. Excavated surface soil material would be stockpiled for use during reclamation. Borrow ditches, crowning, waterbars, culverts, side slope stabilization measures, and riprap would be used, as necessary, to control erosion (DOE, 2014).

Exploration holes are typically about 6 inches (15 centimeters) in diameter and can vary in depth from shallow (tens of feet), to moderate (hundreds of feet), to deep (greater than 1,000 feet). After probing is completed, reclamation via plugging of the exploration holes is performed. However, the temporary roads may or may not be reclaimed immediately. This approach allows exploration to be repeated in the same area if necessary, depending on the results of the probe or grab samples. Reclamation of the temporary roads typically involves contouring the surface, followed by revegetation. The exploration plans are prepared prior to activities to include descriptions of (1) the specific areas to be explored and the designated proposed access roads (existing or new) to be used, accompanied by maps and aerial photos, as available; (2) the exploration method to be employed; (3) how compliance with NEPA or other applicable environmental requirements is being achieved; and (4) the reclamation to be conducted on the disturbed areas (DOE, 2014).

Mining Development and Operations: Before mining, operators would be required to submit mine plans to the respective state for review and approval. Mine plans would include descriptions of the operational activities to be conducted. These operational activities typically involve (1) surface-plant area construction and (2) mine development and operations. In addition, a "Reclamation Permit Application" (plan of operations) must be submitted to the respective state for review and approval.

Figure 1-2 provides a schematic of a generic surface mine plant configuration.

If not already present, buildings to be constructed could vary, from offices to maintenance shops to storage sheds. Utility needs could include electricity, air, and water. Electricity to operate mining equipment, lighting, and ventilation fans could be supplied by above-ground lines or through generators. Air compressors would be used to supply the air needed for drilling equipment and tools. Water would be hauled to the mine site from a water supplier. Sewage and wastewater would be disposed of through a septic system or a portable facility. If not already present, a service area would also be developed to service vehicles, bulldozers, water trucks, and other heavy equipment used for the mining operations.

Fuel storage tanks, water tanks, and forty-five 55-gal (210-liter) oil barrels, if needed for the operations, would be located in this area.

As part of maintenance activities, hoses, fuel lines, tank exteriors, and equipment parts stored in the service area would be routinely inspected by the mine operator. In addition, berms and secondary containment for gasoline, solvent, and oil storage facilities would be installed. If there was a petroleum spill or leak that required notification of Federal and state agencies, the mine operator would be required to conduct containment and cleanup activities that were consistent with spill prevention and control provisions in the approved mine plan.

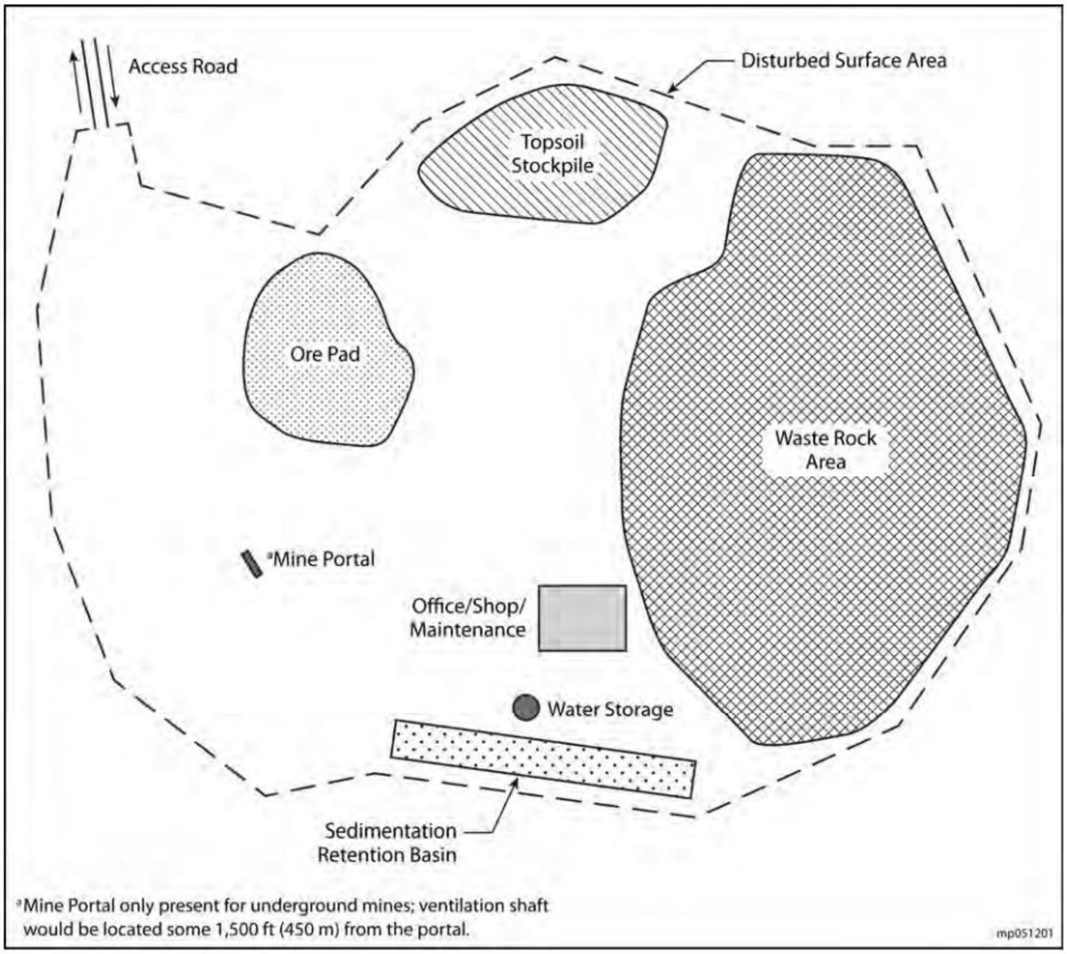


Figure 1-2. Schematic of a Generic Mine Plant Surface Configuration

Materials and chemicals needed for mine operations would be stored in compliance with Federal, state, and local regulations. Chemicals would primarily include solvents, oils, degreasers, and other substances used to maintain vehicles. Similarly, explosives would also be stored away from areas where volatile substances were located. The approved mine plan would also contain a contingency plan that would outline which types of stored material spills would be reported. Emergency equipment (e.g., first-aid supplies, liquid spill response supplies, and fire extinguishers) would also be kept on hand. Emergency equipment, such as mine rescue equipment, would be maintained on-site in a centralized location that would allow for quick response times in accordance with Mine Safety and Health Administration requirements.

Mine water discharge and/or treatment ponds for receiving discharge water from the mines may be required. Regulations might require that ponds be adequately lined, fenced, and netted to ensure the surrounding environment, including wildlife and livestock, would not be adversely affected. Water would be pumped to discharge ponds from mine sumps constructed in mine areas where water accumulation is possible. Mine water would be treated to meet applicable discharge standards, as necessary. Water would then be allowed to flow into a settling pond, where it could be evaporated or discharged to the environment at a discharge location specified per a state water discharge permit and National Pollutant Discharge Elimination System (NPDES) requirements. The surface-plant area would also hold a mine waste-rock pile. Mining operations (underground and surface open pit) would involve removing rock materials to allow access to the ore deposits of interest. Most of the waste-rock pile would be composed of large fractions of coarse rock. The uranium content of the waste-rock pile would be minimal (0% to 0.05% of uranium). These waste materials would be contained temporarily on the surface plant until taken off-site to a disposal facility. Any hazardous waste would also be taken off-site for disposal per Federal, state, and local requirements (DOE, 2014, pp. 2-4 to 2-13).

<u>Regulatory Authority:</u> Conventional mining on private lands is regulated by the Department of Interior Office of Surface Mining Reclamation and Enforcement, and the individual states where the mines are located (NRC, 2020a).

<u>Reclamation:</u> When mining activities are complete and no future intended lease activities remain, the mine operator is required to initiate reclamation activities consistent with the reclamation provisions included in the approved mining plan. Reclamation provisions are consistent with state closure regulations. Mine permit and mine permit amendment applications are required to include reclamation plans. Reclamation activities include recontouring the land to restore it to its original topography, replacing surface soil, implementing erosion-control measures, and revegetating disturbed areas with appropriate native and adapted species. Surface-plant improvements would be removed in accordance with agency requirements. Open shafts, adits, and declines would be closed. Mine waste-rock piles would be graded to a slope (e.g., 3:1 slope or shallower) determined to provide stable soils and where vegetation could grow to desired standards, contoured, covered with surface soil, and seeded in accordance with an approved reclamation plan. Residual ores and other radioactive materials inherent to the site, but not taken to the mill for processing would be placed back into the mine workings as part of the portal closure process. Effort would be made to retain all topsoil material removed from the area and stockpiled for use in reclamation. Mine site debris and waste (other than waste rock) would be managed according to waste management procedures defined in the mine plans (e.g., waste would be transported to permitted landfills or licensed disposal facilities, as in the case of waste containing low-level radioactivity). Consideration would be given to recycling or returning the materials to the manufacturers, as appropriate. Lessees would be required to comply fully with applicable 14 U.S. Department of Transportation requirements (Title 49 Code of Federal Regulations [CFR] Parts 100−180). Appropriate agencies (e.g., state, U.S. Fish and Wildlife Service [USFWS]) would be contacted before reclamation activities began to assure that wildlife species that might have taken up residence (e.g., bat or bird species listed as sensitive) would not be adversely affected by permanent shutdown activities. Ecosystem concerns associated with wetland areas would be addressed if a determination was made that wetlands were created as a result of mining operations (DOE, 2014, pp. 2-13 to 2-14).

Conventional milling processes uranium ore that was removed from the earth by either open-pit or underground mining. The ore is crushed and sent through a mill, where extraction processes concentrate the uranium. Sulfuric acid dissolves the soluble components, including 90% to 95% of the uranium, from the ore. The uranium is then separated from the solution, concentrated, and dried to form yellowcake. Waste from this process poses a potential hazard to public health and safety due to its radioactive and chemical content. Conventional milling produces a substantial amount of "mill tailings." The NRC regulates the recovery process and the safe storage and disposal of mill tailings. During operation of conventional mills (and ISR facilities discussed previously), monitoring wells are required to help assure that fluids used to extract uranium do not leave the facility and contaminate groundwater above acceptable levels (NRC, 2020a). A conventional uranium mill is a chemical plant that extracts uranium using the following process (NRC, 2021b):

1) Trucks deliver uranium ore to the mill, where it is crushed into smaller particles before being extracted (or leached). In most cases, H_2SO_4 is the leaching agent, but alkaline solutions can also be used to leach the uranium from the ore. In addition to extracting 90% to 95% of the uranium from the ore, the leaching agent also extracts several other "heavy metal" constituents, including molybdenum, vanadium, selenium, iron, lead, and arsenic.
2) The mill then concentrates the extracted uranium to produce a material, which is called yellowcake because of its yellowish color.
3) Finally, the yellowcake is transported to a uranium conversion facility, where it is processed through the stages of the nuclear fuel cycle to produce fuel for use in nuclear power reactors.

Conventional mills are typically located in areas of low population density, and they process ore from mines within a geographic radius of approximately 160 kilometers (km) (100 miles). Most mills in the United States are in decommissioning or have already been decommissioned. Currently, a majority of the milling of conventionally mined uranium is performed at the White Mesa Mill in Utah (NRC, 2021b).

<u>Regulatory Authority:</u> Although mining operations are regulated by the Bureau of Land Management and the U.S. Department of the Interior on Federal lands, and the individual states on private lands where the mines are located, the NRC regulates conventional milling operations under 10 CFR 40, *Domestic Licensing of Source Material*. As defined in that regulation, uranium milling is any activity that produces byproduct material. Like Section 11e(2) of the Atomic Energy Act, 10 CFR 40 defines byproduct material as "the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content." However, 10 CFR 40 expands upon this definition by adding, "including discrete surface wastes resulting from uranium solution extraction processes." ISR perform uranium milling under this expanded definition (NRC, 2021b).

The heart of the NRC's regulatory definition of uranium milling is the concept of the mill tailings produced by the extraction and concentration of uranium. Mill tailings are the fine-grained, sandy waste byproduct material that remains after the milling process has extracted and concentrated the uranium from the ore. Mill tailings are typically created in slurry form during processing and are then deposited in an impoundment or "mill tailings pile," which must be carefully regulated, monitored, and controlled. These actions are necessary because the mill tailings contain the heavy metal ore constituents, as well as a residual amount of radium, which is produced during the radioactive decay of uranium. The radium, in turn, decays to produce a radioactive gas, known as radon, which may then be released to the environment. Because this radon is a radioactive gas, which may be inhaled and deposited in the respiratory tract, some researchers have suggested that its presence in confined areas (such as mines or homes) may be associated with an increased risk of lung cancer (NRC, 2021b).

ISR versus Milling Comparison. Table 1-1 is meant to provide an overview on the potential types of activities associated with ISR versus conventional milling, which could affect the resources.

Table 1-1. Potential Types of Activities Associated With In-Situ Recovery vs. Conventional Milling

Feature	*In-Situ Recovery Facility*	*Conventional Uranium Mill*
Recovery Method	Chemical process to extract uranium from underground deposits.	Physical and chemical process to extract uranium from mined ore.
Siting/Location	The well field area is located within the ore body. The processing plant is typically in the vicinity of the ore body.	Generally located in the vicinity of the ore body. Mine ore can be trucked from the mine to the mill. The mine can be either a deep underground shaft or a shallow open pit. The NRC does not regulate the mining of ore.
Surface Features	Well field(s) consisting of groundwater injection and extraction wells; header house(s), pipes, processing facility, storage or evaporation pond(s), and deep injection wells for liquid waste	Mill building(s), process tanks, tailings impoundment, and evaporation ponds
Approximate Size	Thousands of acres	Impoundments are limited to 40 acres in size; however, a facility can have multiple impoundments and typically total on the order of hundreds of acres.
Wastes Generated	Liquid waste, which is disposed of in a deep disposal well or through an evaporation system; pipes, pumps, and other process equipment that cannot be decontaminated are sent to an NRC or Agreement State - licensed facility for permanent disposal.	Mill tailings, a sandy material left over from the crushing process, disposed of within an impoundment; pipes, pumps, and other process equipment that cannot be decontaminated
Decommissioning	Restoration of groundwater, decommissioning of injection wells, removal of pipes and processing building	Demolition of mill and site buildings, final cover system installed over tailings pile, groundwater monitoring
Status at End Use	Site released for unrestricted use when cleanup criteria are met	Site permanently transferred to DOE for long-term care; annual inspections performed

Source: (NRC, 2020b)
Key: DOE = Department of Energy; NRC = U.S. Nuclear Regulatory Commission

1.1.3 Potential Facilities

Uranium mining and milling requires various facilities to extract and process the uranium into yellowcake. The type of facilities varies between ISR and conventional mining/milling. The Leidos Team has determined enough capacity exists within existing permitted domestic mining operations, including operating mines, mines on standby, and mines that have been permitted but not constructed. Therefore, construction of an entirely new unpermitted mine is not considered in the Technical Report. Implementation of the Proposed Action could result in expansion of ISR and conventional mining occurring within existing permitted mining sites requiring construction of additional facilities as described below. The Leidos Team does not anticipate any construction related to conventional milling; all milling activities from conventional mining would be performed at the existing White Mesa Mill in Utah.

ISR. A commercial ISR facility consists of underground and surface infrastructure. Underground infrastructure includes injection and production wells drilled to the uranium mineralization zone, monitoring wells drilled to the surrounding ore body aquifer and to the adjacent overlying and underlying aquifers, and possibly deep injection wells to dispose of liquid wastes. ISR facilities in the uranium milling regions of Wyoming West, Wyoming East, Nebraska-South Dakota-Wyoming, and Northwestern New Mexico are commonly exposed to freezing conditions during winter months. Therefore, pipelines to transfer groundwater extracted from the well fields to the uranium processing circuit are buried to avoid freezing and are considered to be part of the underground infrastructure.

ISR facilities also include a surface infrastructure that supports uranium processing. Surface facilities may include a central uranium processing facility, header houses to control flow to and from the well fields, satellite facilities to house ion-exchange columns and reverse osmosis equipment for groundwater restoration, and ancillary buildings that house administrative and support personnel. Surface impoundments, such as solar evaporation ponds, may be constructed to manage liquid effluents from the central processing plant and the groundwater restoration circuit. The surface extent of a full-scale (i.e., commercial) ISR facility includes a central processing facility and supporting surface infrastructure for one or more well fields (sometimes called mine units) and encompasses approximately 2,500 acres (1,000 hectares [ha]) to 16,000 acres (6,475 ha). However, the total amount of land disturbed by such infrastructure and ongoing activities at any one time is much smaller, and only a small area around surface facilities is fenced to limit access. Well fields typically are not enclosed by fencing. For the purposes of the Technical Report analysis, the Leidos Team assumes existing central uranium processing facilities and related surface impoundments would be used; however, new production wells and transfer pipelines to the central uranium processing facility could be required.

Conventional Mining. The following types of infrastructure are typically located at the plant area of a surface mine site (applicable for underground and open-pit mining methods): buildings; other structures; utilities; a service area; a storage area; mine water discharge and treatment ponds; a mine waste-rock pile; and other waste containment areas. These types of infrastructure make up the infrastructure that supports mining operations. This surface area footprint could take up to 25 acres (10 ha), depending on the size of the mine in operation (DOE, 2014, pp. 2-4 to 2-13). Unlike ISR that has an existing central uranium processing facility that would process extracted uranium from existing and new wells, conventional mining would likely require the construction of the above-mentioned facilities at the mining site if existing facilities were not already located at or directly adjacent to the mining site.

1.1.4 Existing NEPA Documentation

The Leidos Team determined the scope of ISR mining and milling activities by reviewing the ISR GEIS (NRC, 2009a). The NRC prepared the ISR GEIS to access the potential environmental impacts associated with the construction, operation, aquifer restoration, and decommissioning of ISR uranium recovery facilities. The NRC developed the ISR GEIS using (1) knowledge gained during the past 30 years licensing and regulating ISR facilities, (2) the active participation of the State of Wyoming Department of Environmental Quality as a cooperating agency, and (3) public comments received during the preparation of the ISR GEIS. The NRC's licensing experience indicates that the technology used for ISR uranium recovery is relatively standardized throughout the industry and therefore appropriate for a programmatic evaluation in a GEIS. The ISR GEIS determined which impacts would be essentially the same for all ISR facilities and which ones would result in varying levels of impacts for different facilities, thus requiring further site-specific information to determine the potential impacts. As such, the ISR GEIS provides the Leidos Team with a starting point for ISR uranium recovery NEPA analysis to determine the region of influence (ROI) and scope for resources under consideration for detailed analysis within the Technical Report related to uranium mining and the Proposed Action. The Technical Report incorporates by reference information and analysis contained in the 2009 ISR GEIS and focuses on new information related to regulatory changes or changes to environmental conditions since publication of the 2009 ISR GEIS. The ISR process includes on-site processing to yellowcake.

The Leidos Team also reviewed the Final Uranium Leasing Program Programmatic Environmental Impact Statement (DOE/EIS-0472) (referred to as the "ULP PEIS") in determining the scope for conventional mining activities, which considers environmental impacts from conventional (underground) mine development in western Colorado (Mesa, Montrose, and San Miguel Counties) (DOE, 2014). The Uranium Leasing Program (ULP) contributes to the development of a supply of domestic uranium consistent with the provisions of the Atomic Energy Act and Energy Policy Action of 2005, which has commitments to decrease the United States' dependence on foreign energy supplies. Although Section 2001 of the Energy Act of 2020 (42 United States Code [U.S.C.] 16281) states the Secretary of Energy "shall consider options for acquiring or providing HALEU…that does not require extraction of uranium or development of uranium from lands managed by the Federal government, cause harm to the natural or cultural resources of Tribal communities or sovereign Native Nations, or result in degraded ground[water] or surface water quality on publicly managed or privately owned lands" (42 U.S.C. 16281: Advanced nuclear fuel availability (house.gov), the Leidos Team is using the ULP PEIS as a reference to gauge the type and magnitude of impacts and mitigations that could be expected if the Proposed Action and post-Proposed Action activities were to be supported through conventional mining on private lands. The analyses in this Technical Report focuses on impacts estimated for Alternative 4 in the ULP PEIS, which evaluated continued operation of 18 underground mines and one large open-pit mine in the project region for at least the next 10 years.

Regarding milling of conventionally mined uranium, the Leidos Team reviewed the Environmental Assessment for Renewal of Source Material License No. SUA-1358 for the White Mesa Uranium Mill in San Juan County, Utah, because that facility is currently used for milling conventionally mined uranium from Colorado (NRC, 1997a).

In addition to the ISR GEIS (NRC, 2009a), the ULP PEIS (DOE, 2014), and the White Mesa EA (NRC, 1997a), the Leidos Team also reviewed the following site-specific NEPA analyses for conventional mines and ISR facilities for resource conditions and impact considerations:

- *Draft Environmental Impact Statement for the La Jara Mesa Mine Project* (USDA, 2012)
- *Draft Environmental Impact Statement for Roca Honda Mine Sections 9, 10 and 16, Township 13 North, Range 8 West, New Mexico Principal Meridian, Cibola National Forest, McKinley and Cibola Counties, New Mexico* (USDA, 2013)
- *Environmental Impact Statement for the Moore Ranch ISR Project In Campbell County, Wyoming: Supplement to the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities — Final Report, NUREG-1910 Supplement 1* (NRC, 2010)

- *Environmental Impact Statement for the Nichols Ranch ISR Project in Campbell and Johnson Counties, Wyoming: Supplement to the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities — Final Report, NUREG-1910 Supplement 2* (NRC, 2011a)
- *Environmental Impact Statement for the Lost Creek ISR Project in Sweetwater County, Wyoming: Supplement to the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities — Final Report, NUREG-1910 Supplement 3* (NRC, 2011b)
- *Environmental Impact Statement for the Dewey-Burdock Project in Custer and Fall River Counties, South Dakota: Supplement to the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities – Final Report, NUREG-1910 Supplement 4* (NRC, 2014a)
- *Environmental Impact Statement for the Ross ISR Project in Crook County, Wyoming: Supplement to the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities — Final Report, NUREG-1910 Supplement 5* (NRC, 2014b)
- *Environmental Impact Statement for the Reno Creek In Situ Recovery Project in Campbell County, Wyoming: Supplement to the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities, Final Report, NUREG-1910 Supplement 6* (NRC, 2016)

A full list of documents considered within this section can be found in Section 10, *References*.

1.2 Approach to NEPA Analyses

This Technical Report incorporates by reference resource conditions and impact considerations of the primary existing NEPA documentation sources discussed previously, as well as other online/available sources including site-specific NEPA documentation (where available), and Federal and state databases. The analysis also considers information provided by Federal and state regulatory authorities, Tribes, stakeholders, and other interested parties during the scoping period. Existing permitted ISR mining occurs primarily in the following locations (also see Figure 1-3):

- Northwest Nebraska (Dawes County)
- Northwest New Mexico (McKinley County)
- Southwest South Dakota (Fall River and Custer Counties)
- South Texas (Karnes, Bee, Goliad, Brooks, and Duval Counties)
- Eastern Wyoming (Campbell, Crook, and Johnson Counties)
- Southwestern Wyoming (Sweetwater County)

Existing permitted conventional mining occurs primarily in the following locations:

- Northwest Arizona (Mojave and Coconino Counties)
- Northwest New Mexico (McKinley and Cibola Counties)
- Southwest Colorado (Montrose and San Miguel Counties)
- Southeast Utah (San Juan and Garfield Counties)

Existing milling facilities (for processing conventionally mined uranium) are located in South-Central Utah (Garfield and San Juan Counties) and Southwestern Wyoming (Sweetwater County). White Mesa in Garfield County, Utah, is the only mill currently in operation.

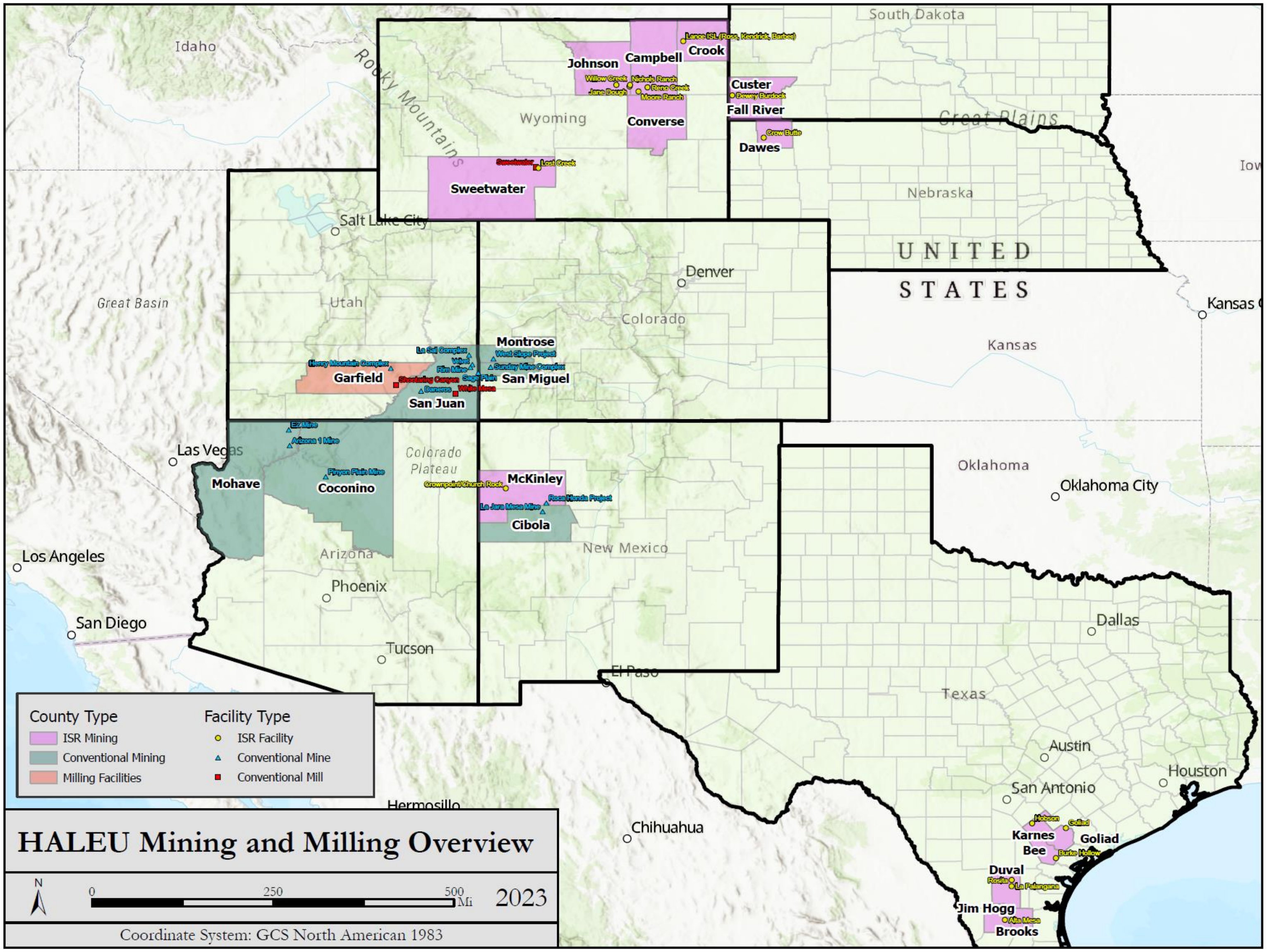


Figure 1-3. Possible HALEU Mining and Milling Locations

The intent of this Technical Report is to provide a summary of potential impacts that could occur at existing permitted mines4 and mills, using existing NEPA documentation and other available sources. Private industry, along with NRC or Agreement State approvals, would determine the actual mining techniques employed and site-specific NEPA evaluation would be required for changes to existing permitted mining operations.

1.3 Affected Environment and Environmental Consequences

The following outlines the approach in characterizing the *affected environment* for mining and milling within the Technical Report:

- The Leidos Team reviewed existing NEPA documentation to incorporate by reference (as applicable) resources affected by mining and milling operations in their respective regions. The Leidos Team also considered relevant Federal and state regulations and permits related to mining exploration, development and operations, and those related to milling operations.

The following outlines the approach in characterizing the *environmental consequences* for mining and milling within the Technical Report:

- The Leidos Team reviewed existing NEPA documentation to incorporate by reference (as applicable) and summarize impacts of mining and milling on resources previously documented within existing NEPA documentation. This included the following:
  - A review of the intensity and type of impacts by ISR, conventional mining and milling activities
  - Consideration of any permitting and regulatory requirements, best management practices (BMPs), and standard operating procedures that serve to minimize or avoid adverse impacts on resources

1.3.1 Land Use

The following section discusses potential land use impacts from uranium mining and milling activities that would support the Proposed Action described in Section 1.1, *Description of the Activity*. The analysis of potential impacts relies on analyses from previous NEPA documents that assessed the impacts from construction and operation of licensed/permitted uranium mining and milling facilities. In general, mining locations are within relatively rural and undeveloped areas away from population centers. Land use restrictions and permitting processes related to mining can vary by state- and local-level approvals. Some communities such as the Navajo Nation have banned uranium mining from within their lands and Federal trust lands.

ISR Mining

ISR mining is currently the predominant uranium mining technology in the United States (EIA, 2023). Implementation of the Proposed Action is likely to stimulate demand in uranium and cause industry to develop new mines or restart existing mines. The impact analysis for an ISR facility relies largely on analyses presented in the ISR GEIS (NRC, 2009a). A majority of the ISR mining sites occur in rural, agriculturally dominated and undeveloped locations. A commercial ISR facility, in its full scale, includes a central processing facility as well as supporting surface infrastructure for one or more well fields, sometimes referred to as mine units. The surface area these facilities cover generally ranges from about

[4] Existing permitted mines, includes mines that have NEPA documentation and are permitted, but not yet constructed.

2,500 to 16,000 acres (1,000 to 6,000 ha) (NRC, 1997b) (see Section 2.11 of the ISR GEIS). Despite this, the actual amount of land disturbed by such infrastructure and the ongoing activities is considerably smaller. Only a minor area surrounding surface facilities is usually fenced off to restrict access. Typically, well fields are not enclosed by fencing.

The ISR GEIS analyzed the impacts of construction, operation, aquifer restoration, and decommissioning of ISR facilities for uranium mining in the Nebraska-South Dakota-Wyoming Uranium Milling Region. Expansion of existing operations into undeveloped locations permitted for mining is expected to have similar impacts as those analyzed in the ISR GEIS. Construction can lead to land use impacts including changes and disturbances in land use, restriction of access, impact on mineral rights, restriction of livestock grazing areas, alteration of ecological, cultural, and historical resources, and restriction of recreational activities. ISR mining activities in privately owned lands could result in potential impacts that would need to be resolved through arrangements such as leases, mineral rights sales, and royalties with individual landowners (NRC, 2009a, pp. 4.4-1). Due to the small amount of land disturbance that would be associated with construction of existing permitted mining areas, and based on the impact analysis provided in the ISR GEIS, the overall effect on land use due to the Proposed Action would be SMALL.

Operation impacts of ISR facilities would have similar impacts to those observed during the construction phase. During operation, the primary changes to land use would be the sequential development of well fields from one area of the site to another. As one well field finishes uranium recovery activities, it could be restored and reopened for grazing or recreation, while a new well field is developed elsewhere (NRC, 2009a, pp. 4.4-1). The overall potential impacts on land use from operational activities are expected to be SMALL, as they would occur within existing permitted mines.

Impacts during aquifer restoration would be similar to those seen during the construction and operational phases. As fewer wells and pump houses are used and equipment traffic and use diminish, land use impacts from aquifer restoration would decrease (NRC, 2009a, pp. 4.4-2). Thus, the overall potential impacts on land use during the aquifer restoration phase are comparable to those of the operations phase and are expected to be SMALL.

Decommissioning impacts on land use would be similar to those described for the construction, operations, and aquifer restoration phases, but with a temporary increase in activity intensity due to the increased use of earth- and material-moving equipment and other heavy equipment (NRC, 2009a, pp. 4.4-2). As decommissioning and reclamation proceed, the amount of actively disturbed land would decrease, and the overall potential impacts on land use during the decommissioning phase would range from SMALL to MODERATE.

Conventional Mining

The impact analysis for conventional mining relies on analyses presented in the ULP PEIS (DOE, 2014). A majority of the conventional mining sites occur in rural, agriculturally dominated and undeveloped locations. A minimal amount of vegetation might be cleared to establish a drilling location for exploratory purposes, which would convert land cover to use for uranium recovery. If roads need to be constructed or upgraded, more vegetation may be cleared, converting land cover to developed area. However, the impact from construction is expected to be limited due to the small size of the typical drilling location and the limited width of exploratory roads. Small modifications to agriculturally dominated and undeveloped locations would not likely impact surrounding areas.

The development of both underground and open-pit mines would require clearing of vegetation, large rocks, and other objects, which would necessitate a change in land cover. Some minor construction of new access roads and/or upgrading of existing roads might be required during mine development, which would further change land cover to developed areas. Road development would depend on the routes selected, as well as the widths, lengths, and surface treatments of the roads. During mine operations, roads would need to be maintained, which could involve additional land cover change. Construction and operation would occur on approximately 50% of a site's area (DOE, 2014, pp. 2-15). However, given the rural nature of most conventional mining sites and the abundant opportunities for agricultural and recreational activities in the regions, conflicts arising from land use are considered minor (SMALL).

Conventional Milling

The White Mesa Uranium Mill located in San Juan County in Utah is currently the only operating mill in the United States. The White Mesa facility neighbors Ute Mountain Ute Tribe's White Mesa community and is located 6 miles south of the city of Blanding (NRC, 1997a, p. 5; Groetzinger, 2020). The project site consists of 1,971 ha (4,871 acres) of private land together with mill site claims. The mill site itself occupies approximately 20 ha (50 acres) and the tailings disposal cells another 182 ha (450 acres) (NRC, 1997a, p. 5). Tailings ponds cover almost 300 acres of the facility (Groetzinger, 2020). The Shootaring Canyon Mill in Utah and Sweetwater Uranium Mill in Wyoming are fully permitted and licensed by the NRC but are on standby and care and maintenance operations (EIA, 2023). The impacts for license renewal and continued operation of the White Mesa Uranium Mill and Sweetwater Uranium Mill were evaluated in the *Environmental Assessment for Renewal of Source Material License No. SUA-1358, White Mesa Uranium Mill* (NRC, 1997a) and the *Environmental Assessment for the Proposed Renewal of SUA-1350 Sweetwater Uranium Project in Sweetwater County, Wyoming* (NRC, 2018), respectively. Operations would occur within the existing facility. No additional construction activities associated with continued operation other than the potential construction of new lined tailings impoundments, which would trigger a license review and require its own environmental analysis, would be expected (NRC, 2018). Project area land use at all three mill sites have been previously impacted through change of ownership and continued possession of byproduct material in the form of uranium waste tailings and other uranium byproduct waste generated by milling operations (NRC, 1997a, pp. 1, 4). As a result, impacts on land use in these areas would be considered SMALL due to the already disturbed nature of the sites.

1.3.2 Visual and Scenic Resources

The following section discusses potential visual and scenic resources impacts from uranium mining and milling activities that would support the Proposed Action described in Section 1.1, *Description of the Activity*. The analysis of impacts relies on analyses from previous NEPA documents that assessed the impacts from construction and operation of licensed/permitted uranium mining and milling facilities. In general, aesthetics vary drastically from site to site and impacts vary based on site-specific conditions with respect to the mining technique and its impacts on the surrounding area's landscape and viewshed.

ISR Mining

Impacts on visual and scenic resources from the construction, operation, aquifer restoration, and decommissioning phases of ISR mining facilities have been previously analyzed in the ISR GEIS (NRC, 2009a). General impacts from this report from construction, operation, aquifer restoration, and decommissioning activities are considered SMALL. The impacts of expansion of ISR facilities would likely be similar to the impacts described in the ISR GEIS; however, the magnitude of impacts depends on site-specific conditions.

Impacts on visual and scenic resources from mining and milling activities in support of the Proposed Action could primarily occur during construction and well field development, where vertical drilling rig masts contrast with the existing topography. Other sources of impact could include the dust generated during clearing for construction and the potential visibility of lighted drill rigs during nighttime operations. These visual impacts are usually temporary and considered SMALL. However, the impacts could be more pronounced in rural, previously undeveloped areas where the baseline visual landscape is less disturbed. Vegetation clearing and introduction of drilling rigs and roads could result in visual contrast with the baseline landscape. Mine expansion and associated road development could also introduce visual contrasts. However, ISR mining is proposed to occur at existing permitted mines on private lands. As such, impacts on visual and scenic resources would be considered SMALL to MODERATE, dependent on the site location.

During operations, the primary source of visual contrast would be the network of pipes, wells, power lines, and the structures associated with the well field operation. Figure 1-4 shows the Butte Crowe ISR facilities in Nebraska as an example of well drilling contrast against the landscape. Centralized processing plants and other facilities may also impact the visual landscape, but the extent of this impact will vary based on location, intervening topography, distance, and lighting. The impact is expected to be greater for facilities in rural, previously undeveloped areas, but overall, the visual impact of an operating well field is deemed SMALL.

Source: (Power, 2017)

Figure 1-4. Example ISR Uranium Mining Facility in a Rural Setting

Visual impacts during aquifer restoration are expected to be similar to or less than those during the operational period. The equipment used in plugging and abandoning production and injection wells could create visual contrast. However, since no active drilling takes place during this phase, the visual impacts are anticipated to be temporary, and less than those present during construction.

During decommissioning, all facilities are removed, and the landscape is restored, minimizing permanent impacts on visual resources. Activities such as dismantling buildings and milling equipment, removing contaminated soils, and grading the surface may cause temporary visual contrasts. However, the visual impacts are expected to be SMALL and temporary; once decommissioning and reclamation activities are complete, the visual landscape should return to its baseline state. For all phases, mitigation strategies like dust suppression and coloration of well covers would reduce the overall visual and scenic impacts, and the total impacts are considered SMALL. The excerpt suggests that the greatest visual/scenic impacts would occur for facilities located near sensitive viewsheds, especially those in rural, previously undeveloped areas.

Conventional Mining

The impacts analysis for conventional mining relies on analyses presented in the ULP PEIS (DOE, 2014). A minimal amount of vegetation might be cleared to establish a drilling location, which may expose bare soil and create a change in the color of the ground surface. If roads need to be constructed or upgraded, more vegetation may be cleared, possibly introducing visual contrasts. However, the impact is expected to be limited due to the small size of the typical drilling location and the limited width of exploratory roads. Exploratory drill rigs, typically 11 m (35 feet) tall, would be used for drilling. These rigs could be visible from within the mines and from surrounding lands, potentially causing visual contrast. If road upgrading or new construction was necessary, it could introduce visual contrasts due to changes in form, line, color, and texture. Improper road maintenance could potentially lead to invasive species growth or erosion, which could further introduce visible contrasts. Workers, personal and commercial vehicles, and construction equipment could be visible from surrounding areas. Worker activities could result in visible dust, depending on site and weather conditions. If proper site sanitation practices are not followed, litter could also be visible.

The development of both underground and open-pit mines would require clearing of vegetation, large rocks, and other objects. The removal of vegetation would result in contrasts in color, texture, form, and line, as the varied colors and textures of the vegetation would be replaced by the more uniform color and texture of bare soil. Some minor construction of new access roads and/or upgrading of existing roads might be required during mine development, potentially introducing strong visual contrasts to the landscape. Road development would depend on the routes selected, as well as the widths, lengths, and surface treatments of the roads. During mine operations, roads would need to be maintained, which could involve additional vegetation or ground clearance, grading, or removal of overgrowth. Support facility construction including waste storage areas could introduce contrasts in form, line, color, and texture. Some outdoor lighting might be necessary for security and safety around the mines, including around temporary facilities like construction trailers, parking, and work areas. During mine operations, exterior lighting might be needed around structures, parking locations, and work areas.

Impact minimization measures described in the ULP PEIS could be implemented to minimize visual contrasts with the land surrounding the mining areas, and to minimize light pollution. For instance, lighting could be designed to provide the minimum illumination required and could be turned off when not required. New structures, if required, could be designed to blend in with the surrounding environment, both in color and in material, although it is anticipated that existing structures would be utilized, where possible. With implementation of appropriate impact minimization measures, use of existing, permitted conventional mines would be expected to result in SMALL impacts on visual and scenic resources.

Conventional Milling

The White Mesa Uranium Mill in Utah is currently the only operating mill in the United States. The Shootaring Canyon Mill in Utah and Sweetwater Uranium Mill in Wyoming are fully permitted and licensed by the NRC but are on standby, with only care and maintenance operations occurring at present (EIA, 2023). The White Mesa Mill is located within a flat landscape. The impacts for license renewal and continued operation of the White Mesa Uranium Mill were evaluated in the 1997 White Mesa EA (NRC, 1997a), although impacts on visual and scenic resources were not assessed.

Under the Proposed Action, operations at the White Mesa Mill would continue in support of HALEU production. No additional construction activities would be required, other than the potential construction of new lined tailings impoundments, the construction of which would trigger a license review and require its own independent environmental analysis. The viewshed and scenic landscape at and surrounding the White Mesa Uranium Mill have been previously impacted by the initial construction of the mill (operations began in 1980), through the introduction of mill buildings and tailings cells, as well as fugitive dust emissions (NRC, 1997a, p. 14). Continued operations of the mill in support of HALEU production would not be expected to further degrade the existing viewshed or contribute additional contrasts to the existing landscape. As a result, impacts on visual and scenic resources associated with HALEU production are considered to be SMALL. The licensed capacity of the White Mesa Mill is enough to process 4,380 MT of yellowcake per year (Utah DEQ, 2018), which is over three times the amount of yellowcake required to supply the Proposed Action.

1.3.3 Geology and Soils

The following section discusses potential geology and soil impacts from uranium mining and milling activities that would support the Proposed Action described in Section 1.1, *Description of the Activity*. The analysis of impacts relies on analyses from previous NEPA documents that assessed the impacts of construction and operation of licensed/permitted uranium mining and milling facilities.

ISR Mining

Impacts on geology and soils from the construction, operation, aquifer restoration, and decommissioning phases of ISR mining facilities have been previously analyzed in the ISR GEIS (NRC, 2009a) and were found to be SMALL.

Construction impacts include disturbance, compaction, and mixing of soils from earth-moving activities such as excavation, drilling, and grading. These impacts would potentially result in increased wind and water erosion potential, changes in infiltration rates and water retention capacity, and loss of fertility. These impacts are considered temporary, local, and can be mitigated through proper BMPs such as minimizing land disturbance, use of sediment and erosion-control measures, and implementing a spill prevention plan. A list of potential BMPs can be found in Table 6-1 of the 2016 *Environmental Impact Statement for the Reno Creek In Situ Recovery Project in Campbell County, Wyoming: Supplement to the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities, Final Report* (NRC, 2016) (referred to as the "ISR GEIS 2016 Supplement"). Decommissioning activities would recontour and reseed disturbed sites, which would also mitigate construction impacts. No additional impacts on geology are expected during construction because the majority of construction impacts would occur in shallow soils.

Impacts on soils from operation of the facility and aquifer restoration would be similar as both would utilize the same infrastructure and would not generally require new construction. Impacts would primarily result from leaks, spills, or wastewater discharge. Injection and extraction of water and lixiviant solution into the geology will result in a change in the composition and could theoretically pressurize or depressurize the target formations. However, no rock matrix or structure is removed from the formation, uranium-producing sandstone is typically highly transmissive to groundwater, and target formations are typically thin and deep, thus these changes to geology are unlikely to cause surface subsidence or induce earthquakes. However, site-specific characteristics would need to be evaluated as these could vary. Proper soil and groundwater monitoring, BMPs, and decommissioning procedures including aquifer restoration activities and cleanup of contaminated sites would mitigate the impacts on geology and soils.

Decommissioning activities would attempt to restore the site to pre-production conditions and would have impacts on geology and soils that would be similar but smaller in magnitude to construction impacts. Activities such as building demolition, earth moving, excavation, and grading would be similar in scale to construction activities but is typically for a much shorter duration (NRC, 2009a).

Sites with a higher erosion potential or sensitive geology may require additional review or other BMPs to limit impacts. Overall, impacts on geology and soils, considering all BMPs and decommissioning procedures are followed, would likely be SMALL.

Conventional Mining

Impacts on geology and soils from uranium exploration were analyzed in the ULP PEIS (DOE, 2014). The ULP PEIS evaluated multiple options for managing uranium mining in the Colorado West Slope Region including lease termination and program continuation, which would lead to continued exploration, mine development, and operations. Exploration generally covers a very small area and involves little to no ground disturbance. Impacts on soils from exploration would be dependent on-site characteristics but are generally small, local, and limited.

Construction activities generally include building of access roads, slope stabilization, grading, vegetation removal, exploratory drilling, and other site preparation activities. Impacts on soils would include compaction, mixing, potential for increased soil and wind erosion, and changes to physical and chemical properties of the soil that may impact water holding capacity, infiltration rates, and productivity. Generally, no impacts on geology would occur since most construction activities would be conducted in shallow soils. Impacts on geology and soils from exploration are typically SMALL and could be mitigated through following of BMPs such as implementing a spill prevention plan, use of erosion and sedimentation control, and proper reclamation activities after the end of the exploration phase.

Impacts on geology and soils from mine construction and operation would be highly site dependent largely based on the type, size, and local characteristics of the mine. For example, shallow shaft mines like the Canyon mine (NRC, 1986) would have much smaller impacts on geology and soils than a room and pillar or open-pit mine due to the size of the staging area, which is largely dependent on amount of topsoil and overburden to be removed and stockpiled. Nearby sensitive geology can also be a factor in how geological formations are impacted. The La Jara Mesa mine, which is constructed in a hillside requires BMPS such as soil stabilization, buttressing, and others to prevent impacts on soils that could cause shaft collapse or landslides (USDA, 2012). Construction of a new mine would include grading, excavation, construction of buildings, service areas, utilities, storage areas, support structures, and roads. Impacts on soils would include compaction, mixing, potential for increased soil and wind erosion, and changes to physical and chemical properties of the soil that may impact water holding capacity, infiltration rates, and productivity. Generally, no impacts on geology would occur during the construction and staging phase since most activities will occur in shallow soils and would not disturb the geological formation.

The impacts on geology and soils from mine construction and operation are variable. Some mines may be small and have very little impact, while others may have much more prominent and lasting impacts. There are a number of existing fully permitted uranium mines in the United States that are on standby due to uranium prices. Impacts from construction activities at these sites would likely be similar and smaller in magnitude since the land is already disturbed. Mine operation consists of removing and stockpiling topsoil and overburden from the mine. Impacts on geology would be more significant during this phase, but variable as larger amounts of rock removed from the geological formation would be more likely to cause permanent changes to the geological formation and could potentially lead to collapse, surface subsidence, or induce earthquakes. Impacts on geology and soils could be mitigated during construction and operation of the mine by following BMPs such as those listed in Table 4.6-1 of the 2014 ULP PEIS and following proper mine decommissioning and reclamation procedures. The general impacts on geology and soils from conventional mine development and operation range from SMALL to MODERATE.

Reclamation activities would attempt to restore the site to pre-production conditions and would have impacts on geology and soils that would be similar but smaller in magnitude to construction impacts. Activities such as building demolition, earth moving, excavation, backfilling of the mine, and grading would be similar in scale to construction activities but is typically for a much shorter duration. Reseeding of the site to establish a root zone to prevent erosion would require spreading of productive soils at the site. Topsoil removed from the mine site during operation is typically stockpiled for reuse during the reclamation phase; however, this soil can become contaminated or erode from wind and water. Productive soils and mine backfill from off-site locations could be borrowed for reseeding efforts, which could result in SMALL impacts on nearby sites. Generally, reclamation efforts mitigate the impacts of mine development operations and impacts on geology and soils are considered SMALL.

Conventional Milling

The White Mesa Uranium Mill in Utah is currently the only operating mill in the United States. The Shootaring Canyon Mill in Utah and Sweetwater Uranium Mill in Wyoming are fully permitted and licensed by the NRC but are on standby and care and maintenance operations (EIA, 2023). The impacts for license renewal and continued operation of the White Mesa Uranium Mill and Sweetwater Uranium Mill were evaluated in the 1997 White Mesa Environmental Assessment (EA) and 2018 Sweetwater EA, respectively. No additional construction activities associated with continued operation other than the potential construction of new lined tailings impoundments would be expected, which would trigger an NRC license review and would require additional environmental analysis (NRC, 2018). Geology and soil resources at all three mill sites have been impacted through contraction of mill buildings and tailings cells (NRC, 1997a, p. 14). Impacts of the disposal of mill waste and contaminated soils was evaluated in a 2023 NRC EIS (NUREG-2243) from a former mill site at Church Rock, New Mexico, the *Environmental Impact Statement for the Disposal of Mine Waste at the United Nuclear Corporation Mill Site in McKinley County, New Mexico* (NRC, 2023a). No major construction or changes in operations are expected to occur as a result of the implementation of the Proposed Action, with the exception of potential new tailings impoundments, which would require its own NEPA review. As a result, impacts on geology and soils are considered SMALL.

The licensed capacity of the White Mesa Mill is enough to produce 3,630 MT of yellowcake per year, which is more than the amount of the 2,500 MT/yr of yellowcake required to supply the Proposed Action, associated with one enrichment contract totaling 145 MT of HALEU. The Sweetwater Mill is licensed to produce 2,050 MT/yr and the Shootaring Canyon Mill is licensed to produce 273 MT/yr.

1.3.4 Water Resources

The following section discusses potential water resource impacts from uranium mining and milling activities that would support the Proposed Action described in Section 1.1, *Description of the Activity*. The analysis of impacts relies on analyses from previous NEPA documents that assessed the impacts of construction and operation of licensed/permitted uranium mining and milling facilities. In general, mining locations are located within relatively rural and undeveloped areas. General water uses in these rural areas include potable water, irrigation, livestock, industry, recreation, aquatic wildlife, and aesthetics/scenic value. Water quality and impairment type vary greatly by region, with presence of arsenic and *E. coli* impacting surface waterbodies in northwest Nebraska, elevated concentrations of ammonia-nitrogen and selenium affecting waterbody uses in northwest Arizona, and presence of bacteria and impaired fish and microbenthic communities reported in south Texas, for example (NDEQ, 2019; NDEE, 2021; ADEQ, 2023; TCEQ, 2022).

Section 303(d) of the Clean Water Act (CWA), as amended, requires states to develop lists of waterbodies failing to meet water quality standards and to submit updated lists to EPA every 2 years, along with the Integrated Report on water quality conditions that is required in Section 305(b) of the CWA. States are responsible for producing Section 303(d) lists, which includes all waterbody segments that are failing to meet the water quality parameters necessary to maintain their beneficial uses. In compliance with Section 303(d) of the CWA, the 303(d) list is used to establish a list of water-quality-limited segments that require Total Maximum Daily Loads, which are a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards (EPA, 2022).

ISR Mining

The Technical Report considers existing permitted and operational mining locations in the United States. For ISR mining, this includes locations in northwest Nebraska, northwest New Mexico, southwest South Dakota, south Texas, eastern Wyoming, and southwestern Wyoming, as discussed above. The water resources analysis for ISR mining relies on analyses presented in the ISR GEIS. The 2009 ISR GEIS (NRC, 2009a) analyzed impacts on water resources likely to result from ISR mining within a broad study area that included areas analyzed in the Technical Report. It is anticipated that impacts in those areas not previously analyzed in the ISR GEIS would be similar in type and intensity. Site-specific NEPA would be required for substantial changes to existing permitted mining operations or construction and operation of new mines.

Section 4.5.4.1 of the 2009 ISR GEIS (NRC, 2009a) presents impacts on surface water resources and concludes that impacts resulting from the construction and operation of ISR mines and subsequent aquifer restoration would be SMALL. Impacts on groundwater resources are presented in Section 4.5.4.2. Expected impacts from construction of ISR mines and subsequent aquifer restoration were SMALL. Impacts from mining operations to deep aquifers were considered or SMALL, but operational impacts on shallow aquifers were considered SMALL to LARGE, depending on site-specific conditions (NRC, 2009a, pp. 4.5-9 to 4.5-19).

For the purposes of the Technical Report analysis, the Leidos Team assumes that existing central processing facilities and related surface impoundments would be used, although new production wells and transfer pipelines could be required. Construction and operation impacts on surface waters identified in the 2009 ISR GEIS that are relevant to this project include temporary water quality degradation associated with wastewater effluents and short-term increases in runoff during ground-disturbing activities. Ground disturbance may occur during construction of new access roads and installation of new well pads and pipelines. Wastewater produced during construction and operation would be treated prior to discharge, subject to permitting requirements. Likewise, stormwater discharges resulting from construction and operation would be controlled by Federal and state permit conditions, as applicable, effectively minimizing the potential for surface water contamination (NRC, 2009a, pp. 4.2-15 to 4.2-16).

Short-term impacts on surface waters could also result from the increased risk of contaminant leaks and spills during both construction and operation. The increase in vehicle traffic, equipment, and activity during on-site construction creates an increased risk of leaks or spills of oil, lubricant, and other contaminants. The potential for impact would be minimized in both instances with the implementation of spill prevention plans and spill response procedures (NRC, 2009a, pp. 4.2-15 to 4.2-16).

Surface water impacts associated with aquifer restoration are similar to those just described. Wastewater associated with aquifer restoration may be disposed of in a variety of ways, including land application of treated wastewater, discharge to solar evaporation ponds, and discharge to surface waters. Although land application requires treatment of wastewater, it is possible that some contaminants would remain after treatment, which have the potential to wash off the land into nearby surface waters. Failure of an evaporation pond embankment could likewise result in contamination of nearby waters. Direct discharge to surface water would require permitting, which would likely include monitoring requirements. Management of brine reject, a process waste from the reverse osmosis system, may additionally be impactful to nearby surface waters (NRC, 2009a, pp. 4.2-18 to 4.2-20). Due to adherence to necessary permitting requirements and the implementation of BMPs designed to retain and treat waste and stormwater, impacts on surface waters resulting from ISR mining are expected to be SMALL.

As discussed above, ISR mining involves drilling wells into rock formations known to contain uranium ore, and injecting lixiviant into the wells to dissolve the uranium into groundwater, which is then pumped out of the formation so the uranium can be extracted. Potential impacts on groundwater may result from consumptive groundwater use (used during construction for dust suppression, mixing cements, and drilling support), the introduction of drilling fluids and muds during well drilling, the risk of fuel, lubricant, or similar contaminant leaks or spills, and management of wastewater. It can be assumed that the amount of groundwater required for consumptive use and the amount of drilling fluids and muds introduced to groundwater would result in SMALL impacts. Wastewater and the risk of contaminant leaks and spills would be managed as described above. Brine slurries resulting from reverse osmosis during aquifer restoration have the potential to impact groundwater when disposed of by deep well injection, potentially altering water quality and consequently, water supplies for nearby users. Aquifer restoration activities would also mitigate impacts on groundwater quality by returning concentrations to baseline conditions. Underground injection requires a permit from EPA. Adherence to permit conditions would mitigate potential impacts from deep well injection (NRC, 2009a, pp. 4.2-19).

In general, ISR mining operations extract slightly more groundwater than is reintroduced to the uranium-bearing formation after processing is completed to extract dissolved uranium. This slight decrease in groundwater may affect groundwater supplies in the region and may also result in a depletion of flow in nearby surface water resources if the uranium-bearing aquifer is hydraulically connected to such features. However, it is anticipated that ISR mining will occur in areas where there are weak connections between surface water and groundwater, as permitting difficulties arise in the event of a strong hydraulic connection. Therefore, any effects of net extraction during operations and aquifer restoration would be expected to be SMALL (NRC, 2009a, pp. 4.2-17 to 4.2-18).

The ISR mine includes a network of underground pipelines transporting lixiviant to and from the uranium-bearing formation. A leak or spill of lixiviant could result in MODERATE to LARGE impacts if the affected groundwater table is located close to the ground surface, is an important source of water for local domestic or agricultural uses or is hydraulically connected to other important aquifers. Supplemental NEPA analysis conducted in support of the construction and operation of specific mines within the general, permitted areas discussed in the 2009 ISR GEIS determined that in most regions, groundwater impacts resulting from the operation of ISR mines would be SMALL to MODERATE; however, existing mines in Crook, Sweetwater, Campbell, and Johnson Counties, Wyoming, were determined to meet the conditions outlined above, in which LARGE impacts on groundwater would be possible (NRC, 2010; NRC, 2011a; NRC, 2011b; NRC, 2014b; NRC, 2016). To minimize the potential for such an impact, pipelines would be monitored frequently to quickly detect and prevent leaks or spills. Additionally, spill response and cleanup procedures would be in place to mitigate an impact in the event that a leak or spill does occur (NRC, 2009a, pp. 4.2-19 to 4.2-20).

Conventional Mining

The Technical Report considers existing permitted and operational mining locations in the United States. For conventional mining, this includes locations in northwest Arizona, southwest Colorado, and southeast Utah, as discussed above. The water resources analysis for conventional mining relies on analyses presented in the Final ULP PEIS (DOE, 2014).

The first phase in conventional mining is exploration, as detailed in the above sections. Groundwater may be affected by the drilling of exploration boreholes and wells in the event that drilling muds and O_2 enter the aquifers, potentially altering water chemistry, pH, and solubility conditions, or in the event that drilling unintentionally provides a connection between previously disconnected aquifers, allowing water of differing qualities to mix (DOE, 2014, pp. 4-82).

Surface waters are most likely to be impacted by short-term increases in erosion resulting from temporary ground disturbance. To facilitate exploratory drilling, temporary access roads are typically installed, which may result in increased erosion due to grading, if grading is required to provide level, safe transport of drilling equipment and personnel. Other land-disturbing activities that may occur during the exploration phase include vegetation clearing, drilling, and the installation of drill pads. While increased erosion has the potential to temporarily decrease the quality of nearby surface waters, these activities would be temporary in nature and occur within relatively small areas (DOE, 2014, pp. 2-3 to 2-4, 4-82).

Potential impacts on water resources resulting from ground disturbance would be prevented or minimized through the implementation of BMPs appropriate for the site location and constraints. For example, excavated surface soil material would be stockpiled in a secure location designed to prevent runoff. Temporary access roads may not be removed immediately following exploration activities if it is anticipated that further exploration will be needed at a specific site; however, when reclamation does occur, exposed soil surfaces will be appropriately revegetated to prevent continued erosion (DOE, 2014, pp. 2-3 to 2-4).

During mine development and operations, water resources may be adversely affected by erosion resulting from ground-disturbing activities, mine water runoff, the staging of ore and waste rock, the potential alteration of shallow aquifers, and the associated mixing of groundwater sources varying in chemical composition. Water resources are also vulnerable to increased potential for leaks and spills of gasoline, solvents, and other chemical contaminants, consumptive water use, and wastewater generation. The potential implications of these activities are discussed in more detail in the 2014 ULP PEIS, with specific examples relevant to water features in southwestern Colorado (DOE, 2014, pp. 4-83 to 4-88).

Mining operations are conducted in accordance with a pre-approved, mine-specific plan that dictates the use of BMPs to minimize impacts on the surrounding environment, including nearby water resources. Certain mines, such as those located in close proximity to the Dolores River and the San Miguel River, may require the implementation of larger stormwater control systems to account for the increased potential for erosion and runoff. Such site-specific conditions would be specified in the pre-approved, mine-specific plan as well as in required permits (DOE, 2014, pp. 4-86). Permitting through appropriate state and Federal agencies would be required for all mines to address water resource concerns and decrease the risk of adverse effects. Stormwater infrastructure such as berms, drainage swales, and detention basins would be designed to retain and treat stormwater discharges in accordance with state and Federal regulations. In general, existing mines have been developed to divert upgradient stormwater away from the site and to collect stormwater generated on-site in detention basins prior to release (DOE, 2014, pp. 4-84). Likewise, sanitary and industrial wastewaters generated on-site would be collected and treated prior to release into the environment, in accordance with the appropriate permits. The potential for leaks and spills of chemical contaminants would be managed with the implementation of BMPs regarding the proper storage and use of such chemicals, and an action plan would be in place in the event of a spill or leak. Permitting through appropriate state and Federal agencies would likely also address this issue through permit conditions (DOE, 2014, pp. 4-86).

The primary uses for water in conventional mining are dust suppression, operation of machinery, and potable water use. Due to the lack of high-quality and readily available water resources in the regions of interest, it is assumed that water would most likely be brought to the site from elsewhere. As a result, conventional mining activities associated with the Proposed Action would be expected to have a minor effect on water supplies at the location of existing mines (DOE, 2014, pp. 4-86).

Reclamation occurs when mining activities at a specific location are complete, and no future activities are expected. Reclamation would be completed in accordance with the previously approved mine plan, which is required to include a reclamation plan (DOE, 2014, pp. 2-13). During reclamation, underground working areas are backfilled, and boreholes are plugged. Potential impacts on groundwater include leaching of backfill and poor sealing of drill holes, which can be minimized through BMPs (DOE, 2014, pp. 4-88).

Due to adherence to necessary permit conditions and the implementation of BMPs, impacts on water resources associated with conventional mining activities in existing, permitted areas are expected to be SMALL.

Conventional Milling

Most milling of conventionally mined uranium in the United States is performed at the White Mesa Mill in San Juan County, Utah. Major surface water features and groundwater resources in San Juan County are highlighted in Section 2.4 of the 1997 White Mesa EA (NRC, 1997a).

Groundwater under the site begins at a depth of approximately 22 to 33 m (73 to 109 feet) below the surface in the Burro Canyon Formation. At the time of the environmental analysis conducted in support of continued operations at the White Mesa Mill, groundwater quality in the Burro Canyon Formation beneath and downgradient of the project site was reported to be poor and extremely variable, with high concentrations of total dissolved solids. The mill water supply comes from groundwater from the more prolific Entrada and Navajo Sandstone aquifers, located beneath and in the vicinity of the site (NRC, 1997a, p. 9).

The 1997 White Mesa EA determined that impacts on surface waters associated with continued operation of the White Mesa Mill would be negligible, because effluents and tailings are discharged to state-approved leach fields and to partially below-grade, lined impoundments rather than to nearby surface waters. Additionally, it was not anticipated that continued operations at the mill would adversely affect groundwater due to the use of tailings cells designed to retain tailings slurry and solutions and other approved wastes, and the low permeability of formations below the site preventing potential contamination of groundwater resources in the event of a tailings cell failure (NRC, 1997a, pp. 15–16).

It is expected that impacts on water resources resulting from continued operations at the White Mesa Mill in support of HALEU production would be SMALL.

1.3.5 Air Quality

The following section discusses potential air quality impacts from uranium mining and milling activities that would support the Proposed Action described in Section 1.1, *Description of the Activity*. The analysis of impacts relies on analyses from previous NEPA documents that assessed the impacts from construction and operation of licensed/permitted uranium mining and milling facilities. The impacts of greenhouse gases emitted by transportation vehicles is evaluated in the HALEU EIS, Section 4.3.2, *Greenhouse Gases and Climate Change*.

Operation of uranium mining and milling facilities would result in air emissions of criteria pollutants, hazardous air pollutants (HAPs), radiological compounds, and greenhouse gases. The following evaluates projected emissions relative to air quality conditions within project regions and applicable air pollution standards and regulations. Section 1.3.11, *Public and Occupational Health – Normal Operations*, and Section 1.3.12, *Public and Occupational Health – Facility Accidents*, present estimates of health effects due to radiological air emissions that would occur from the project.

Under the Clean Air Act (CAA), EPA establishes National Ambient Air Quality Standards (NAAQS) for common air pollutants known as criteria pollutants. The NAAQS represent the maximum allowable atmospheric concentrations that may occur and still protect public health and welfare. The CAA establishes air quality planning processes and requires states to develop a State Implementation Plan that details how they will maintain the NAAQS or attain a standard in nonattainment within mandated time frames. Under the CAA, states are allowed to develop their own ambient air quality standards so long as they are at least as stringent as the NAAQS.

In addition to criteria pollutants, EPA also regulates HAPs that are known or are suspected to cause serious health effects or adverse environmental effects. EPA sets Federal regulations to reduce HAP emissions from stationary sources in the *National Emission Standards for Hazardous Air Pollutants* (EPA, 2023a).

ISR Mining

The air quality analysis for an ISR facility relies on analyses presented in the ISR GEIS (NRC, 2009a). The ISR GEIS evaluated impacts from an ISR facility in four different regions in the western United States. The following presents air quality impacts estimated for an ISR facility in the Wyoming West Uranium Milling Region, as impacts from facilities within the remaining three regions would be similar to impacts identified for this region. In addition, it is expected that air quality impacts from ISR activities at other locations not analyzed in the ISR GEIS would be similar to those identified in the ISR GEIS. ISR facility activities at any location would have to take into consideration current air quality conditions and to comply with the applicable regulatory requirements at that location.

EPA designates all areas of the United States as having air quality better than (attainment) or worse than (nonattainment) the NAAQS. Former nonattainment areas that have attained the NAAQS are designated as maintenance areas. Presently, EPA categorizes the area within the Wyoming West Uranium Milling Region as in attainment of all NAAQS (EPA, 2023b). The State of Wyoming Department of Environmental Quality regulates sources of air pollution in Wyoming. Additional descriptions of the air quality resource within the Wyoming West Uranium Milling Region ROI are presented in Section 3.6.2 of the 2009 ISR GEIS (NRC, 2009a).

Construction

Air quality impacts from construction activities associated with clearing and grading, road and building construction, drilling wells, trenching and laying pipelines, and building evaporation pond impoundments would occur from (1) combustive emissions due to the use of fossil-fuel-powered equipment, trucks, and worker commuter vehicles and (2) fugitive dust emissions due to the operation of equipment and vehicles on exposed soil. Impacts would occur primarily during initial clearing and grading and well development.

The ISR GEIS analysis determined that emissions from proposed construction activities would not contribute to an exceedance of any NAAQS. The proposed ISR facility would implement best management and action practices to reduce fugitive dust and equipment combustive emissions (listed in ISR GEIS Table 7.4-1). Since the project region attains all NAAQS and construction equipment would comply with applicable regulatory limits and restrictions, the 2009 ISR GEIS concluded that air quality impacts from proposed construction activities would be SMALL (NRC, 2009a, p. § 4.2.6.1).

Operation

Based on the description of an ISR facility in the ISR GEIS (NRC, 2009a), air quality impacts from operation of the facility would occur from (1) nonradiological emissions and radon from pipeline system venting, resin transfer, and elution processes; (2) natural gas-fired heaters used to dry yellowcake; (3) releases of uranium particles from yellowcake drying and packaging and the filling of sodium bicarbonate storage containers; (4) on-site vehicles and associated road dust; (5) the transport by truck of supplies and finished product; and (6) worker commuter vehicles. Mobile sources (trucks and worker commuter vehicles) that operate off-site would produce dispersed and SMALL impacts on air quality.

Nonradiological emissions from yellowcake drying (the main source of emissions) would be SMALL and would be controlled with high-efficiency particulate air filters. Airborne uranium emissions from yellowcake drying and packaging and the filling of sodium bicarbonate storage containers would be controlled with the use of vacuum drying equipment, wet scrubbers, or dust collection systems. In addition, the site would operate an environmental monitoring program that would measure concentrations of radioactive and nonradioactive materials released to the environment from facility operations (see ISR GEIS Chapter 8). Due to these measures and the relatively low operational emission rates, the ISR GEIS concluded that potential air quality impacts from the operation of the ISR facility would be SMALL (ISR GEIS Section 4.2.6.2).

Aquifer Restoration

Based on the description of an ISR facility in the ISR GEIS, aquifer restoration would use most of the same infrastructure used for operations. Air quality impacts from aquifer restoration would occur from (1) combustive emissions due to the use of fossil-fuel-powered equipment for the plugging and abandonment of production and injection wells, (2) radon from pipeline system vents and leaks and potential use of evaporation ponds; (3) natural gas-fired heaters used for the brine concentrators; (4) on-site vehicles and associated road dust; (5) the transport by truck of supplies; and (6) worker commuter vehicles.

Aquifer restoration activities would implement BMPs to reduce fugitive dust and equipment combustive emissions (NRC, 2009a, pp. Table 7.4-1). In addition, the site would operate an environmental monitoring program that would measure concentrations of radioactive and nonradioactive materials released to the environment from facility operations (see ISR GEIS Chapter 8). Due to these measures and relatively low emission rates, the ISR GEIS concluded that potential air quality impacts from aquifer restoration would be SMALL (ISR GEIS Section 4.2.6.3).

Decommissioning

Air emissions from decommissioning activities would occur from the same types of sources as those identified for proposed construction activities. The magnitude of air quality impacts from decommissioning activities would be similar to those identified for construction but would decrease as decommissioning proceeds. Similar to construction, decommissioning air quality impacts would be SMALL.

Conventional Mining

The air quality analysis for conventional mining relies on analyses presented in the Final ULP PEIS (DOE, 2014). The ULP PEIS evaluated impacts from various alternatives associated with exploration, mine development and operations, and reclamation of uranium mines at existing facilities in western Colorado. The following analysis focuses on air quality impacts estimated for Alternative 4 in the ULP PEIS, which evaluated continued operation of 18 underground mines and one large open-pit mine in the project region for at least the next 10 years. It is expected that air quality impacts from conventional mining and milling at other locations would be similar to those identified in the ULP PEIS. However, conventional mining and milling activities at any location would have to take into consideration current air quality conditions and to comply with the applicable regulatory requirements at that location.

Presently, EPA categorizes Mesa, Montrose, and San Miguel Counties, which encompass the ULP mines in western Colorado, as in attainment of all NAAQS (EPA, 2023b). The Colorado Department of Public Health and Environment regulates sources of air pollution in Colorado. Additional descriptions of the air quality resource within the western Colorado ULP ROI are presented in ULP PEIS Section 3.1 (DOE, 2014).

Exploration

Air quality impacts from exploration activities would occur from (1) combustive emissions due to the use of fossil-fuel-powered equipment such as drilling rigs and trucks and (2) fugitive dust emissions due to the operation of equipment and vehicles on exposed soils. These activities would generate minor amounts of annual emissions (DOE, 2014, pp. Table 4.4-1), in part due to the implementation of compliance measures, mitigation measures, and BMPs, as presented in ULP PEIS Section 4.6. These measures include the following:

To minimize fugitive dust emissions:

- Apply water or chemical suppressants on unpaved haul roads, disturbed surfaces, and temporary stockpiles.
- Limit soil-disturbing activities and travel on unpaved roads.
- Design and construct new access roads to meet appropriate standards; roads should be no larger than necessary to accommodate their intended function.
- Cover unpaved access roads, frequently used on site roads, and parking lots with aggregate.
- Reduce vehicle speeds on unpaved surfaces.
- Ensure that all vehicles transporting loose materials are covered (e.g., with tarpaulins), both when traveling with a load of ore and when returning empty; loads should be sufficiently wet and kept below the freeboard.

To minimize combustive emissions:

- Assure all heavy equipment meets emission standards as required.
- Limit idle time of vehicles and motorized equipment.
- Fuel all diesel engines used with ultra-low sulfur diesel (sulfur content of ≤ 15 parts per million [ppm]).

The ULP PEIS concluded that these minor amounts of air emissions would result in negligible impacts on ambient air quality and climate change.

Mine Development and Operations

Under Alternative 4, the ULP PEIS evaluated a daily uranium ore production rate of 2,000 tons and annual surface disturbances of 460 acres. Air quality impacts from mine development and operations would occur from (1) combustive emissions due to the use of fossil-fuel-powered equipment such as scrapers, bulldozers, and production drills, (2) fugitive dust emissions due to the operation of equipment and vehicles on exposed soils, and (3) combustive and fugitive dust emissions from the use of explosives. Mine development would result in the highest amount of fugitive dust, whereas mine operations would generate the highest amounts of combustive emissions.

The ULP PEIS analysis determined that the combined peak annual emissions from all 19 mines would be rather small when compared to the combined emissions of the surrounding three counties (Mesa, Montrose, and San Miguel Counties) (DOE, 2014, pp. Table 4.4-1). However, nitrogen oxide emissions from the largest mines would be relatively large and would have the potential to exceed the one-hour nitrogen dioxide NAAQS. Implementation of the mitigation measures and BMPs presented in ULP PEIS Section 4.6 (see above) would minimize these emissions. Therefore, the ULP PEIS concluded that mine development and operations would result in minor (SMALL) impacts on ambient air quality and negligible impacts on climate change.

Reclamation

Air emissions from reclamation activities would occur from (1) combustive emissions due to the use of fossil-fuel-powered earth-moving equipment such as excavators, bulldozers, and dump trucks and (2) fugitive dust emissions due to the handling of soils, wind erosion of stockpiles, and operation of equipment and vehicles on exposed soils. The main pollutant of concern from reclamation would be particulate matter less than or equal to 10 microns in diameter in the form of fugitive dust. The ULP PEIS analysis determined that the combined peak annual particulate matter less than or equal to 10 microns in diameter emissions from reclamation of all 19 mines would amount to 1.1% of the emissions of the surrounding three counties (see ULP PEIS Table 4.4-1). Implementation of the mitigation measures and BMPs presented in ULP PEIS Section 4.6 (see above) would minimize these emissions. Therefore, the ULP PEIS concluded that reclamation activities would result in minor (SMALL) impacts on ambient air quality and negligible impacts on climate change.

Conventional Milling

Milling of conventionally mined uranium in the United States is performed at the White Mesa Mill in San Juan County, Utah. Air quality impacts from operation of the White Mesa Mill would occur from (1) fugitive dust from handling uranium ore, ore stockpiles, ore tailings piles, and road dust from on-site vehicle operations, (2) volatile organic compounds from the uranium extraction processes; (3) natural gas- or propane-fired heaters used to dry yellowcake; (4) the transport by truck of feedstock and finished product; and (5) worker commuter vehicles. The transport, handling, storage, and processing of uranium ore and tailings piles would emit uranium particles and the tailings piles would emit minor amounts of radium and radon. The facility licensing conditions require the implementation of control measures and environmental and radiation monitoring that would minimize facility air quality impacts to regulatory levels (Denison Mines (USA) Corp, 2007; Utah DEQ, 2018). As the facility is currently operational, it is expected that impacts on air quality resulting from continued operations at the White Mesa Mill in support of HALEU production would be SMALL.

1.3.6 Ecological Resources

The following section discusses potential impacts on ecological resources from uranium mining and milling activities that would support the Proposed Action described in Section 1.1, *Description of the Activity*. The analysis of impacts considers the analyses from previous NEPA documents that assessed the impacts from construction and operation of licensed/permitted uranium mining and milling facilities. In general, impacts on ecological resources from mining operations, aquifer restoration, and decommissioning activities associated with the Proposed Action could occur from removal or degradation of vegetation that could in turn affect wildlife habitats, wetlands, and Federal- and state-listed species. Impacts on ecological resources could also occur from contamination by radioactive or hazardous materials via air- or water-borne pathway. For the Proposed Action, the severity of impacts (i.e., SMALL, MODERATE, to LARGE) on ecological resources will be dependent on the current ecological conditions of the selected site, in comparison to the disturbance footprint associated with the facility.

As this analysis considers existing permitted facilities with previous NEPA documentation, the Leidos Team anticipates mining locations considered for the Proposed Action already contain some degree of disturbance, such as existing development (on or near the site) and exposure to human activity, which would inherently lessen the degree of impacts on ecological resources compared to activities associated with construction and operating a new mining facility. As such, SMALL to MODERATE impacts on ecological resources would likely be anticipated for ongoing mining and milling activities within the existing licensed or permitted facilities. However, LARGE impacts, while unlikely, could occur under the following conditions: critical habitat loss or alteration and incremental habitat fragmentation; displacement of special status species from project construction; and direct or indirect mortalities to special status species from project construction and operation. Special status species are defined as those protected under the Endangered Species Act, the Migratory Bird Treaty Act (U.S.C. 703–712), the Bald and Golden Eagle Protection Act (16 U.S.C. 668–668d), and state-listed species. Because Federal- and state-listed species statuses change over time (i.e., uplisted, delisted, proposed for listing, and updated occurrence data), new surveys for special status species could be required if a substantial amount of time has passed since the previous survey or site-specific NEPA analysis. These new surveys could find the presence of special status species not previously evaluated when the prior site-specific NEPA document was prepared.

ISR Mining

The ecological resources analysis for an ISR facility considers the analyses presented in the ISR GEIS (NRC, 2009a). The ISR GEIS evaluated impacts from an ISR facility associated with the construction, operation, aquifer restoration, and decommissioning of an ISR facility in four different regions in the western United States. The ISR GEIS determined which impacts could be inherently the same for all ISR facilities and which ones would result in varying levels of impacts for different facilities, thus requiring further site-specific information to determine the potential impacts. Subsequent NEPA documents were published for the various facilities between 2010 and 2016 to evaluate the site-specific impacts on ecological resources. Potential impacts were identified as SMALL, MODERATE, or LARGE based on the resources known to occur, or identified with potential to occur, during the time of publication. As such, the ISR GEIS provides guidance for the NRC's and Agreement State NEPA analyses for site-specific license applications for new ISR facilities, as well as for applications to amend or renew existing ISR licenses.

It is expected that impacts on ecological resources from ISR activities at other locations would be similar to those identified in the ISR GEIS and site-specific NEPA documentation reviewed. However, ISR facility activities at any location would have to take into consideration the current ecological conditions present at the site and comply with the applicable regulatory requirements at that location.

Construction

Impacts from construction activities could have SMALL, MODERATE, or LARGE impacts on ecological resources depending on those resources disturbed and mitigation and minimization measures employed to offset the impacts. Impacts on ecological resources would be SMALL if new construction and/or land disturbance were to occur entirely within previously developed and disturbed lands, as these areas are subject to frequent disturbance from human activity, grounds maintenance, disruptions from ongoing facility operations, and native habitats are no longer present or have likely degraded overtime. Previously developed and disturbed areas are not likely to support habitat for wildlife—other than for those species adapted to human disturbance (such as transient small mammals, insects, and birds).

Any new construction and/or land disturbance occurring within undeveloped lands associated with ISR mines could have SMALL, MODERATE, or LARGE impacts on ecological resources depending on those resources disturbed and mitigation and minimization measures employed to offset the impacts. Implementation of wildlife surveys and mitigation measures following established guidelines would limit impacts such that LARGE impacts would be unlikely. Land-clearing activities as part of new construction within undeveloped lands would likely result in increased erosion, stormwater runoff, and loss of vegetation. Additionally, impacts on wildlife could include habitat fragmentation, disturbance, and injury or mortality, as habitats within the footprint disturbed by construction and/or land disturbance would be reduced or altered, and associated activities would result in habitat fragmentation. Loss of habitat could result in a long-term reduction in wildlife abundance and richness. Habitat disturbance could facilitate the spread and introduction of invasive plant species. Wildlife habitat could be adversely affected if invasive vegetation became established in the disturbed areas and adjacent off-site habitats. Construction activities could cause wildlife disturbance, including interference with behavioral activities. Wildlife could respond in various ways, including attraction, habituation, and avoidance. Principal sources of noise would include vehicle traffic and operation of machinery. Regular or periodic noise could cause adjacent areas to be less attractive to wildlife and result in a reduction in use. Construction activities could result in the direct injury or death of certain wildlife species.

Wildlife could also be exposed to accidental fuel spills or releases of other hazardous materials. Temporary contamination or alteration of soils would be likely from operational leaks and spills and possibly from land application of treated wastewater. However, detection and response to leaks and spills (e.g., soil cleanup) and eventual remediation of potentially impacted soil would limit the magnitude of overall impacts on terrestrial ecology. Migratory birds could be affected by exposure to constituents in evaporation ponds. Mitigation measures such as perimeter fencing and netting would reduce impacts.

For federally listed species present at a specific location, additional analysis would be required to determine the severity and nature of impacts as part of the final design of the ISR facility. Removal of native habitats could impact vegetation, wildlife, and possibly special status species. As such, targeted species surveys may be required, and interagency coordination would be warranted.

Migratory birds are protected under the Migratory Bird Treaty Act. Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act. Numerous migratory birds, including some birds of conservation concern and eagles, likely occur or have the potential to occur as transients throughout the vicinity of the proposed ISR sites. The USFWS recommends conducting tree-clearing activities outside of the bird nesting season to avoid the need for active nest relocation or destruction, when appropriate. To avoid impacts on migratory birds, tree clearing within undeveloped lands would need to occur outside of the nesting season (late February through early August). Tree-clearing work during the nesting season would require a migratory bird nest survey 72 hours prior to the start of clearing activities. A permit would be required for the purposeful take of an active migratory bird nest. A permit is not required to destroy migratory bird inactive nests.

Wetlands and/or water features (such as streams, lakes, ponds, or other waters) subject to protection under Section 404 of the CWA (33 U.S.C. 1251 et seq.) could occur within the ISR facility area. Wetlands could be impacted by alteration of surface water runoff patterns, soil compaction, or groundwater flow. Formal wetland delineation surveys could be required to determine presence or absence of jurisdictional wetlands. Impacts on federally protected wetlands could require consultation with the U.S. Army Corps of Engineers to obtain a permit. Additionally, subsequent NEPA analysis by the NRC or Agreement State may also be required.

Operation

Impacts from ISR could have SMALL or MODERATE impacts on ecological resources depending on those resources disturbed and mitigation and the minimization measures employed to offset the impacts. The level of impact would be dependent on site-specific characteristics and the presence of the resource (including threatened and endangered species) in proximity to activities.

Operation impacts of ISR facilities would have similar impacts to those observed during the construction phase. During operation, the primary changes to ecological resources would be the sequential development of well fields from one area of the site to another. Clearing and grading activities associated with facility expansion during operations could result in a small, temporary increase in sediment load in local streams, but aquatic species would recover quickly as sediment load decreases. Clearing of riparian vegetation could affect light and thus the temperature of water. Construction impacts on wetlands would be identified and managed through U.S. Army Corps of Engineers permits, as appropriate. Construction impacts on surface waters and aquatic species would be temporary and mitigated to SMALL by BMPs. Operational impacts from spills or releases into surface water would be SMALL and minimized by spill prevention, identification, and response programs, and NPDES permit requirements.

Aquifer Restoration

Aquifer restoration could have SMALL impacts on ecological resources depending on those resources disturbed and mitigation and the minimization measures employed to offset the impacts. Impacts on ecological resources from aquifer restoration could include habitat disruption or potential impacts from spills or releases of untreated groundwater. However, the facility operator would use existing (in-place) infrastructure during aquifer restoration, with little additional ground disturbance. The potential of spills or releases of untreated groundwater would be minimized through spill prevention practices, response programs, and NPDES permit requirements. Contamination of soils could result from leaks and spills and land application of treated wastewater. However, detection and response techniques, and eventual remediation of potentially impacted soils, if employed, would limit the magnitude of overall impacts on ecological resources.

Decommissioning

Impacts from decommissioning activities could have SMALL, MODERATE, or LARGE impacts on ecological resources depending on those resources disturbed and mitigation and the minimization measures employed to offset the impacts. During decommissioning and reclamation, there could be a temporary disturbance (e.g., excavated soils and buried piping, removal of structures) to terrestrial and aquatic resources. However, terrestrial habitat altered during construction and operations would be restored through revegetation and BMPs. Wildlife could be temporarily displaced but would be expected to return after decommissioning and reclamation are completed, and habitat has been reestablished (depending on site-specific conditions). Decommissioning and reclamation activities could also result in small and temporary increases in sediment load in local streams. However, it is anticipated that aquatic species would recover as sediment loads decrease. Implementation of wildlife surveys and mitigation measures following established guidelines would limit impacts such that LARGE impacts would be unlikely.

Conventional Mining

The ecological resources analysis for conventional mining relies on analyses presented in the Final ULP PEIS (DOE, 2014). The ULP PEIS evaluated impacts from various alternatives associated with exploration, mine development and operations, and reclamation of uranium mines at existing facilities in western Colorado. It is expected that impacts on ecological resources from conventional mining and milling at other locations would be similar to those identified in the ULP PEIS. However, conventional mining and milling activities at any location would have to take into consideration current ecological resources present at the specific site and to comply with the applicable regulatory requirements at that location.

Impacts from conventional mining could have SMALL, MODERATE, or LARGE impacts on ecological resources depending on those resources disturbed and mitigation and the minimization measures employed to offset the impacts. Impacts from exploration could result from disturbance of vegetation and soils, the removal of trees or shrubs, compaction of soils, destruction of plants, burial of vegetation under waste material, or erosion and sedimentation. The localized destruction of ecological soil crusts, where present, would be considered a longer-term impact, particularly where soil erosion has occurred. Direct impacts could include the destruction of habitats during site clearing and excavation. Indirect impacts from mining could be associated with fugitive dust, invasive species, erosion, sedimentation, and impacts due to changes in surface water or groundwater hydrology or water quality. The deposition of fugitive dust and the establishment of invasive species, including the potential alteration of fire regimes, could result in long-term impacts. Additional habitats could be affected by any access roads or utility lines required for the mines. Impacts on wildlife could occur from habitat disturbance, wildlife disturbance, and wildlife injury or mortality and habitat loss.

Impacts on aquatic resources could result from increases in sedimentation and turbidity from soil erosion and runoff during mine development and operations. There would be a very low likelihood of an accidental ore spill into a perennial stream or river.

Potential impacts on special status species could occur, depending on the location of the mines and amount of surface disturbance. Direct impacts could result from the destruction of habitats during site clearing, excavation, and operations. Indirect impacts could result from fugitive dust, erosion, sedimentation, and impacts related to altered surface water and groundwater hydrology. Implementation of wildlife surveys and mitigation measures following established guidelines would limit impacts such that LARGE impacts would be unlikely.

Conventional Milling

Milling of conventionally mined uranium in the United States is performed at the White Mesa Mill in San Juan County, Utah. Ecological resources present at that location are described in Section 2.4 of the 1997 White Mesa EA. As the facility is currently operational, it is expected that impacts on ecological resources resulting from continued operations at the White Mesa Mill in support of HALEU production would be SMALL.

1.3.7 Historic and Cultural Resources

The following section discusses potential impacts on cultural resources from uranium mining and milling activities that would support the Proposed Action described in Section 1.1, *Description of the Activity*. The analysis of impacts relies on analyses from previous NEPA documents that assessed the impacts from construction and operation of licensed/permitted uranium mining and milling facilities.

ISR and Conventional Mining

Construction-related impacts on cultural resources (defined here as historical, cultural, archaeological, and traditional cultural properties) can be direct or indirect and can occur at any stage of a uranium recovery facility project (i.e., during construction, operation, aquifer restoration, and decommissioning). Construction involving land-disturbing activities, such as grading roads, installing wells, and constructing surface facilities and well fields, are expected to be the most likely to affect historic and cultural resources. These land-disturbing activities would occur for both ISR mining and conventional mining and are generally discussed below. The impact analysis for conventional mining relies on analyses presented in the ULP PEIS (DOE, 2014). The cultural resources analysis for an ISR facility relies on analyses presented in the ISR GEIS (NRC, 2009a), and the Crownpoint Uranium Solution Mining Project EIS (NRC, 1997b).

Prior to engaging in land-disturbing activities, licensees and applicants would review existing literature and perform region-specific records searches to determine whether historic or cultural resources are present and have the potential to be disturbed. Along with literature and records reviews, the project site area and all its related facilities and components would be subjected to a comprehensive cultural resources inventory (performed by the licensee or applicant) that meets the requirements of responsible Federal, state, and local agencies (e.g., the appropriate State Historic Preservation Officer [SHPO]). The literature and records searches would help identify known or potential cultural resources and Native American sites and features. The cultural resources inventory would identify the previously documented sites and any newly identified cultural resources sites. The eligibility evaluation of cultural resources for listing in the National Register of Historic Places (NRHP) under criteria in 36 CFR 60.4(a)–(d) and/or as traditional cultural properties is conducted as part of the site-specific review and NRC or Agreement State licensing procedures undertaken during the NEPA review process. The evaluation of impacts on any historic properties designated as traditional cultural properties and Tribal consultations regarding cultural resources and traditional cultural properties also occur during the site-specific licensing application and review process. Consultation to determine whether significant cultural resources would be avoided or mitigated would occur during consultations with the other agencies, state SHPOs, and Tribal representatives as part of the site-specific review. Additionally, as needed, the NRC or Agreement State license applicant would be required, under conditions in its license, to adhere to procedures regarding the discovery of previously undocumented cultural resources during initial construction, operation, aquifer restoration, and decommissioning. These procedures typically require the licensee to stop work and to notify the appropriate Federal and state agencies. Licensees and applicants typically consult with the responsible state and Tribal agencies to determine the appropriate measures to take (e.g., avoidance or mitigation) should new resources be discovered during land-disturbing activities at a specific facility. The NRC and licensees/applicants may enter into a memorandum of agreement with the responsible state and Tribal agencies to ensure protection of historical and cultural resources, if encountered (NRC, 2009a, p. § 4.4.8).

Construction

Most of the potential for significant adverse effects to NRHP-eligible or potentially NRHP-eligible historic properties and traditional cultural properties, both direct and indirect, would likely occur during land-disturbing activities related to conventional uranium mine development and/or expansion or building an ISR facility. Buried cultural features and deposits that are not visible on the surface during initial cultural resources inventories could be discovered during earth-moving activities. Indirect impacts may also occur outside the uranium mining project site and related facilities and components. Increased access to formerly remote or inaccessible resources, traditional cultural properties and culturally significant landscapes, as well as other ethnographically significant cultural landscapes may adversely affect these resources. Significant cultural landscapes should be identified during literature and records searches and may require additional archival, ethnographic, or ethnohistorical research that encompasses areas well outside the area of direct impacts. Indirect impacts on some of these cultural resources may be unavoidable and exist throughout the lifecycle of a conventional uranium mine or an ISR facility.

Because of the localized and transient nature of land-disturbing activities related to construction, impacts on historic and cultural resources are anticipated to be SMALL, but could be MODERATE for facilities located near known highly significant resources, such as Devils Tower (NRC, 2009a, p. § 4.4.8.1) or Chaco Canyon (NRC, 1997b) National Monuments. Facilities adjacent to these types of culturally significant properties are likely to have the greatest potential impacts. Mitigation measures (e.g., avoidance, implementation of a cultural resources management plan for lease areas, recording, and archiving samples) and additional consultations with the appropriate state SHPO and affected Native American Tribes would reduce the impacts. From the standpoint of cultural resources, the most significant impacts on any sites that are present would occur during initial mine development and/or construction within the area of potential effect (NRC, 2009a, p. § 4.4.8.1).

Operation

Depending on the location, impacts on NRHP-eligible properties, potentially NRHP-eligible historical properties, traditional cultural properties, and other cultural resources are possible during operation of a ISR facility and conventional uranium mine. Potential impacts during operation are expected to occur through new earth-disturbing activities, new construction, maintenance, and repair. Because fewer earth-disturbing activities are expected during operations, potential impacts would be SMALL (less than during construction) (NRC, 2009a, p. § 4.4.8.1).

Aquifer Restoration

Depending on the location, both direct and indirect adverse effects on NRHP-eligible properties, potentially NRHP-eligible historical properties, traditional cultural properties, and other cultural resources are possible during the aquifer restoration phase of an ISR project. Potential impacts during aquifer restoration may occur through new earth-disturbing activities or other new construction that may be required for the restoration process. Such activities may have inadvertent impacts on cultural resources and traditional cultural properties in or near the site of aquifer restoration activities located within the extended ISR project area. Inadvertent impacts on historic and cultural resources located within the extended ISR permitted area and other cultural landscapes that are identified before construction are expected to continue during aquifer restoration. Overall impacts on cultural and historical resources during aquifer restoration are expected to be less than those during construction, as aquifer restoration activities are generally limited to previously disturbed areas (e.g., access roads, central processing facility, well sites) and would be SMALL (NRC, 2009a, p. § 4.4.8.1).

Conventional Milling

Milling of conventionally mined uranium in the United States is performed at the White Mesa Mill in San Juan County, Utah. Cultural resources present at that location are described in Section 4.3 of the 1997 White Mesa EA (NRC, 1997a). As the facility is currently operational, it is expected that impacts on cultural resources resulting from continued operations at the White Mesa Mill in support of HALEU production would be SMALL.

1.3.8 Infrastructure

The following section discusses potential impacts on infrastructure from uranium mining and milling activities that would support the Proposed Action described in Section 1.1, Description of the Activity. For the purposes of the Technical Report, infrastructure refers to utilities, such as electricity and natural gas.

Impacts on infrastructure could occur if an action causes an increase in demand for utility services during construction or operations. A significant adverse effect to infrastructure would occur if construction and/or operation of the proposed HALEU mining and milling activities caused long-term disruption of utility operations, negatively affected the ability of local and regional utility suppliers to meet customer demands, or required substantial public utility system upgrades.

Expansion of existing ISR facilities may require additional utility lines and pipelines. Unlike an ISR facility that has an existing central uranium processing facility, expansion of an existing conventional mining facility may require the construction of additional infrastructure, such as utilities. Most mining activities are not intensive users of electricity and water, and fuel can be purchased and transported to the site as needed. Therefore, it is expected that additional utility demand from mining activities would have SMALL impacts on infrastructure at an ISR facility or a conventional mining facility. It is anticipated that all milling activities from conventional mining would be performed at the existing White Mesa Mill in Utah, which would not require any construction or use of additional infrastructure; therefore, no additional infrastructure impacts related to milling activities would occur.

Any expansion of existing infrastructure or installation of new utility infrastructure would comply with all applicable usage agreements, permits, and regulatory requirements. Any increase in demand would not exceed the capacity of existing utility providers nor affect service to other users. No impacts on infrastructure are anticipated to result from aquifer restoration activities due to the use of existing infrastructure and the nature of conducted activities, which are similar to those previously discussed (e.g., well field operation, transfer activities, liquid effluent treatment and disposal). Decommissioning would have no adverse impacts on infrastructure; existing infrastructure would be removed or decommissioned in place.

1.3.9 Waste Management

The following section discusses potential impacts on waste management from uranium mining and milling activities that would support the Proposed Action described in Section 1.1, *Description of the Activity*.

Construction and Operation

Industrial (i.e., construction debris), hazardous, and radioactive wastes would be generated. All wastes generated have a disposal path forward. The generated wastes do not have any unique or problematic characteristics that would preclude use of the existing disposition paths. All wastes would be managed in accordance with applicable regulatory requirements. The waste quantities generated are a small portion of the total quantities of waste generated annually by all generators. Available commercial facilities' capacities can accommodate the lifecycle disposition requirements for all the waste categories. Impacts would be SMALL since all wastes generated have a disposal path forward and represent a fraction of the available capacities of the commercial facilities.

1.3.10 Noise

The following section discusses potential noise impacts from uranium mining and milling activities that would support the Proposed Action described in Section 1.1, *Description of the Activity*. The analysis of impacts relies on analyses from previous NEPA documents that assessed the impacts from construction and operation of licensed/permitted uranium mining and milling facilities. In general, mining locations are located within relatively rural and undeveloped areas, where ambient noise levels would be expected to be low. Limited sensitive noise receptors occur in these areas.

Any pressure variation that the human ear can detect is considered "sound," and "noise" is defined as unwanted sound. Sound is described in terms of amplitude (perceived as loudness) and frequency (perceived as pitch). Sound pressure levels are typically measured with a logarithmic decibels (dB) scale. To account for human sensitivity to frequencies of sound (i.e., less sensitive to lower and higher frequencies, and most sensitive to sounds between 1,000 and 5,000 hertz), A-weighted sound levels (denoted by dBA) is widely used (Acoustical Society of America, 1985, pp. 19–20). Most noise standards, guidelines, and ordinances use the A-weighted scale.

The day-night average sound level (L_{dn}) is the average over a 24-hour period, with the addition of 10 dB to sound levels from 10:00 p.m. to 7:00 a.m. to account for the greater sensitivity of most people to nighttime noise. The L_{dn} scale is widely used for community noise assessment and has been adopted by several government agencies (e.g., Federal Aviation Administration, Department of Housing and Urban Development). In general, a 3-dB change over an existing noise level is considered a barely discernible difference, and a 10-dB increase is subjectively perceived as a doubling in loudness and almost always causes an adverse community response (NWCC, 2002, p. 48).

Background noise is defined as the noise from all sources other than the source of interest. The background noise level can vary considerably, depending on the location, season, and time of day. Background noise levels in a busy urban setting can be as high as 80 dBA during the day. In isolated outdoor locations with no wind, vegetation, animals, or running water, background noise may be under 10 dBA. Typical noise levels in rural settings are about 40 dBA during the day and 30 dBA during the night, which correspond to an L_{dn} of 40 dBA; in wilderness areas, typical noise levels can be below 35 dBA (Harris, 1991, p. 5.16 to 5.17).

At the Federal level, the Noise Control Act of 1972 and subsequent amendments (Quiet 4 Communities Act of 1978, 42 U.S.C. 4901–4918) delegate the authority to regulate noise to the states and direct government agencies to comply with local noise regulations. EPA guidelines recommend L_{dn} of 55 dBA as sufficient to protect the public from the effect of broadband environmental noise in typically quiet outdoor and residential areas and farms (EPA, 1974a, p. 4). For protection against hearing loss in the general population from nonimpulsive noise, EPA recommends equivalent continuous sound level of 70 dBA or less over a 40-year period. HALEU activities would have to follow applicable Federal, state, or local guidelines and regulations on noise.

ISR Mining

The noise analysis for ISR mining relies on analyses presented in the ISR GEIS (NRC, 2009a, pp. 3.2-50 to 3.2-52).

Construction

It is anticipated that because of the use of heavy equipment (e.g., bulldozers, graders, drill rigs, compressors), potential noise impacts would be greatest during expansion of existing ISR facilities. Standard construction techniques using appropriate heavy equipment would be used to build well fields and buildings and to grade access roads as required. Depending on the type of construction and equipment used, noise levels (other than occasional instantaneous levels) resulting from construction activities might reach or occasionally exceed 85 dBA at 15 m (50 feet) from the source (NRC, 2009a). Personal hearing protection would be required for workers in these areas.

Noise resulting from construction activities could impact residents within 300 m (1,000 feet) of the noise sources, particularly during the night. Traffic associated with construction activities would include workers commuting to and from the jobsite, as well as relocation of construction equipment to different parts of the project. This might affect small communities located along existing roads. Because well field and facility construction activities would generally occur during daytime hours (see ISR GEIS Section 2.7), related noise would not be expected to exceed the 24-hour average sound-energy guideline of 70 dBA EPA (1978) determined to protect hearing with a margin of safety (NRC, 2009a, pp. 4.2-39). As a result, construction-related noise impacts would be expected to be SMALL to MODERATE (NRC, 2009a, pp. 4.2-40).

Operation

Except for heavy truck traffic, operations at ISR facilities generally do not create important sources of noise for off-site receptors. In the well fields, the only noise sources would be the groundwater pumps and occasional truck traffic required to perform maintenance and inspections. For operations, heavy truck traffic associated with transporting uranium-loaded resins to the central processing facility and shipments of yellowcake would also result in short-term noise. Operational noises at an ISR facility would be typical of an industrial facility. Noise would be generated by trucks, pumps, generators, and other heavy equipment used around the production facilities. This noise would likely be less than that generated during construction, but the production facilities would still generate noise that would be audible above the undisturbed background levels of 50–60 dBA. Administrative and engineering controls would be used to ensure that noise levels meet Occupational Safety and Health Administration exposure limits (29 CFR 1910.95). Personal hearing protection would be used for those working in areas that exceed these noise levels. Noise from operations within the production facilities would be reduced outside of the buildings, but noise resulting from operations could occasionally be annoying to nearby residents, particularly during the night.

Compared to existing traffic, truck traffic associated with yellowcake and chemical shipments and traffic noise related to commuting would have a small, temporary impact on communities located along the existing roads. Therefore, overall noise impacts during operations would be expected to be SMALL (NRC, 2009a, pp. 4.2-42).

Conventional Mining

The noise analysis for conventional mining relies on analyses presented in the Final ULP PEIS (DOE, 2014, pp. 2-58, § 3.2).

Exploration

For the exploration phase, if existing roads did not provide site access, noise sources would include a grader or bulldozer for construction of an access road. Other noise sources would include vehicular traffic for commuting or delivery to and from the site and, where siting could not avoid brush, chainsaws and chippers for brush clearing.

Most noise-generating activities would occur intermittently during the exploration phase. It is anticipated that all of these activities would be conducted by using only a small crew and a small fleet of heavy equipment and would occur during daytime hours, when noise is tolerated better than it is at night because of the masking effect of daytime background noise. Accordingly, it is anticipated that potential noise impacts during the exploration phase on neighboring residences or communities, if any, would be minor and intermittent.

Exploration activities occur over relatively small areas, involve little ground disturbance, and require only a small crew and a small fleet of heavy equipment. Accordingly, it is anticipated that potential noise impacts from the exploration phase on neighboring residences or communities, if any, would be minor (SMALL) and intermittent (DOE, 2014, pp. 4-78).

Mine Development and Operations

During the mine development and operations phase, heavy construction and mining equipment would be used. Primary sources of noise during this phase would include operation of machinery, on-road and off-road vehicle traffic, and, if necessary, blasting. Underground equipment would include loaders, haul or support trucks, and drills, while above-ground equipment would include bulldozers, graders, loaders, haul or support trucks, scrapers, and power generators. During surface-plant area improvements, most activities would occur above-ground. However, most mine development and operational activities would occur above the ground for surface open-pit mines and under the ground for underground mines. Ventilation shafts would also contribute noise during mine development and the operation of underground mines. The average noise levels from most of these pieces of heavy equipment range from 80 to 90 dBA, except for a rock drill at a distance of 50 feet (15 m), which is 98 dBA (FTA, 2018, p. 176).

In general, the dominant noise source from most construction equipment is a diesel engine without sufficient muffling that is continuously operating around a fixed location or with limited movement. Except for rock drills, noise levels for typical construction equipment that would likely be used at the ULP mines range from about 80 to 90 dBA at a distance of 50 feet (15 m) from an equipment. To estimate noise levels associated with these activities, a composite noise level of 95 dBA at a distance of 50 feet (15 m) from the construction site is conservatively assumed if impact equipment such as rock drills are not being used. Typically, this level could be reached when several pieces of heavy equipment operate simultaneously in close proximity to each other at peak load.

When only geometric spreading and ground effects are considered (FTA, 2006), noise levels would attenuate to about 55 dBA at a distance of 1,650 feet (500 m) from the mines. If a 10-hour daytime work schedule is considered, the EPA guideline level of 55 dBA L_{dn} for residential areas (EPA, 1974a) would occur approximately 1,200 feet (360 m) from the construction site. In addition, other attenuation mechanisms, such as air absorption, screening effects (e.g., natural barriers by terrain features), and skyward reflection due to temperature lapse conditions typical of daytime hours, would reduce noise levels further. Thus, noise attenuation to EPA limits would occur at distances somewhat shorter than the aforementioned distances. In many cases, noise above guidance levels would not reach any nearby residences or communities.

In summary, the potential for noise impacts from mine development on humans and wildlife is anticipated near the mine sites and along the haul routes, but impacts would be minor (SMALL) and limited to proximate areas unless the activities occurred near a mine boundary adjacent to nearby residences or communities or areas specially designated to be of concern with regard to wildlife. Implementation of mitigation measures and BMPs identified below and adherence to coherent noise management plans could minimize these impacts (DOE, 2014, pp. 4-79).

During mine operations, over-the-road heavy haul trucks would transport uranium ores from the mines to the mill. These shipments could produce noise along the haul routes. A peak pass-by noise level of 84 dBA from a heavy truck operating at 55 miles per hour (88 km per hour) was estimated in the ULP PEIS (DOE, 2014) based on the Federal Highway Administration's *FHWA Traffic Noise Model (FHWA TNM®) Technical Manual* (Menge et al., 1998). At a distance of 120 feet (37 m) and 230 feet (70 m) from the route, noise levels would attenuate to 55 and 50 dBA, respectively. Noise levels above the EPA guideline level of 55 dBA L_{dn} for residential areas would be reached up to the distance of 60 feet (18 m) from the route. Accordingly, EPA guideline levels would be exceeded within 230 feet (70 m) of the haul route, and any residences within this distance might be affected.

Depending on local geological conditions, explosive blasting during mine development and operations might be needed. Rock blasting would be expected to last approximately 6 months and would be heard within a 1,250-feet (380-m) radius. Blasting techniques are designed and controlled by blasting and vibration control specialists to prevent damage to structures or equipment. Noise controls may be implemented at the noise source (e.g., substitution of materials or equipment or changing work methods) or by attenuating noise propagation (e.g., use of barriers, enclosures, linings, or mufflers). These controls attenuate blasting noise as well. However, given the impulsive nature of blasting noise, it is critical that blasting activities be avoided at night and on weekends and that affected neighborhoods be notified in advance of scheduled blasts.

In summary, potential noise impacts from mine development on humans and wildlife would be anticipated near the mine sites and along the haul routes, but the impacts would be minor and limited to proximate areas unless these activities occurred near mine boundaries adjacent to nearby residences or communities or areas specially designated for wildlife concerns, if any. Implementation of measures (i.e., compliance measures, mitigation measures, and BMPs) and coherent noise management plans could minimize these impacts (DOE, 2014). Therefore, noise impacts from mine development would likely be SMALL to MODERATE.

Reclamation

Reclamation activities would be similar to conventional construction activities in terms of procedures and equipment; however, activities would generally proceed in reverse order and would also proceed more quickly; thus, the associated impacts would last for a shorter time and on a more limited scale. Potential noise impacts on nearby residences or communities would be correspondingly less than those from operational activities. During reclamation, heavy construction equipment would be used including backhoes, bulldozers, graders, loaders, track hoes, trucks, and scrapers. Heavy equipment used during reclamation is similar to that used during mine development and operations, so it is conservatively assumed that noise levels during reclamation would be the same as they were during the mine development and operations phase. A composite noise level of 95 dBA at a distance of 50 feet (15 m) is assumed. When only geometric spreading and ground effects among several sound attenuation mechanisms are considered (FTA, 2018, pp. 48-54), noise levels would attenuate to approximately 55 dBA at a distance of 1,650 feet (500 m) from the reclamation site. If a 10-hour daytime work schedule is considered, the EPA guideline level of 55 dBA L_{dn} for residential areas (EPA, 1974a, pp. A-36) would occur approximately 1,200 feet (360 m) from the site.

In addition, other attenuation mechanisms, such as air absorption, screening effects (e.g., natural barriers by terrain features), and skyward reflection due to temperature lapse conditions typical of daytime hours would reduce noise levels further. Due to the remote setting of mining activities, most residences are located beyond these distances; however, if reclamation activities occurred near the boundaries of the mines, noise levels at nearby residences could exceed the local limits. It is assumed that most reclamation activities would occur during the day, when noise is better tolerated, because the masking effects from background noise are better at that time than at night. In addition, reclamation activities at the mines would be temporary in nature (typically a few weeks to months depending on the size of the area to be reclaimed). Accordingly, reclamation within the mines would cause some unavoidable but localized short-term and minor noise impacts on neighboring residences or communities. The same measures (i.e., compliance measures, mitigation measures, and BMPs) adopted during the mine development and operations phase, identified below could also be implemented during reclamation activities. Accordingly, noise impacts from reclamation activities would be anticipated to be SMALL.

Conventional Milling

EPA has promulgated information that indicates ambient sound levels below 55 dB do not degrade public health and welfare. No increase in ambient sound levels was estimated for the noise-sensitive areas of Blanding and White Mesa (NRC, 1978, pp. 4-6 to 4-7). Activities associated with uranium milling for HALEU would change milling operations and therefore would not affect noise levels.

Best Management Practices

To reduce noise-related impacts:

- Maintain equipment in good working order in accordance with manufacturer's specifications.
- Limit noisy activities to the least noise-sensitive times of the day (daytime between 7 a.m. and 7 p.m.) and weekdays and limit idle time for vehicles and motorized equipment.
- Notify area residents of high-noise and/or high-vibration-generating activities (e.g., above-ground and below-ground blasting) in advance.
- Employ noise-reduction devices (e.g., mufflers) as appropriate.
- Provide a noise complaint process for surrounding communities.
- Site noise sources to take advantage of topography and distance; construct engineered sound barriers and/or berms as necessary.

1.3.11 Public and Occupational Health – Normal Operations

This section discusses potential public and occupational health impacts from uranium mining and milling activities that would support the Proposed Action described in Section 1.1, *Description of the Activity*. The analysis of impacts relies on analyses from previous NEPA documents that assessed the impacts from construction and operation of licensed/permitted uranium mining and milling facilities. In general, mines are located within relatively rural and undeveloped areas, away from populated areas.

All milling facilities regulated by the NRC or Agreement States are subject to the regulations at 10 CFR 20. These regulations address the health and safety of workers and the public from potential exposure to radiation from all phases of uranium milling. Facility operators are required to develop and implement an NRC-approved radiation protection program, which the NRC would monitor for compliance. The basic elements of a 10 CFR 20 radiation protection include (NRC, 2009a, pp. 2-40 to 2-41):

- Effluent Control. Effluents to air (e.g., radon, uranium particulates) and surface water must meet NRC limits in 10 CFR 20 for radioactive effluents and worker and public doses. Public doses are limited to 100 millirem (mrem) per year in 10 CFR 20.1301(a)(1) and worker doses are limited to 5 rem per year in 10 CFR 20.1201(a). Plans and procedures must include minimum performance specifications for control systems and frequencies of tests and inspections.
- External Radiation Exposure Monitoring Program. Each licensee must have a program designed to monitor worker exposure and ensure worker dose levels are as low as reasonably achievable and comply with NRC requirements in 10 CFR 20.
- Airborne Radiation Monitoring Program. Each licensee must have a program to determine concentrations of airborne radioactive materials (including radon) in the workplace during all phases of operation. Information from this program is used to verify and ensure worker exposures are as low as reasonably achievable and meet requirements specified in 10 CFR 20.
- Exposure Calculations. Each licensee must have procedure to document the methodologies used to calculate intake of airborne radioactive materials in the workplace during routine and nonroutine operations, maintenance, and cleanup activities.
- Bioassay Program. Each licensee must have a program that assesses ecological intake of uranium by workers routinely involved in operations where radioactive material can be inhaled. Action levels are set to maintain exposures as low as reasonably achievable and within worker requirements in 10 CFR 20.
- Contamination Control Program. Each licensee must have a contamination control program of standard operating procedures to prevent employees from entering clean areas or leaving the site while contaminated with radioactive materials.
- Environmental Monitoring Program. Each licensee must have a program to measure concentrations and quantities of radioactive and nonradioactive materials released to the environment. Surface water, groundwater, vegetation, food and fish, and soil and sediment measurements near and beyond the site boundary are to be a part of the program. Direct radiation and radon must also be measured.

Uranium recovery facilities are also subject to the EPA's uranium fuel cycle environmental standards in 40 CFR 190. These standards include an annual dose limit of 25 mrem per year from fuel cycle operations; not including any dose due to radon and its daughter products (radioactive elements resulting from the decay of radon) (NRC, 2009a, pp. 2-40).

A combination of ISR mining/milling, conventional mining and subsequent milling, and utilization of foreign sources could be used to meet the needs of the Proposed Action. For conventional mining techniques to fully provide the amount of uranium needed to support two enrichment facilities operating at a capacity of 25 MT of HALEU/yr, about 2.6 million MT of uranium ore per year would be required[5].

[5] Assuming an average uranium content of 0.1% for all uranium ores.

Any combination of the three sources identified above would reduce the quantity of ore mined conventionally. Since human health impacts associated with mining can be roughly correlated to the quantity of ore mined, impacts from mining would be correspondingly reduced.

ISR Mining

The ISR GEIS provides estimates of impacts for ISR facilities based on region. The document identifies four regions: Wyoming West; Wyoming East; Nebraska, South Dakota; and Wyoming; and Northwest New Mexico (NRC, 2009a, pp. 1-6, 2-4). Six Supplements to the ISR GEIS provide site-specific information for an additional six sites.

With regard to human health impacts from construction, operation, aquifer restoration, and decommissioning of an ISR facility, the ISR GEIS (NRC, 2009a) and Supplements used data from seven sites to assess impacts in the four geographical regions. The Supplements to the ISR GEIS did not identify significant differences between the impacts at these locations. Regardless of the ISR sites selected, the analysis of the ISR GEIS adequately addresses the impacts on human health.

Construction

Two potential hazards were identified for construction: fugitive dust bearing radioactive material, and combustion products from construction equipment. None of the sites evaluated in the ISR GEIS or its six supplements had quantities of radioactive material sufficient to be of concern due to fugitive dust exposure to workers or the public (NRC, 2009a, pp. 4.2-53).

Operation

ISR facilities use hazardous chemicals to extract uranium, process wastewater, and restore groundwater quality. The following 11 hazardous chemicals are typically used at ISR facilities in the largest quantities:

- Ammonia
- Sodium hydroxide
- Sulfuric acid
- Hydrochloric acid
- Oxygen
- Hydrogen peroxide
- Carbon dioxide
- Sodium carbonate
- Sodium chloride
- Hydrogen sulfide
- Sodium sulfide

The risks to workers and the public from the use and handling of these hazardous chemicals during normal operations at ISR facilities would be expected to be SMALL (NRC, 2009a, pp. 4.2-57).

Radiological risks to workers results primarily from the release of radon gas during processing activities. Worker doses from ISR facilities would be expected to be similar regardless of the facility's location because workers are expected to be involved in similar activities regardless of geographic location. As an example of dose to workers, the license renewal application for the Crow Butte ISR facility in Davis County, Nebraska, reports the average individual total effective dose equivalents for monitored employees for 1994–2006. This facility is assumed to be representative of an operating ISR facility because it is a commercial facility with many years of operating history. The largest reported annual individual worker dose from 1997 to 2006 was 713 mrem (NRC, 2009a, pp. 4.2-54). This dose is below the annual worker dose limit of 5 rem provided in 10 CFR 1201 (a).

Radionuclides can be released to the environment during ISR facility operation. Quarterly and biannual measurements of downwind concentrations of radon at an operational ISR facility boundary from 1991 to early 2007 were below 2.0 picocuries per liter (pCi/L) with a majority of measurements below 1 pCi/L (an exception at Crow Butte occurred during the second half of 2003 where potentially anomalous results peaked at 3.7 pCi/L). For comparison, these measured values are well below the NRC effluent limit for radon at 10 CFR Part 20, Appendix B of 10 pCi/L.

Radiological exposures to the public are also primarily associated with the release of radon gas from the ISR facilities. As such, these releases are not subject to the EPA's National Emission Standards for Hazardous Air Pollutant (NESHAP) limits of 10 mrem per year to a member of the public from airborne releases.[6] They are subject to 10 CFR 20 (a)(1) (100 mrem per year) and the 40 CFR 190 fuel cycle facility limits (25 mrem per year), although in practice almost all of the dose is a result of radon gas exposure, which is exempt from the 40 CFR limits. The ISR GEIS and all six supplements identified doses of between 0.4 and 31.7 mrem per year to a maximally exposed individual (MEI) either on the facility property or at the site boundary. The largest individual dose identified at an occupied residence was 4.5 mrem per year. All public dose estimates are within the requirements of 10 CFR and 40 CFR. The NRC identified these impacts as SMALL (NRC, 2009a, pp. 4.2-54; NRC, 2010, pp. 4-69; NRC, 2011a, pp. 4-89; NRC, 2011b, pp. 4-92) (NRC, 2014a, pp. 4-216; NRC, 2014b, pp. 4-100; NRC, 2016, pp. 4-125).

Three of the supplemental EISs also identified population doses. All were under 1 person-rem per year (ranging from 0.009 to 0.36 person-rem). The highest of these is slightly larger than the average dose to an individual in the United States from natural background radiation, about 310 mrem per year) (NRC, 2010, pp. 4-71; NRC, 2011b, pp. 4-91; NRC, 2014b, pp. 4-102).

Aquifer Restoration

The impacts from aquifer restoration are expected to be similar to those resulting from normal operations. As the two activities overlap and operations would be expected to be slowing down during aquifer restoration, the combined operational and aquifer restoration impacts would be similar to those described above for operations. Impacts may be extended for a couple of years as restoration activities would be expected to continue past facility operation (NRC, 2009a, pp. 4.2-59).

Decommissioning

Any ISR licensee would be required to submit a decommissioning plan that would meet the requirements of 10 CFR 20. Decommissioning impacts are expected to be SMALL, occur over a short time, and be transient in nature. The NRC therefore categorized their impacts as SMALL (NRC, 2009a, pp. 4.2-60).

Conventional Mining

Historical conventional mining and to an extent milling have resulted in legacy issues,[7] some of which impact the health of the local communities, including Native American peoples. By some measures, this legacy has had a significant health effect for some residents in the past and continues to affect health in the present. These issues may remain deeply embedded within the social history and collective psyche of these communities and continue to affect perceptions of communities toward new proposed projects (USDA, 2013).

[6] The analysis of public impacts did include impacts from a small amount of uranium from some of the ISR facilities. However, the public dose from this part of the release was a small fraction of the total public dose.

[7] Legacy issues pertain to the historical impacts of uranium mining, including peoples' biophysical, social, and political experiences.

Part of the legacy issues are the health effects experienced as a result of previous mining activity. The following discussion is from a Draft EIS for the Roca Honda Mine (USDA, 2013), but the sentiments regarding legacy issues are not isolated to this one mining region. By some studies, a direct result of previous mining activity is increased instances of diseases experienced by miners, their families, and other community members. As many of the miners were members of Native American communities, the health impacts were particularly felt by them and their families. There is a perception that the full extent of health impacts from uranium mining and milling remains uncertain (USDA, 2013).

In addition, in many areas where uranium mining may occur in the future there are unreclaimed mining sites, including on Native American lands that may continue to affect health.[8] While assessment programs and plans have been initiated to reclaim the land and rectify some of the environmental and health legacy, there is a feeling from some residents that the cleanup effort has not gone quickly enough. This has led to a lack of trust in government and in mining companies (USDA, 2013).

While actual impacts on human health from mines operated adhering to modern health and safety requirements (e.g., improved mine ventilation, more extensive dust control requirement for personnel and vehicles) and ore handling protocols are expected to be minor (see discussion below), perceived health impacts from operations on the part of Native Americans and others, along with actual changes to water and land from the project in the vicinity of sacred lands, may have real effects on the mental and physical health of some community members. This may include stress and anxiety levels, which in turn, impact the mental, physical, and social health effects of these local populations (USDA, 2013).

Uranium miners working in conventional uranium mines (primarily deep pit mines) are subject to potential health hazards resulting from occupational hazards (occupational injuries and fatalities), exposure to radiological material, and chemical hazards. The radiological exposure results from exposure to uranium and daughter products from uranium decay. Principal among these is exposure to radon gas in the uranium mines. Nonradiological hazards result from the chemical toxicity of uranium and vanadium, present in uranium mines.

Uranium mining can result in physical injuries or fatalities. The Final ULP PEIS used 2010 Bureau of Labor Statistics for 2010 to assess these hazards. Using the fatal occupational injury rate for the mining industry of 19.8 per 100,000 full-time workers, and the nonfatal occupational injury and illness rate of 2.3 per 100 full-time workers, the ULP PEIS concluded there would be 5 nonfatal injuries and illnesses[9] (DOE, 2014).

Data from 1985 to 1989 was used to estimate potential radiological impacts on miners. During that period, radiological exposure ranged from 350 to 433 mrem per year. Underground miners received larger doses than open-pit miners due to the accumulation of higher radon and airborne uranium dust concentrations in deep mines versus open-pit mines; these doses are less than the 5-rem limit in 10 CFR 835.202. Using the 433 mrem per year dose, the ULP PEIS estimated a latent cancer risk of 4×10^{-4} per year or a 1 in 2,500 chance of a miner developing cancer. Over 10 years of mine operation, this results in a 1 in 250 chance of developing cancer for an individual miner (DOE, 2014).

Exposure to chemicals, primarily vanadium and uranium, does present toxicological health risks to the miners. And while not considered to be fatal, exposure to high levels of vanadium in the air can result in lung damage (when in the form of vanadium pentoxide). Ingestion can cause nausea and vomiting.

[8] The Energy Act of 2020 includes a requirement option to provide that HALEU does not require extraction of uranium or development of uranium from lands managed by the Federal government, or cause harm to the natural or cultural resources of Tribal communities or sovereign Native Nations.

[9] These injury and fatality numbers were associated with Alternative 4, which assumed operation of 19 mines that employed a total of 218 miners for 10 years.

Animal studies (at exposure levels much higher than those found in the environment) have shown effects including reduced red blood cells, high blood pressure, and mild neurological symptoms. The Occupational Safety and Health Administration (OSHA) has limited exposure in the workplace to 0.1 milligrams per cubic meter (mg/m^3) for vanadium pentoxide fumes and 0.5 mg/m^3 for vanadium pentoxide dust. (ATSDR, 2012)

Exposure to uranium is known to result in kidney damage in humans mostly due to high acute exposures, whether inhaled or ingested. There is evidence that kidney damage due to high occupational exposures can eventually heal after the exposure ends. Non-malignant respiratory diseases (e.g., fibrosis, emphysema) have been observed in human and animal studies. Extremely high exposure may be lethal (may lead to renal or respiratory failure). Uranium exposure to children is expected to have the same impacts as on adults, and there is no evidence that children are more susceptible than adults. Neurobehavioral changes have been seen in animal studies of high exposures and conflicting evidence suggests a potential decrease in fertility among subjects of animal studies. However, human studies have not confirmed these same effects. OSHA limits for insoluble and soluble airborne uranium in the workplace are 0.25 and 0.05 mg/m^3 for an 8-hour time weighed average. (ATSDR, 2009)

Using potential air concentrations in the mines, a hazard index of slightly more than 1 was estimated. A hazard index of 1 implies that non-cancer health effects are possible, but not certain. Mitigation features could potentially reduce the miners' exposure to vanadium. Modern mining procedures include dust control and proper ventilation. These features have the potential to reduce both hazardous chemical exposure, as well as radiological exposure (DOE, 2014).

The limited lifetime of uranium mines means that the mines would be reclaimed after the 10-year operational period. During reclamations, workers would be exposed to the same hazards as the miners during operation. Reclamation worker exposure would be significantly less than the miners' exposure. Estimates for worker doses range from 14 to 32 mrem for the duration of reclamation. This corresponds to a lifetime cancer risk of about 1 in 100,000. The hazard index associated with chemical toxicity of uranium and vanadium would be less than one, meaning no health impacts would be expected (DOE, 2014).

The ULP PEIS also provided estimates of population health impacts associated with uranium mining activities. The ULP PEIS addressed two individual scenarios: a residential exposure scenario and a recreational scenario, and a population dose.

The primary source of radiation exposure for members of the public would be from the release of radon gas from mining operations. Residential exposures depend upon the size of the mine and the assumed distance from the mine to the residence. The quantity of radon released from a medium and large mine was assumed to be two and four times that released from a small mine, which is assumed to mine 12,000 tons of uranium ore per year (24,000 tons for a medium mine and 48,000 tons for a large mine). The ULP PEIS estimated the dose to a residential receptor at distances ranging from 500 m to 5,000 m. At 500 m the residential receptor dose was estimated to range from 7.8 mrem per year for a small mine to 31 mrem per year for a large mine. The NESHAP limit for an individual dose from a uranium mine (40 CFR 61, Subpart B) is 10 mrem per year. For a medium-sized mine, the residential receptor dose is above this limit at 1,000 m (11.3 mrem per year) and drops below this limit by 1,500 m (7.44 mrem) per year. For a large-sized mine, the residential receptor dose is slightly above this limit at 2,000 m (10.7 mrem per year) and drops below this limit by 2,500 m (8.2 mrem per year). All of these dose estimates were generated for a resident living in the dominant wind direction from the mine. Residents in other directions would be expected to receive a smaller dose (DOE, 2014, pp. 4-96, 4-206).

Since the conservatively estimated dose to a resident could exceed the NESHAP criteria, mitigation measures would be needed to reduce the public receptor dose if site-specific data result in receptor doses above the NESHAP limit. Measures for reducing impacts on the general public could include:

- Increase the ventilation flow rate
- Reroute ventilation flow
- Reroute ventilation to a new vent
- Modify the vent stack
- Decrease the vent stack diameter
- Increase the vent stack release height
- Construct additional bulkheads (DOE, 2014)

The maximum latent cancer fatality (LCF) risk for a resident living close to a small underground uranium mine was estimated to range from 1×10^{-6} per year at a distance of 3.1 miles (5,000 m) to 1×10^{-5} per year at a distance of 0.3 miles (500 m). That is, the probability of developing an LCF ranges from 1 in 1,000,000 at a distance of 3.1 miles (5,000 m) to 1 in 100,000 at a distance of 0.3 miles (500 m) from each year of exposure. The probability would increase by a factor of two or four if the resident lived close to a medium-sized or a large underground mine, respectively (DOE, 2014, pp. 4-97).

The recreational individual dose estimates were much less than those estimated for the resident receptor. The lower doses were primarily due to the limited time the recreational receptor would be exposed to radionuclides associated with camping on waste-rock piles. Provided the waste-rock piles are properly covered, doses to recreational users would be less than 1 mrem.

Population doses from the operation of the underground mines were estimated to be between 16 and 93 person-rem during the peak year of operation. From the population doses and population figures provided in the ULP EIS, estimates were made for populations ranging in size from 27,000 to 178,000, resulting in average individual doses ranging from 0.52 mrem per year to 0.93 mrem per year. The assessment assumed all uranium mine leases were within the same lease tract (all affecting the same population). The range of population doses represents doses associated with releases from the operation of 19 mines located at the center of 4 different lease tracts. Should the leases be distributed among different tracts, the total population would be larger, but the total population dose would not change significantly. Therefore, individual doses would be smaller (DOE, 2014, pp. 4-209).

Conventional Milling

The production of the approximately 2,500 MT of yellowcake (required to support 2 enrichment facilities producing 25 MT of HALEU per year each) needed to support the Proposed Action could exceed the capacity of the licensed White Mesa facility to process uranium ore. The facility is licensed to process on average 2,000 tons (about 1,800 MT) of uranium-bearing ore per day (DOE, 2014). Assuming the ore is on average 0.19% uranium[10], this equates to 1,270 MT of yellowcake per year[11].

Workers at a uranium mill would be exposed to similar hazards as those described for the ISR production facilities described above. Occupational risks would be expected to be similar to those associated with the ISR facilities as described above. Risks to workers from exposure to hazardous chemicals would be

[10] The average uranium content of the ore mined from the mines assessed in the ULP EIS (DOE, 2014, pp. 1-12 to 43) was 0.193%.

[11] The White Mesa facility is licensed to produce 3,600 MT of yellowcake per year (DOE, 2014). If all of the feed material were uranium ore, the ore would need to have a uranium content of 0.5% for the facility to operate at its licensed capacity for product.

expected to be small from activities requiring the handling of these chemicals during normal operations (NRC, 2009a, pp. 4.2-57).

Worker radiological doses would also be expected to be similar to those estimated for ISR workers. As noted in the ISR GEIS, the highest worker dose from 1997 through 2006 was 713 mrem (NRC, 2009a, pp. 4.2-55). The ULP PEIS identified a cumulative impact on workers equivalent to 25% of the Federal limits for mill workers. The regulatory limit for mill workers is 5 rem per year (Utah State Rule R313-15-201 and 10 CFR 20.130(a)(1)). This results in an estimate of about 1.25 rem per year for an individual worker: slightly higher than the ISR facility worker dose estimate.

The Utah Division of Waste Management and Radiation Control evaluated the dose to various public receptors for operation of the White Mesa Mill during the years 2007 to 2014. During this period, the mill did not operate full time; the highest usage occurred in 2011 when the plant operated at 68% capacity. Annual doses to three public receptors were evaluated in the assessment: a residential individual, a worker at a facility other than the White Mesa Mill, and a recreational camper using the Federal lands near the White Mesa Mill for no more than 14 days (the limit for camping on Federal lands). The State of Utah and EPA regulations provide limits for public exposure to radiation from fuel cycle facilities. State Rule R313-15-301 specifies that a member of the public cannot be exposed to a dose that exceeds 100 mrem in a calendar year from the licensee's operations, including from radon emissions. Utah R313-15-101(4) states that the individual dose from air emissions of radioactive material to the environment, excluding radon and its decay products, is limited to 100 mrem in a calendar year. EPA's requirement found in 40 CFR 190.10(a) limits an individual member of the public to a dose of less than 25 mrem to the whole body. Based on the assessment of operating data, considering the three receptors identified above, the Utah Division of Waste Management and Radiation Control estimated the maximum for these three doses during the period considered to be 6.17 mrem, 2.95 mrem, and 16.2 mrem: all below the regulatory limits (UDWMRC, 2017).

In response to a request from the Ute Mountain Ute Tribe, the Agency for Toxic Substances and Disease Registry (ATSDR) provided assistance in evaluating radiological and chemical data collected by the Tribe for the area around the White Mesa Uranium Mill. The request asked for assistance in evaluating "(1) if exposures could occur from inhalation of suspended radiological waste products and if on-site settling ponds could impact aquifers used for drinking water; (2) if radon from the mill and settling ponds is impacting people at the mill fenceline and at residences nearby; (3) if soil and vegetation in the public lands surrounding the mill poses a health hazard to people; and (4) if springs and seeps pose a health hazard to people." With the data provided, the ATSDR was able to reach the following conclusions:

- Residential air exposures do not result in elevated risks of adverse cancer or non-cancer health effects from radiological material. Annual doses from airborne radionuclides ranged from 9 to 23 mrem per year.
- Residential drinking water quality reports are within EPA regulatory limits. For radiological water quality standards, these limits have been shown to be protective of human health and are below the ATSDR minimal risk level and were not evaluated further.

Due to a lack of information, the ATSDR was not able to address the potential impacts from radon nor the potential impacts from radionuclides in the environment (soil, vegetation, non-public water supplies) (ATSDR, 2023).

Normal Operations Impact Summary for HALEU Mining and Milling

Some combination of conventional mines/mills and ISR facilities could be used to support the Proposed Action. Individual worker doses for conventional mines supporting the HALEU fuel cycle would be no different than for any uranium miner. The number of mines required to support the total annual requirement for uranium ore would be less than the 19 mines used in the analysis of the ULP PEIS (total capacity of 2,000 tons per day or almost 5 million tons per year). If all of the uranium mines evaluated in the ULP EIS were used at full capacity for the Proposed Action, they would supply less than half of the material needed for the production of 50 MT of HALEU per year. The individual miner annual dose would be roughly 433 mrem per year. Conventional milling would result in mill workers receiving an annual individual dose of between 700 and 1,200 mrem. The capacity of the White Mesa milling facility is only about half of the capacity required to support the Proposed Action (50 MT per year). The use of ISR facilities would result in average worker doses of no more than 713 mrem per year. The six facilities analyzed in the supplements to the ISR GEIS (NRC, 2009a) have a total capacity of more than twice the quantity needed for the Proposed Action. Average worker doses would depend upon the mix of conventional mining and milling and ISR operations used to support the Proposed Action. Regardless of the facilities used all miners and process facility workers would be expected to receive doses well below the regulatory limit of 5 rem per year. The use of foreign sourced uranium for any portion of the HALEU fuel supply would correspondingly reduce the number of mines required to support the Proposed Action.

Exposure to chemicals, primarily vanadium, do present non-cancer health risks to the miners. Using potential air concentrations in the mines, a hazard index of slightly more than one was estimated. A hazard index of one implies that non-cancer health effects are possible, but not certain. Mitigation features could potentially reduce the miners' exposure to vanadium. Modern mining procedures include dust control and proper ventilation. These features have the potential to reduce both hazardous chemical exposure, as well as radiological exposure (DOE, 2014).

Health risks to individual members of the public are limited to exposure to radiological materials emitted from the mines, mills, and ISR facilities.

Radiological exposures to the public are primarily associated with the release of radon gas from the ISR facilities. These releases are not subject to the EPA's NESHAP limits of 10 mrem per year to a member of the public from airborne releases.[12] The facilities are subject to 10 CFR 20 (a)(1) (100 mrem per year) and the 40 CFR 190 fuel cycle facility limits (25 mrem per year), although in practice almost all of the dose is a result of radon gas exposure, which is exempt from the 40 CFR limits. Assuming that any individual ISR facility would be operated at full capacity to support the Proposed Action results in individual maximum and population doses equivalent to those presented in the ISR GEIS and its supplements. The ISR GEIS and all six supplements identified doses of between 0.4 and 31.7 mrem per year to an MEI either on the facility property or at the site boundary. Population doses were all under a person-rem per year (ranging from 0.009 to 0.36 person-rem). Two of the larger-capacity ISR facilities would be capable of providing all of the yellowcake needed for the Proposed Action. Assuming these two facilities have the larger population, doses would result in a total population dose of less than a person-rem (about 0.7 person-rem).

Population doses from the operation of conventional mines were estimated to be between 16 and 93 person-rem during the peak year of operation. These estimates were based on the operation of all 19 mines (ULP PEIS). Operation of the White Mesa Uranium Mill at full capacity would be sufficient to meet less than half of the needs of the Proposed Action. This results in an estimated public dose to an individual of about 16 mrem per year from operation of the mill.

[12] The analysis of public impacts did include impacts from a small amount of uranium from some of the ISR facilities. However, the public dose from this part of the release was a small fraction of the total public dose.

As with the impacts on workers, public health impacts would depend upon the mix of conventional mines/mills, ISR facilities, and foreign supplies used to meet the needs of the Proposed Action.

1.3.12 Public and Occupational Health – Facility Accidents

Construction

Accidents during construction would be from standard industrial hazards. Accidents from standard industrial hazards are described in Section 1.3.11, *Public and Occupational Health – Normal Operations*.

Operation

Uranium mining and milling techniques are designed to recover the uranium from uranium-bearing ores. As discussed in Section 1.1.2, *Description of the Process*, various physical and chemical processes may be used, and selection of the uranium milling technique depends on the physical and chemical characteristics of the ore deposit and the attendant cost considerations (NRC, 2009a, p. xxxvi). ISR mining and milling is the predominant uranium extraction method used in the United States. Because ISR techniques may not be appropriate in all circumstances, conventional mining (underground or open-pit/surface mining) and milling techniques are viable alternative technologies.

Section 1.1.3, *Potential Facilities*, discusses potential facilities for ISR, and conventional mining and milling. These facilities are considered because they have existing NEPA coverage and impacts would be similar for any facility used to supply uranium for the Proposed Action. Conventional mining activities involve standard industrial hazards, and any radiological accidents would be bounded by accidents associated with milling. Therefore, conventional mining is not considered further in the accident analysis in the Technical Report.

The accident scenarios for conventional milling and ISR are quite similar for the locations described in Section 1.2, *Approach to NEPA Analyses*, and for HALEU. The differences in accident consequences would primarily be due to differences in assumed worker exposure times and in site-specific parameters such as distances to receptors and population distribution. The production capacity of a combination of these uranium milling operations would exceed the capacity required for HALEU. The accidents associated with conventional milling and ISR are considered in the following section and the accident consequences are expected to be similar to or greater than the consequences of accidents related to HALEU operations.

Accident Consequences

Radiological and nonradiological accidents could involve processing equipment failures, which could result in yellowcake slurry spills, radon gas releases, or uranium particulate releases. Consequences of accidents to workers and the public would be generally low, with the exception of a dryer explosion, which could result in worker dose above NRC limits. The likelihood of such an accident would be low, and therefore, the risk would also be low. Potential nonradiological accidents impacts include high-consequence chemical release events (e.g., NH_3) for both workers and nearby populations. As a result of operators following commonly applied chemical safety and handling protocols, the likelihood of such release events would be low based on historical operating experience at NRC-licensed facilities. Consequently, the impacts are considered to be SMALL to MODERATE (NRC, 2009a, pp. Lii, Executive Summary) and are further discussed below. Nuclear criticality is not a hazard for mining and milling because the nuclear material consists of natural (not enriched) uranium throughout the processes.

ISR Mining

Radiological Impacts from ISR Process Accidents

A radiological hazards assessment considered the various stages within the ISR process. Consequences from accident scenarios were conservatively modeled (NRC, 2009a, pp. 4.2-55; NRC, 2001). To prevent or mitigate accidents, ISR facilities are designed to incorporate controls to reduce the exposure to individuals in the event of an accident. Emergency response procedures would be in place to direct employee actions in the event of an accident. As part of worker protection, respiratory protection programs would be in place. In addition to the mitigation items discussed after each accident, additional measures would be in place to protect workers and members of the public. Employee personnel dosimetry programs are required. As part of worker protection, respiratory protection programs are in place as well as bioassay programs that detect uranium intake in employees. Contamination control programs involve surveying personnel, clothing, and equipment prior to their removal to an unrestricted area (NRC, 2009a, pp. 4.2-55 to 4.2-56).

Thickeners are used to concentrate the yellowcake slurry before it is transferred to the dryer. Radionuclides could be inadvertently released to the atmosphere through a thickener failure and spill. The analysis assumed a tank failure or pipe break that caused the tank contents to spill with 20% of the thickener content being spilled inside and outside the building. For receptor distances of 100 and 500 m, radiation doses were calculated to be 25 mrem and less than 1 mrem, respectively. Both of these are less than 25% of the 10 CFR 20 annual dose limit for the public of 100 mrem. Because dose estimates increase for closer distances, smaller consequences would be expected to members of the public in urban areas. There could be external doses from the spill to workers, but off-site individuals would be too far away to observe any effects. Doses to the unprotected worker could exceed the 5-rem annual dose limit specified in 10 CFR 20 if workers did not evacuate the area soon enough after the accident. Spills or leaks would normally be detected by loss of system pressure, observation, or flow imbalance. Operating procedures are developed for spill response. Air samples are also routinely collected, and action levels are set at 25% of limits so that samples can be taken more frequently, and investigations can be undertaken (NRC, 2009a, pp. 4.2-55 to 4.2-56).

Radon-222 released to the air, especially in an enclosed area without adequate ventilation, presents a potential hazard. A pipe or valve failure at the ion-exchange columns used in ISR processing facilities could be a source for such an exposure. Dose calculations were performed for an instantaneous release of 8×10^5 picocuries per liter. For a 30-min exposure, doses to a worker within the building performing light activity without respiratory protection was 1.3 rem, which is 26% of the 5-rem annual dose limit specified in 10 CFR 20. Even though radon concentration within the facility could be high if such a scenario occurred, only a small amount would be released to the environment to potentially expose a member of the public at 500 m because little radon is expected to leave the building. Air samples are also routinely collected, and action levels are set at 25% of limits so that samples can be taken more frequently, and investigations can be undertaken if such an accident were to occur (NRC, 2009a, pp. 4.2-55 to 4.2-56).

Dryers used to turn wet yellowcake into dry powder present another potential hazard at an ISR facility. The two main types of dryers used are multihearth dryers for older facilities and rotary vacuum dryers for new facilities. The multihearth dryers are assumed to be more hazardous than the rotary vacuum dryers because they operate at higher temperatures and may be direct gas fired. An explosion in the dryer could disperse yellowcake into the central processing facility. Assuming a conservative release of 2.2 lbs of yellowcake and a respirable fraction of 1, the dose to off-site individuals at 200 m would be below the 10 CFR 20 public dose limit of 100 mrem. The analyses also showed that the radiation dose to a worker in a full-face-piece powered air-purifying respirator would result in a dose of 8.8 rem, which would exceed the annual worker dose limit of 5 rem by 76% (NRC, 2009a, pp. 4.2-55 to 4.2-56).

In the unlikely event of an unmitigated accident, radiation doses to the workers could have a MODERATE impact depending on the type of accident, but radiation doses to the general public would have only a SMALL impact.

Nonradiological Impacts from ISR Process Accidents

ISR facilities use hazardous chemicals to extract uranium, process wastewater, and restore groundwater quality. The following hazardous chemicals are typically used at ISR facilities in the largest quantities:

- NH_3
- Sodium hydroxide
- H_2SO_4
- Hydrochloric acid
- O_2
- Hydrogen peroxide
- Carbon dioxide
- Sodium carbonate
- Sodium chloride
- Hydrogen sulfide
- Sodium sulfide

If released by an accident, these chemicals could pose significant hazards to workers and the public. As with other industrial operations, releases of hazardous chemicals of sufficient magnitude to adversely impact workers and the public are possible, but are generally considered unlikely, given commonly applied safety practices and the history of safe use of these chemicals at NRC or Agreement State-regulated ISR facilities (NRC, 2009a, pp. 4.2-57 to 4.2-59).

In addition, strong bases such as NH_3 and sodium hydroxide and strong acids such as H_2SO_4 and hydrochloric acid strongly react with each other, and with water, if accidentally mixed. During operations, precautions are taken to ensure that these chemicals do not inadvertently come into contact with each other. Oxidizers such as hydrogen peroxide and O_2 also can react strongly with natural gas (piped to the ISR facility) should a spark or ignition source be present (NRC, 2009a, pp. 4.2-57 to 4.2-59).

Potential hazards to workers or the public due to specific types of high-consequence, low-probability accidents (e.g., a fire or large magnitude sudden release of chemicals from a major tank or piping system rupture) are not specifically analyzed. The application of common safety practices for handling and use of chemicals is expected to lower the likelihood of these severe release events and therefore lower the risk to acceptable levels (NRC, 2009a, pp. 4.2-57 to 4.2-59).

Conventional Mining

Conventional mining activities involve standard industrial hazards, and any radiological accidents would be bounded by accidents associated with milling. Therefore, conventional mining is not considered further in the accident analysis in the Technical Report.

Conventional Milling

Accident analysis from two NRC EAs (the *Environmental Assessment for Renewal of Source Material License No. SUA-1358* (NRC, 1997a) and the *Environmental Assessment for Source Material License SUA-1350, Renewal for Operations and Amendment for the Reclamation Plan (Rev 1)*[13] (NRC, 1999a)) were used to represent typical accident scenarios and consequences for milling operations. The White Mesa facility is operating, and the Sweetwater facility previously operated but is currently shutdown. Accident scenarios considered included:

- Failure of storage tanks and piping
- Fires and explosions
- Centrifuge failure
- Minor pipe or tank leaks
- Tailing impoundment system accidents

Failure of Storage Tanks and Piping

Tanks are used at a conventional mill to store a variety of industrial chemicals, process fluids, and slurries, as well as flammable liquids. Various systems have been implemented to contain or direct routine or unplanned spillage. Tanks that are most likely to overflow are equipped with high-level alarms (alarm sounds in the control room) to reduce the possibility of spillage due to tank overflow. Spills resulting from the failure of any chemical holding tank would first be contained by engineered dikes or curbs and mill sumps. If the volume was too great, such as that from a rupture in one or more of the large production tanks, flow would be captured by the catchment basin (NRC, 1997a, pp. 21–22; NRC, 1999a, p. 21).

Fires and Explosions

The most likely location for a fire is in the solvent extraction (SX) building or dryers for yellowcake and vanadium. The SX process is located in a separate building and can hold up to approximately 6,700 lbs of uranium at a time, assuming an ore grade of 0.2% U_3O_8. Approximately 12,500 gal of kerosene are contained in the SX process, and this kerosene represents the greatest potential for a serious fire at the site. The SX building is equipped with an automatic sprinkler system capable of foam injection, and 30-lb portable foam fire extinguishers are spaced at 50-foot (15-m) intervals around the area. Safety precautions are in place to ensure that a fire in one of the process tanks would be contained before other tanks are damaged. Smoke generated by a fire would be released to the atmosphere through air vents in the top of the building (NRC, 1997a, p. 22; NRC, 1999a, p. 21).

Fire is not expected to cause significant impact beyond the NRC site boundary. The short-term release of smoke, soot, and unburned hydrocarbons would decrease air quality and potentially cause some damage to vegetation within the immediate vicinity of the plant, but the effects would be minimal in nature due to wind dispersion. The conservative release estimate dose is approximately 25 mrem (NRC, 1999a, p. 21).

The consequences of explosion accidents are limited by the concentration of yellowcake that can be maintained in the air of the enclosed yellowcake dryer room. The quantity of yellowcake that could be released from the room is estimated to be approximately 2.25 lbs. Individuals at the closest residence (28 km [17 miles]) could receive a 50-year committed dose to the lungs and whole-body dose of

[13] The *Final Environmental Assessment for the Proposed Renewal of SUA-1350, Sweetwater Uranium Project in Sweetwater County, Wyoming* (NRC, 2018), confirmed the results of the accident analysis in the 1997 EA for this facility.

approximately 0.49 mrem and 3×10^{-4} mrem, respectively. These values are significantly below the radiation dose standards (NRC, 1999a, p. 21).

Centrifuge Failure

Prior to drying, the thickened yellowcake slurry would be dewatered by use of a centrifuge. If the centrifuge rotor fails, it could conceivably penetrate a tank containing uranium solution or slurry, releasing radioactive materials into the interior of the mill building. The entire contents of a tank, however, would be contained within sumps and would not leave the mill building (NRC, 1999a, p. 22).

Minor Pipe or Tank Leakage

Minor pipe or tank leakage of uranium-bearing slurries and solutions can occur at the acid leach, washing and clarification, and SX stages of the mill. Human error, during the filling or emptying of tanks or the failure of valves or piping in the process, would result in spills that may occur periodically during operation of the mill. The entire content of any spill would be contained within the mill sumps or diked area and would not leave the mill building. Any spillage that may occur would be pumped back into the process system (NRC, 1997a, pp. 21–22; NRC, 1999a, p. 21).

Tailings Impoundment System Accidents

At the average estimated processing rate, approximately 125 tons per hour of sand, silt, and clay-sized particles would be transported to the tailings cells through the tailings disposal system piping. A rupture in the main tailings delivery pipe between the mill and operating tailings cell would release material within containment berms then into sumps for re-entry into the mill process, or the slurry would be pumped to the tailings cell. The tailings would be pumped into an impoundment through multiple discharge laterals. The flow of any material released from the rupture of one these laterals would be toward the interior of the tailings impoundment, where it would be contained along with the existing tailings material (NRC, 1999a, p. 22).

The potential for seismic and flood damage to the tailings dam would be addressed for the site and the impoundment design would be evaluated by the NRC or Agreement State. A diversion channel would be designed and built for the probable maximum precipitation event, to protect the tailings impoundment dams for up to 1,000 years (NRC, 1999a, p. 22).

A worst-case scenario is assumed for assessing the potential radioactive release from a tornado strike even though the probability of a tornado occurring is quite small. It is assumed that 3 days of yellowcake production at average throughput rates and an ore grade of 0.2% U_30_8 (11,160 lbs/day of yellowcake × 3 days = 33,480 lbs) is not packaged in containers; an inventory of 50 tons of yellowcake is on-site when a tornado strikes; and 15% of the contained material is released. Thus, it is assumed that the tornado lifts about 48,480 lbs of yellowcake. Further, it is conservatively assumed that all of the yellowcake is in a respirable form, and that all of the material is entrained as the vortex passes over the site (NRC, 1999a, p. 22).

The maximum exposure is predicted at approximately 4 km (2.5 miles) from the mill, where the 50-year committed dose to the lungs of an individual is estimated to be 1.60×10^{-3} mrem. For individuals at the closest residence to the site, the 50-year committed dose is estimated to be 6.6×10^{-5} mrem. These values are significantly lower than the 40 CFR 190 standard for nuclear fuel cycle facilities (25 mrem annual dose equivalent), or the 10 CFR 20 50-year dose commitment limit (100 mrem annual dose equivalent) (NRC, 1999a, p. 22).

Accident Impact Summary for HALEU Mining and Milling

Construction

Accidents during construction would be from standard industrial hazards. Accidents from standard industrial hazards are described in Section 1.3.11, *Public and Occupational Health – Normal Operations*.

Operation

In the unlikely event of an unmitigated accident, radiation doses to the workers could have a MODERATE impact depending on the type of accident, but radiation doses to the general public would have only a SMALL impact. Radiological accidents are not expected to result in doses to a member of the public above a few millirem. The fire scenario at the Sweetwater Mill yields an individual dose of approximately 25 mrem while other accidents yield doses of less than a millirem. Doses to workers could exceed the 5-rem annual dose limit specified in 10 CFR 20.

Standards for handling and managing hazardous chemicals in the workplace have been developed by relevant regulatory agencies and industries. Specific quantities or uses of chemicals that require certain controls, procedures, or safety measures are defined in these standards. Key aspects of applicable regulations are shown below:

- 40 CFR 68, Chemical Accident Prevention Provisions. This regulation lists regulated toxic substances and threshold quantities for accidental release prevention.
- 29 CFR 1910.119, Occupational Safety and Health Administration Standards – Process Safety Management of Highly Hazardous Chemicals. This regulation lists highly hazardous chemicals and toxic and reactive substances (chemicals that can potentially cause a catastrophic event at or above the threshold quantity).
- 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response. This regulation instructs employers to develop and implement a written safety and health program for their employees involved in hazardous waste operations. The program shall be designed to identify, evaluate, and control safety and health hazards and provide for emergency response for hazardous waste operations.
- 40 CFR 355, Emergency Planning and Notification. This regulation lists extremely hazardous substances and their threshold planning quantities so that emergency response plans can be developed and implemented. There are about 360 extremely hazardous substances. Over a third of them are also Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) hazardous substances. This regulation also lists reportable quantity values for these substances for reporting releases. The reportable quantities are for any CERCLA hazardous substances identified in 40 CFR 302, Table 302.4.
- 40 CFR 302.4, Designation, Reportable Quantities, and Notification – Designation of Hazardous Substances. This regulation lists CERCLA hazardous substances. There are approximately 800 of these substances, and they are compiled from the (1) CWA, Sections 311 and 307(a); (2) CAA, Section 112; (3) Resource Conservation and Recovery Act, Section 3001; and (4) Toxic Substance Control Act, Section 7.

Requirements from these regulations for the chemicals in use at mining and milling facilities may cause an increased level of regulatory oversight regarding possession, storage, use, and subsequent disposal of these chemicals. Compliance with the necessary requirements would reduce the likelihood of an accidental release. Off-site impacts from chemical accidents would be SMALL, while impacts on workers involved in response and cleanup could receive MODERATE impacts that would be mitigated by establishing procedures and training requirements.

1.3.13 Traffic

This section discusses potential traffic impacts from increased vehicles related to proposed HALEU mining activities. The analysis of impacts relies on analyses from previous NEPA documents that assessed the impacts from construction and operation of licensed/permitted uranium mining and milling facilities.

Mining activities would generate vehicle trips from trucks (transporting equipment, materials, supplies, and wastes) and from personal vehicles of commuting workers. A vehicle trip is defined as a one-way trip movement; a round trip or a shipment is defined as two vehicle trips. Annual average daily traffic (AADT) is a measure of the average daily number of vehicles that pass through a given segment of roadway and is indicative of traffic conditions (i.e., higher AADT volumes lead to increases in traffic congestion and delays). Because the mining sites are typically located in remote areas, roadways in the project region experience relatively low to moderate levels of daily traffic. A review of recent AADT data from state databases indicates that public roadways leading up to the existing permitted mining sites currently have excess capacities.

ISR Mining

Table 2.8-1 of the ISR GEIS (NRC, 2009a) presents vehicle trip estimates for the construction, operation, and decommissioning phases of a proposed ISR facility. The ISR GEIS estimated 1 daily truck shipment (or 2 vehicle trips per day) for construction activities and less than 5 daily truck shipments (or 10 vehicle trips per day) for operation could occur. The majority of daily vehicle traffic would be generated by commuting personnel. The ISR GEIS estimated that staff levels at ISR facilities range from about 20 to 200, depending on the scheduling of construction, drilling, and operational activities. For the Technical Report, the traffic analysis conservatively assumes that 400 daily vehicle trips from commuters would serve as an upper bound for potential daily traffic volumes (i.e., assuming 200 employees would result in 1 round trip or 2 vehicle trips per day).

Additional vehicle trips for an ISR facility could result in increased congestion, delays, and traffic hazards on the highways. Increases in the rate of required road maintenance could also occur from high traffic demands. Considering the relatively low existing regional AADT volumes, operation of an ISR facility would result in a small potential increase in daily traffic from trucks (up to 10 vehicle trips per day). During the peak commuting hours, the highways leading up to a mining site would experience the greatest traffic impacts as the volume of personal vehicles could result in noticeable congestion and delays for other roadway users. During peak mining activities, it is estimated that up to 200 vehicle trips over a commuting period could occur. It is anticipated that regional roads would have the capacity to handle increases in daily traffic as recent AADT volumes are relatively low to moderate; however, due to the potentially high increase in traffic volumes during commuting hours, traffic impacts from mining activities at ISR facilities would range from SMALL to MODERATE, depending on the number of personnel required.

Conventional Mining

For a proposed conventional mining facility, Alternative 4 of the 2014 ULP PEIS (DOE, 2014) conservatively analyzed impacts for a peak year of mining activities. As such, the following estimates on the number of workers and truck shipments were used for the Technical Report to provide an upper bound for potential traffic impacts:

- Section 4.4.8 of the 2014 ULP PEIS provided an estimate of 229 workers during peak mining activities. This would result in approximately 229 daily round trips (or 458 vehicle trips) from commuting workers.
- Section 4.4.10.1.1 of the 2014 ULP PEIS estimated 80 daily truck shipments (or 160 vehicle trips per day) from the mines to a mill. It was estimated that this would result in about 5 additional truck shipments per hour in each direction, assuming a 16-hour workday for truck transport.
- Therefore, the Technical Report, it is assumed that combined vehicle trips from conventional mining activities would total up to 618 vehicle trips per day.

The additional vehicle trips from a conventional mine could result in increased congestion, delays, traffic hazards, and maintenance on the highways. When considered with the regional AADT volumes typical of rural areas, the increases in daily traffic from trucks (up to 160 vehicle trips per day) would be low to moderate. During the peak commuting hours, the highways leading up to a mining site would experience the greatest traffic impacts as the volume of personal vehicles could result in noticeable congestion and delays for other roadway users. During peak mining activities, it is estimated that up to 229 vehicle trips over a commuting period could occur. It is anticipated that regional roads would have the capacity to handle increases in daily traffic as recent AADT volumes are relatively low to moderate; however, due to the potentially high increase in traffic volumes during commuting hours and the increase in daily truck traffic, traffic impacts from conventional mining activities would range from SMALL to MODERATE, depending on the number and size of mining facilities that could be operating in a mining location.

Conventional Milling

For activities at a milling facility, Alternative 3 of the 2014 ULP PEIS (DOE, 2014) conservatively analyzed impacts for a peak year of mining activities (i.e., impacts resulting from the largest number of mines that could be operating simultaneously); Section 4.3.10.2.1 of the 2014 ULP PEIS estimated 40 daily truck shipments (or 80 vehicle trips per day) of ore to the White Mesa Mill would occur under Alternative 3. Since the 40 daily truck shipments is a conservative estimate, it is assumed that other miscellaneous trucks for supplies, materials, and wastes would be covered under this estimate. Section 2.1.4.2 of the 2014 ULP PEIS noted that 150 employees worked at the White Mesa Mill under full operating conditions. As such, it is assumed that 150 workers would generate 300 daily vehicle trips. Therefore, a combined traffic volume of 380 daily vehicle trips from activities at the White Mesa Mill provides an upper bound for traffic impacts.

AADT volumes on US-191, which serves the White Mesa Mill, range from 2,300 to 3,200 vehicles a day (UDOT, 2023). Possible activities from the Proposed Action at the White Mesa Mill could increase the daily traffic volumes on this highway between 10% and 20%. However, the total AADT volumes are still considered relatively moderate and would remain within the operating capacity of US-191. Therefore, traffic impacts from activities at the White Mesa Mill due to the Proposed Action are considered SMALL.

1.3.14 Socioeconomics

The following section discusses potential socioeconomic impacts from uranium mining and milling activities that would support the Proposed Action described in Section 1.1, *Description of the Activity*. The analysis of impacts relies on analyses from previous NEPA documents that assessed the impacts from construction and operation of licensed/permitted uranium mining and milling facilities. These are identified for the specific facilities below but include the ISR GEIS (NRC, 2009a), the 2014 Final ULP PEIS (DOE, 2014), 1997 White Mesa EA (NRC, 1997a), and the 2018 Sweetwater EA (NRC, 2018). In general, mining locations are located within relatively rural and undeveloped areas.

Major industrial projects have the potential to affect the socioeconomic dynamics of their surrounding communities. Capital expenditures and the migration of workers and their families into a community may influence factors such as regional income; employment levels; local tax revenue; housing availability; and area community services such as healthcare, schools, and public safety. The Proposed Action includes potential mining (ISR and conventional) and milling activities at existing permitted sites in the western United States. Some of these have been evaluated in previous NEPA documents that characterize and evaluate socioeconomic impacts on a site's ROI. The ROI for this project is defined as a multi-county region encompassing the area in which the majority of proposed workers for HALEU mining or milling would be expected to reside and spend most of their salary, and in which a significant portion of site purchase and non-payroll expenditures from the construction, operation, and decommissioning phases of the Proposed Action are expected to take place. With respect to the Proposed Action, the ROIs focus mainly on the host counties with existing permitted facilities and select surrounding counties with larger population centers and/or within potential commuting distance and where greatest impacts would be expected to occur. Where available and relevant, information from these NEPA documents is summarized and incorporated by reference into the Technical Report.

With respect to community services, the general finding in past analyses is that impacts would be generally SMALL. The same would be expected for the Proposed Action analyzed in the Technical Report. The analysis included in the Technical Report uses the potential impacts from an in-migrating population on existing population levels as a surrogate for analyzing potential impacts on each of the community services that currently support that population. As such, this analysis does not include a discussion of community services within the ROI where the potential increase in population would be very small (e.g., generally less than 1% of the existing population). At such small levels it is assumed that the level of community services currently available to the population would be sufficient to accommodate the small influx resulting from the Proposed Action. In addition, given the large number of potential sites where mining activities could occur, detailed characterizations of these services are more appropriate as part of a site-specific analysis, rather than in a programmatic level analysis.

Similarly, it is assumed that the potential increases in income levels and tax revenues (e.g., corporate tax, sales tax, state income tax) generated by the Proposed Action, which would be considered a beneficial impact on the economy, would be commensurate with both the number of new jobs the project creates and the associated in-migrating population associated with those new jobs (if they cannot all be filled within the region). In general, the pay for these jobs would be considerably higher than the median household income of many of the counties within the ROI; the more jobs a project creates, the greater the positive impacts on the local and regional economy. Therefore, this analysis does not include a discussion of current income levels or information related to a given state or county's tax structures and distributions and principal sources of revenues; such information also would be more appropriately characterized and evaluated in a site-specific analysis.

ISR Mining

The socioeconomics analysis for ISR mining relies on analyses presented in the ISR GEIS (NRC, 2009a). Potential impacts on socioeconomics would result predominantly from construction and operations employment at an ISR facility and demands on the existing housing, community services, and the local workforce. The impact assumptions regarding workforce requirements used in the ISR GEIS are considered applicable to the Proposed Action and are carried forward in this analysis.

The evaluation of employment impacts typically includes estimating the level of direct and indirect employment created by the proposed action. Direct employment refers to jobs created by the proposed construction activities and facility operations. Indirect employment refers to jobs created in the ROI to support the needs of the workers directly employed by the proposed action and jobs created to support site purchase and non-payroll expenditures. The number of direct jobs created in each stage is estimated based on anticipated labor inputs for various engineering and construction activities. Indirect employment was typically estimated using an economic model known as an input-output model (RIMS-II). The relative magnitude of the impact on regional employment is assessed by comparing total project-generated employment to current regional employment levels.

The direct impacts on population, employment, and community services from ISR mining activities would be dependent upon how many of the construction and operations workers would be obtained from within the ROI. If all workers were obtained from within an ROI, then there would be no change in the ROI total population; however, if any workers were introduced from outside the ROI, there would be potential impacts on regional demography in conjunction with the in-migration of the supporting workforce and their families. Where the impacts occur would also depend on where incoming workers chose to live, and whether there is good distribution across an ROI or workers concentrate in one area.

Construction

The general findings for construction impacts from ISR construction activities, as described in the ISR GEIS, are applicable to the Proposed Action and its associated regions of influence, as summarized below.

The NRC's ISR GEIS (NRC, 2009a) assumed that total peak construction employment would be about 200 people, including company employees and local contractors, depending on timing of construction with other stages of the ISR lifecycle. The construction period would be short term (12 to 18 months). The general practice would be to use local contractors as available; however, the ISR GEIS identified a potential influx population if the majority of construction requirements were filled by a skilled workforce from outside of the region—of approximately 500—if all workers brought their families, based on an average national household size of 2.5 persons per family (200 × 2.5). Updating the average household size to reflect current (2021) household size by states within the ROI, which ranged between 2.4 and 2.8 persons per household, the total influx of persons from outside would vary between 480 and 560, depending on the location of the uranium mine (USCB, 2023a).

The NRC used a local multiplier of 0.7 to indicate how many ancillary (indirect) jobs could be created (in this case about 140). These construction workforce estimates are carried forward in the analysis of proposed impacts from the proposed HALEU ISR mining activities as a conservative estimate of the required workforce. However, in reality, construction workers are less likely to relocate their entire family to the region for short-term work thus minimizing impacts from an outside workforce. More importantly, the estimates do not distinguish between the number of workers needed for construction or development of the mine itself versus construction of the associated above-ground facilities.

Local building materials and building supplies would be used to the extent practical. Most employees would live in larger communities with access to more services. Some construction employees, however, would commute from outside the county or the ROI to the ISR facility, and skilled employees (e.g., engineers, accountants, managers) would come from outside the local workforce. For purposes of this analysis, it is assumed that the majority of construction requirements would likely be filled by a skilled workforce from outside of the region. Assuming a peak workforce of 200, this influx of workers and their families is expected to result in SMALL to MODERATE impact in the region.

If the majority of the construction workforce is filled from within the region, impacts on population and demographics would be SMALL for the ROI, but the potential impact on smaller counties and communities could be MODERATE, especially if workers choose to live close to the mining site and concentrate in a small populated nearby community. In general, potential impacts would be greatest on local communities with small populations.

An influx of 200 workers would be expected to have a SMALL to MODERATE impact on the employment structure, depending on where the workers settle. The use of outside workers would be expected to have a MODERATE (beneficial) impact on communities with high unemployment rates in 2021 (based on a 5-year average 2017–2021), such as McKinley County, New Mexico (11%), and Duval County, Texas (10.3%), due to the potential increase in job opportunities (USCB, 2023b). But if the majority of construction workers are pulled from the local workforce, the impacts would be SMALL. In addition, relocated workers to the project area would contribute to the local economy through purchasing goods and services and taxes. Because of the small relative size of the ISR workforce, net impacts would be SMALL within the ROI and beneficial to the local economy. But the potential economic benefits upon smaller communities and counties could be MODERATE.

Impacts on housing from construction activities would be expected to be short term and SMALL, even if the majority of workers come from outside the ROI. The majority of in-migrating workers would be expected to use temporary housing such as apartments, hotels, or trailer camps. Many construction workers use personal trailers for housing on short-term projects. Potential impacts on the region's housing market would be considered SMALL, although the impact upon specific facilities could be potentially MODERATE if construction workers concentrated in one area. Several of the counties have very high rental rates (over 25% in Campbell and Sweetwater Counties, Wyoming, and over 10% in Dawes County, Nebraska, and Karnes County, Texas). But other locations have very few vacant units (between 700 and 1,000), including Johnson and Crook Counties, Wyoming; Dawes and Box Butte Counties, Nebraska; Fall River and Oglala Lakota Counties, South Dakota; and Goliad County, Texas (USCB, 2023c).

Local finance would be affected by ISR construction through additional taxation and the purchase of goods and services. Not all states have an income tax (e.g., Wyoming), but every state has other taxes (e.g., sales, lodging, use) that construction workers would be expected to contribute toward while working at the ISR facility. In addition, Wyoming imposes an "ad valorem tax" on mineral extraction. The ISR GEIS notes that in 2007 for uranium alone, the state collected $1.2 million from this tax. In New Mexico, state tax revenues generated from mineral (non-oil and gas) production activities include state trust land mineral lease royalties, rentals and bonuses and severance, as well as resource excise and conservation tax revenues. In 2006, revenues from mineral production activities other than oil and gas generated about $37.3 million for New Mexico. The ISR GEIS also indicated that in 2006 almost 130 people were employed in permitting, care, maintenance and reclamation activities associated with closing historic uranium operations in New Mexico. Information on ad valorem taxes from extraction of uranium was not available for Nebraska (per the ISR GEIS), but South Dakota imposes an energy minerals tax on owners of energy minerals (such as uranium). In 2006, the tax rate base was 4.5% of the taxable value and approximately 50% was dispersed to local government. It is anticipated that ISR facility development could have MODERATE impacts on local finances within each of the ROIs; such impacts would be considered beneficial.

The demand for public services (schools, police, fire, emergency services) would be expected to increase with the construction of an ISR facility. There may also be additional standby emergency services not available in some parts of the region. It may be necessary to develop contingency plans and/or additional training for specialized equipment. However, given the relatively small population influx anticipated, potential impacts on already-established schools, healthcare, and public safety services would be SMALL. Regarding education, even if the majority of workers come in from outside the ROI, impacts on education would likely be SMALL because construction workers are less likely to relocate their entire family for a short period.

One possible exception to the impact levels identified above might be for mining activities occurring in Dawes County, Nebraska. This county and its communities are small and, unlike small host counties and communities within other ROIs, there are no surrounding counties or communities with a large population within potential commuting distance to help absorb a population influx. It has one of the smallest labor forces and there would be a MODERATE to LARGE impact if the entire workforce was to be obtained from Dawes County alone, although construction impacts would be short term in nature.

Operation

The ISR GEIS workforce estimates assume construction and operation of an initial ISR facility. For the purposes of this analysis, the ISR GEIS operations workforce estimates are considered to be conservative (an upper bound).

Employment levels for HALEU ISR facility operations would be less than those for construction, with total peak employment (50 to 80 personnel) depending on timing and overlap with other stages of the ISR lifecycle. Assuming 70% of these workers would in-migrate to the area and bring their families, the potential impacts on the local population and public services resulting from an influx of workers (maximum range of 35 to 56) and their families would result in a conservative estimate of about 160 persons based on highest average household size of 2.8 persons per household in the ROI (56 × 2.8, with rounding). Impacts would range from SMALL to MODERATE, depending on the location (proximity to a population center) of the ISR facility.

Potential impacts on housing could be MODERATE at some locations, due to a limited number of available units (assumes one unit per worker family), if workers are not distributed throughout the ROI or there are no other large population centers within commuting distance (e.g., Dawes County, Nebraska). The ISR GEIS estimated that an influx of up to 56 workers and their families would only include about 30 school-age children. Note that the basis for the 30 children is not explained in the GEIS; however, it presumably counts 0.5 children per the national average family household at the time (2.5) as being school age (56 × 0.5 = 28, or 30 with rounding). Updating the national average household size to 2.6 (USCB, 2023a), the number of school-aged children would still be around 30 (56 × 0.6 = 33). While this addition would be greatest in the smaller school districts, even in these districts the impacts on education are estimated to be SMALL. Effects on other community services (e.g., medical, public safety) during operation are anticipated to be similar to construction—less in volume but longer in duration); therefore, the potential impacts would be SMALL.

Employment types would be similar to construction, but the socioeconomic impacts would be less due to fewer employees, and the ability to draw from existing and experienced ISR personnel in the area. This smaller in-migrating workforce would be expected to have a SMALL impact upon the regional labor force.

The increase in job, income, and revenues generated from Federal, state, and local taxes on the facility and the uranium produced would result in a SMALL to MODERATE beneficial impacts on the local and regional economy, similar to construction impacts, depending on the extent to which a local workforce is used. If the entire labor force came from outside the affected community, the economic impacts could be MODERATE in one of the smaller counties (e.g., Dawes County, Nebraska).

Conventional Mining

The potential impacts from mining in southwest Colorado were evaluated previously in the 2014 Final ULP PEIS (DOE, 2014); the ROI included Mesa, Montrose, and San Miguel Counties in western Colorado. The 2014 ULP PEIS characterized the three economic indicators (employment, unemployment and personal income); and measures of social activity including population, housing and levels of service for education, healthcare, and public safety.

The ULP PEIS (DOE, 2014) breaks down the workforce requirements based on mine size, with a small mine requiring approximately 7 workers, a medium mine requiring 11 workers, a large mine requiring

17 workers, and a very large mine requiring 51 workers. A small mine would likely require only 1 shift but a medium to large mine would require 2 to 3 shifts per day, with a maximum of up to approximately 150 workers for a very large mine. These workforce estimates are for mine "operation and development" of an initial or new mine but do not further distinguish between workforce requirements for development versus operation. Presumably, a potentially larger percentage of the estimates would be associated with the construction and development of the (new) mine itself, including above-ground facilities. For operation, the operations workforce, for purposes of the analysis in the Technical Report, also would be expected to be less since it assumed that workers at the existing site could be transitioned in or pulled from other nearby established mining sites or recently decommissioned facilities. This would result in less in—migrating workers and their families having to come into an ROI. Finally, a comparison with the estimated workforce for ISR mining operations discussed previously shows slightly higher estimates for conventional mining, based on adoption of the more conservative analysis in the 2014 DOE ULP EIS: up to 80 workers (direct) (based on development and operations at 2 small mines, 4 medium mines, 1 large mine, and 1 very large mine), with up to approximately 60 workers (35 to 56) in-migrating to the ROI for ISR mining, compared to 229 (direct) and 115 (in-migrating) workers for conventional mining.

In addition, the Leidos Team assumes that the majority (or all) of the uranium required for the Proposed Action would come from one or more mines within a single county or ROI. In reality, the potential impacts (including economic benefits) would likely be spread out through multiple locations and more than one ROI, further reducing the impacts on a single community, county, or ROI.

In-migration of workers would represent 0.05% increase (or less) in all the ROIs except southeast Utah, where the influx would represent approximately 0.6% of the 2022 population (USCB, 2023a). The additional workers would increase current employment by less than 0.1% in all the ROIs, except southeast Utah where the worker influx would represent approximately 1.4% of the 2021 workforce level (USCB, 2023b). The in-migrants would have only a marginal effect on local housing and population and would require less than 1% of vacant housing units during mine development and operations (USCB, 2023c). Potential impacts on community services would be expected to be SMALL to community services in all ROIs. In the ULP PEIS, DOE identified that one additional physician, one additional firefighter, and one additional police officer would be required to maintain current levels of service within the northwest Colorado ROI, and that no additional teachers would be required to maintain the student-teacher ratio.

In the ULP PEIS, DOE determined that impacts in the ROIs would be SMALL because (1) employment would likely be distributed across more than one county, (2) the impacts would be absorbed across multiple governments and many municipalities, and (3) the employment pool would come from a larger population group than if all employment originated from any one county. Mining workers could live in larger population centers in the ROI and close vicinity, such as Grand Junction, Montrose, or Telluride, and commute to mining locations. Similar conditions are found in northwest New Mexico and northwest Arizona ROIs where impacts also would be expected to be SMALL. DOE also acknowledged in the ULP PEIS was that some workers may prefer to commute a greater distance to the mines to protect their home investments, which suggests that the communities in close proximity to the proposed mine might not benefit as greatly from the positive direct and indirect economic impacts from uranium mining, but they could also avoid the adverse conditions under which previous boom-and-bust period occurred.

The number of in-migrating workers from outside the ROI is not expected to be large, and generally would have a minor impact on the ROI as a whole. However, the nature of the impacts on individual communities may vary. Individual municipalities in smaller rural communities could experience an increase in population from workers if they chose to move closer to the mining project rather than commuting longer distances. This would be especially true in the southeast Utah ROI since there are so few towns in the ROI to help absorb a population influx and distribute the impacts. The in-migration into a small area could result in adverse impacts on the local housing market and community services and be considered MODERATE. However, nearby towns just outside the ROI (e.g., Moab in adjacent Grant County, Utah, and Cortez in adjacent Montezuma County, Colorado) could help absorb the influx and further reduce (and evenly distribute) the potential impacts.

The in-migration of workers into a municipality, host county or ROI would also result in jobs, income and revenue generated by the project. This would have a positive beneficial impact on the local or regional economy. These beneficial impacts would be SMALL for the ROI as a whole but could be MODERATE for smaller host counties or municipalities that receive a larger percentage of the population influx.

Conventional Milling

The Leidos Team does not anticipate any construction related to conventional milling under the Proposed Action. All milling activities from conventional mining would be performed at the existing White Mesa Mill in San Juan County, Utah, therefore other socioeconomic analysis focuses only on mill operation. License renewal of the mill was the subject of a 1997 White Mesa EA (NRC, 1997a), which included a brief description of certain demographic characteristics of the county. However, the White Mesa EA did not identify or analyze any adverse impacts on socioeconomics, presumably because none were expected given it was for renewal with no projected change in the workforce. Socioeconomic conditions in San Juan County, Utah, have been described in the previous discussion on conventional mining; the same two-county ROI is used in this analysis, with the potential for some workers to also commute to the mill site from outside the ROI (e.g., Moab in Grant County, Utah, and Cortez in Montezuma County, Colorado).

The city of Blanding, Utah, approximately 8 km (5 miles) north of the mill, is the largest population center near the mill (3,594 in 2020) (USCB, 2023d). San Juan County is very rural, with a population density of 1.9 persons per square mile in 2020 (USCB, 2023a). Additional smaller communities and their 2021 populations, within approximately 40 miles of the site, are as follows (Census Reporter, 2023): White Mesa (104), Bluff (124), Mexican Hat (0), Eastland and Ucolo (current population data is not readily available, but the 1997 White Mesa EA identified a combined population of 249 in 1990 for both towns), Utah; and Dolores (885), Dove Creek (705), and Towaoc (1,284, within the Ute Reservation), Colorado. Note that a comparison of population levels to those from 1990 in the 1997 White Mesa EA (NRC, 1997a) show an increase for all towns except for Aneth (dropped from 991 in 1990 to 459 in 2021); Mexican Hat (down from 495), Bluff (down from 847 in 1990), White Mesa (down from 320 in 1990); this drop could be due, in part, to the boom-and-bust cycle since the 1980s and 1990s tied to uranium mining.

The 1997 White Mesa EA analyzed impacts associated with milling at a nominal rate of 2,000 tons of ore per day, and an average ore grade of 0.60%, for a yellowcake production rate of 4,380 tons per year. The mill is currently owned and operated by Energy Fuels, Inc.; it is one of San Juan County's largest private employers. Energy Fuels, Inc. normally processes lower grade ores at a rate less than 2,000 tons of ore per day. The company planned to process 2,500 tons of uranium ore for rare earth elements in 2021, which is only a tiny fraction of the mill's capacity (Podmore, 2021). The mill currently employs approximately 50 people, down from around 75 in 2021. The layoffs were a result of decrease in domestic uranium mining operations in recent years. With approximately 50 Utah employees, the company remains among the largest private employers in rural San Juan County (Podmore, 2021).

Information about mill operations and its historical workforce levels has been updated below based on a 2007 license renewal application to the State of Utah (Denison Mines (USA) Corp, 2007). It was originally licensed to Energy Fuels, Inc., by the NRC in 1980 and was renewed in 10-year increments in 1987 and 1997 (NRC, 1997a); it provides additional information for this analysis). The State of Utah took over regulatory oversight of the mill in 2004. Between 2007 and 2012 the mill was owned and operated by Dennison Energy. White Mesa Mill is licensed to process an average of 2,000 tons of ore per day and produce 8 million lbs of U_3O_8 per year. The mill began processing conventional ore in November 2011. In

2011, the mill produced approximately 1 million lbs of U_3O_8 and 1.3 million lbs of vanadium oxide. In full operation, the mill employs approximately 150 people.

According to the 2007 license renewal application for the mill, San Juan County was the largest and poorest county in Utah. When operating, it was one of the largest private employers in San Juan, employing up 60 to 140 full-time employees; as such it represents an important economic base for the city of Blanding and rural residents of San Juan County. The unemployment rate for 2021 was 11.1%. The company also pays taxes to San Juan County, supporting the development of the local economic base. The 2007 license application indicated that mill employees are predominantly residents of San Juan County, or residents of neighboring counties who commute daily to the mill. Historically, during past milling campaigns, the mill has drawn upon residents of San Juan County and neighboring county residents, rather than relying upon an influx of workers to the area. As a result, past mill campaigns have not resulted in unusual demands on public services or resulted in any socioeconomic issues for the surrounding areas (Denison Mines (USA) Corp, 2007).

With respect to workforce requirements to support milling operations associated with HALEU production, the Leidos Team has pulled from the more recent 2018 Sweetwater EA, analyzing the potential impacts for start-up operations of a conventional uranium mill facility in Sweetwater County, Wyoming (NRC, 2018). The Sweetwater EA identified long-term workforce requirements of 30 to 35 people to support mill operations that would run 24 hours per day, 365 days per year, with mill throughput expected to range from 2,500 to 3,500 tons of ore per day, with an average rate of 3,000 tons per day.

Given the current mill workforce levels (about 50) compared to what production, and the services within the ROI, have been capable of supporting in the past at full production (up to 150 to 160 workers), the potential impacts from an increase in the existing mill workforce to support milling activities associated with HALEU production, would be expected to be SMALL. Presumably there would be no need for an in-migrating workforce—or if there was it would be very small—as a sufficient number of skilled workers likely remains in the area that could be recalled to work. Rather, an opportunity to create jobs and income for the ROI would be a benefit to the local economy. Increased operations would generate direct and indirect tax revenues. While public services (schools, public safety) could be minimally impacted by operations; such impacts would be SMALL.

1.3.15 Environmental Justice

Executive Order 12898 directs Federal agencies to make the achievement of environmental justice part of their mission. Executive Order 14008, as amended by Executive Order 14096, further directs Federal agencies to take steps to address disproportionate and adverse impacts on disadvantaged communities, as well as the accompanying economic challenges of such impacts. This goal is accomplished by identifying and addressing disproportionate and adverse human health or environmental effects of Federal programs, policies, and activities on minority and low-income populations. The following discussion is consistent with the guidelines and procedures for compliance with the Executive Order promulgated by the Council on Environmental Quality (CEQ, 1997, p. 25) and updated to reflect recent changes in the definition of environmental justice by Executive Order 14096.

The definitions of environmental justice, minority, low income, and minority and low-income populations are presented below.

- **Environmental justice** – the just treatment and meaningful involvement of all people, regardless of income, race, color, national origin, Tribal affiliation, or disability, in agency decision making and other Federal activities that affect human health and the environment.

- **Minority** – Individual(s) who have identified themselves as members of one or more of the following population groups as designated in the U.S. Census Bureau (USCB) data: Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, Some Other Race, as well as Hispanic or Latino of any race.
- **Low income** – The USCB uses a set of money income thresholds that vary by family size and composition to determine who is in poverty (i.e., classified as "low income"). A family and each individual in the family is considered in poverty if the total family income is less than the family's threshold or the dollar amount calculated by the USCB to determine poverty status (USCB, 2023e).
- **Minority or low-income population** – A minority population is a population where either (a) the minority population of the selected geographic units of analysis (block group) exceeds 50%, or (b) the minority population percentage of the block group is meaningfully greater than the minority population percentage in a reference community (state). For low-income populations, the presence of the population is determined if the percentage of low-income individuals residing within the selected geographic units of analysis (block groups) is equal to or greater than the percentage of low-income individuals residing within the reference community (state). In identifying minority or low-income populations, agencies may consider as a community either a group of individuals living in geographic proximity to one another, or a geographically dispersed/transient set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect. The selection of the appropriate unit of geographic analysis may be a governing body's jurisdiction, a neighborhood, census tract, or other similar unit that is to be chosen so as to not artificially dilute or inflate the affected minority population.

The methodology used for the environmental justice analysis is described in EPA's *Promising Practices for EJ Methodologies in NEPA Reviews* (EPA, 2016). The Technical Report applies the 50% analysis and meaningfully greater analysis methodology as defined below.

- **50%** – The method used to evaluate if minority populations are present is to use the 50% analysis (i.e., the percentage of minority individuals residing within the geographic unit of analysis meets or exceeds 50%). This analysis is used with the meaningfully greater analysis (defined below).
- **Meaningfully Greater** – The meaningfully greater analysis requires use of a reasonable, subjective threshold (e.g., 10% or 20% greater than the reference community). What constitutes "meaningfully greater" varies by agency, with some agencies considering any percentage in the selected geographic unit of analysis that is greater than the percentage in the appropriate reference community to qualify as being meaningfully greater. The NRC uses 20% greater for the analysis of nuclear power reactors and other related nuclear processes and this threshold has been adopted for the analysis in the Technical Report.

At this stage, the locations of uranium mining and milling that would support the Proposed Action are not known. For the purposes of this analysis, the Leidos Team assembled information on the Justice40 Initiative as described below and general information on minority and low-income populations by state and county for locations where mining and milling could occur.

On January 27, 2021, U.S. President Joe Biden issued Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*, which established the Justice40 Initiative. This initiative mandates 40% of the benefits of Federal climate and clean energy investments to be provided to disadvantaged communities. As a part of this initiative, DOE has conducted an analysis to identify disadvantaged communities in the United States, which DOE defines as underserved, overburdened, and front-line communities (DOE, 2022a). DOE's analysis considers a community to be disadvantaged if its census tract falls in the 80th percentile or higher of the burden indicators for a state and at least 30% of the households in that census tract are identified as low-income populations (DOE, 2022a). The cumulative burden includes fossil fuel dependence, energy burden, environmental and climate hazards, and socioeconomic vulnerabilities. Priorities for DOE include a decrease in energy burden and environmental exposures; an increase in clean energy jobs, job training, and contracting opportunities; and access to clean energy and resilience. As part of the environmental justice analysis, DOE's analysis and rankings are presented in Table 1-2. Data are provided for cities as representative locations within the regions where existing or permitted mining and milling activities occur. As shown, Green River in Sweetwater County, Wyoming, and Montrose in Montrose County, Colorado, are considered disadvantaged by DOE's analysis.

Table 1-2. Disadvantaged Communities (per DOE Parameters)

City, County, State	*National Ranking*	*State Ranking*	*DAC Score*
Chadron, Dawes, NE	3%	5%	11
Church Rock, McKinley, NM	70%	79%	18
Edgemont, Fall River, SD	23%	70%	14
Custer, Custer, SD	7%	32%	12
Goliad, Goliad, TX	50%	31%	17
Falfurrias, Brooks, TX	84%	70%	20
San Diego, Duval, TX	76%	59%	19
Gillette, Campbell, WY	3%	5%	11
Moorcroft, Crook, WY	27%	66%	14
Buffalo, Johnson, WY	16%	40%	13
Douglas, Converse, WY	16%	38%	13
Green River, Sweetwater, WY	44%	**91%**	16
Walnut Creek, Mohave, AZ	47%	59%	16
Grand Junction, Mesa, CO	45%	64%	16
Montrose, Montrose, CO	67%	**83%**	18
Ophir, San Miguel, CO	3%	5%	11
Panguitch, Garfield, UT	31%	57%	15
Blanding, San Juan, UT	38%	66%	16

Key: % = percent; AZ = Arizona; CO = Colorado; DAC = disadvantaged community; DOE = U.S. Department of Energy; NE = Nebraska; NM = New Mexico; SD = South Dakota; TX = Texas; UT = Utah; WY = Wyoming

Note: The DOE's DAC Score is based on how many of 36 different burden indicators for a state that a census tract exhibits and the percent of the households in that census tract that are identified as low-income populations. DOE considers a community to be disadvantaged if its census tract display 80% or more of the 36 burden indicators and 30% or more households in that census tract are categorized as low income.

This section provides general information on minority and low-income populations by state and county for locations where mining and milling could take place (Table 1-3).

Table 1-3. Minority and Low-Income Demographics for Potential Mining and Milling Locations

Area Name	*Total Population*	*Minority*	*% Minority*	*Population for Whom Poverty is Calculated*	*Low-Income Population*	*% Low Income*
United States	333,036,755	136,997,971	41.1%	325,180,754	42,062,633	12.9%
Nebraska	1,951,480	435,835	22.3%	1,899,516	195,455	10.3%
Dawes	8,383	1,303	15.5%	7,422	1,033	13.9%
New Mexico	2,109,366	1,349,449	64.0%	2,067,620	378,896	18.3%
McKinley	72,946	67,130	92.0%	72,252	24,593	34.0%

Table 1-3. Minority and Low-Income Demographics for Potential Mining and Milling Locations

Area Name	Total Population	Minority	% Minority	Population for Whom Poverty is Calculated	Low-Income Population	% Low Income
South Dakota	881,785	169,050	19.2%	853,175	106,291	12.5%
Fall River	6,979	1,120	16.0%	6,777	1,201	17.7%
Custer	8,360	967	11.6%	8,186	936	11.4%
Texas	28,862,581	17,117,549	59.3%	28,260,264	3,965,117	14.0%
Goliad	7,085	3,035	42.8%	7,001	754	10.8%
Brooks	7,100	6,597	92.9%	6,493	2,437	37.5%
Duval	10,001	9,039	90.4%	9,433	2,225	23.6%
Wyoming	576,641	98,133	17.0%	563,382	60,482	10.7%
Campbell	46,758	6,216	13.3%	45,982	5,070	11.0%
Crook	7,185	496	6.9%	7,085	538	7.6%
Johnson	8,457	829	9.8%	8,370	1,382	16.5%
Converse	13,702	1,598	11.7%	13,557	1,068	7.9%
Sweetwater	42,459	9,216	21.7%	41,941	4,396	10.5%
Arizona	7,079,203	3,297,538	46.6%	6,926,281	934,911	13.5%
Mohave	211,274	50,870	24.1%	207,762	33,239	16.0%
Colorado	5,723,176	1,901,348	33.2%	5,605,422	535,976	9.6%
Mesa	154,685	30,556	19.8%	151,047	17,937	11.9%
Montrose	42,328	10,517	24.8%	41,904	4,844	11.6%
San Miguel	8,084	1,207	14.9%	8,046	754	9.4%
Utah	3,231,370	733,907	22.7%	3,182,692	278,486	8.8%
San Juan	14,610	8,266	56.6%	14,287	3,033	21.2%
Garfield	5,061	603	11.9%	4,870	761	15.6%

Key: % = percent; green shading = greater than 50% minority; yellow shading = meaningfully greater percentage (20%) of low-income population compared to the state

As shown in Table 1-3, using the 50% analysis shows that McKinley County, New Mexico; Brooks and Duval Counties in Texas; and San Juan County, Wyoming, are higher than 50% minority. Low-income populations with meaningfully greater percent (20%) of low income in the county compared to the state include Dawes County, Nebraska; McKinley County, New Mexico; Fall River County, South Dakota; Brooks and Duval Counties, Texas; Johnson County, Wyoming; Mesa County, Colorado; and San Juan and Garfield Counties, Utah.

Since the uranium mining and milling locations that would support HALEU production, are not known, a preliminary analysis on the types of construction and operations impacts that might occur to environmental justice populations in the vicinity of these locations are described below. Environmental consequences are dependent on actual locations and site-specific designs, and are only mentioned in general terms. For facilities that have environmental justice populations within 4 miles, detailed site-specific analyses would be required in NRC or Agreement State, or other Federal or state regulatory agency NEPA documents.

The ISR GEIS (NRC, 2009a) evaluated four regions of Wyoming, South Dakota, Nebraska, and New Mexico using 2000 Census data. The presence of minority and low-income populations identified in the ISR GEIS Chapter 6 are as follows:

- **Wyoming West Region.** Minority and low-income populations are located in the Wind River Indian Reservation and the towns of Ethete, Arapahoe, and Fort Washakie (NRC, 2009a, pp. 6-12 and 6-13).
- **Wyoming East Region.** No minority populations were identified in this area. Albany County was identified as a low-income population but is located 8 km (5 miles) from the nearest location of past, present, or future uranium milling activity (NRC, 2009a, pp. 6-14).
- **Nebraska-South Dakota-Wyoming Region.** Minority and low-income populations are located in the Pine Ridge Indian Reservation and the town of Oglala, and Pine Ridge in South Dakota (NRC, 2009a, pp. 6-14 to 6-15).
- **Northwest New Mexico Region.** Affected minority and/or low-income populations include Acoma Pueblo, Laguna Pueblo, the Navajo Nation, and the Ramah.
- **Navajo Indian Reservation, the Tohajiilee Indian Reservation, and the Zuni Indian Reservation.** Minority and low-income populations are identified for Cibola County, McKinley County, the Gallup Core-Based Statistical Area, and the town of Grants (NRC, 2009a, pp. 6-16).

The NRC concluded that environmental reviews for facilities located in the Wyoming East Uranium Milling Region do not need an environmental justice analysis, because demographic data failed to identify a minority or low-income population that has the potential to receive disproportionately high and adverse environmental or health impacts compared to the general population in the area. Minority populations and Tribal lands were identified in Wyoming West, Nebraska-South Dakota-Wyoming, and Northwestern New Mexico Uranium Milling Regions. The NRC recommended an environmental justice analysis be conducted in these three regions.

The ULP PEIS was also reviewed to determine environmental impacts from conventional mine development in western Colorado (Mesa, Montrose, and San Miguel Counties) (DOE, 2014). In the ULP PEIS, the analysis of environmental justice associated with the development of uranium facilities considered impacts within the proposed lease tracts and an associated 50-mile radius around the boundary of the proposed lease tracts. DOE concluded that in the Colorado portion of the 50-mile radius, the number of low-income individuals is more than 20 percentage points higher than the state average in four block groups in the city of Grand Junction, in two block groups in Montrose, and in one block group in Delta. There is also a single block group in southwestern Montezuma County that is more than 50% minority and is the location of the Ute Mountain Indian Reservation. In the Utah portion of the 50-mile radius, there are block groups in the southeastern part of San Juan County, and in the city of Blanding, that have low-income populations that are more than 20 percentage points higher than the state average. There are no block groups in the 50-mile radius in Utah where the population is more than 50% low income.

The Draft EIS for Roca Honda Mine was reviewed to determine environmental impacts from conventional mine development in New Mexico. In the Draft EIS, the analysis of environmental justice considered impacts within Cibola and McKinley Counties. The analysis indicated that both counties constitute an environmental justice population on the basis of minority and low-income populations.

Construction

The ULP PEIS (DOE, 2014) stated that mine exploration activities would involve some land-disturbance activities, such as vegetation clearing, grading, drilling, and building of access roads and drill pads, occurring over relatively small areas. Impacts on minority or low-income populations would be minor and would not be disproportionate, considering the small spatial extent in which exploration activities would occur. Air emissions from fugitive dust and the operation of construction equipment is expected to be minor, and chemical exposure during exploration would be limited to airborne toxic air pollutants, which would be at less than standard levels and would not result in any adverse health impacts. No disproportionate impacts would therefore occur on low-income or minority populations. Diversion of water from domestic, cultural, religious, or agricultural uses that might disproportionately affect low-income and minority populations is not expected based on water usage for exploration. Short-term soil erosion and runoff could result before areas are revegetated. Exploration would introduce contrasts in form, line, color, and texture, as well as an increasing degree of human activity, into landscapes where activity levels are generally low.

The ULP PEIS (DOE, 2014) concluded that although there are unique radiological exposure pathways (such as subsistence fish, vegetation, wildlife consumption, or well water use) that could potentially result in adverse health and environmental impacts on minority and low-income populations, no radiological impacts are expected during the reclamation of uranium mining facilities. Reclamation would produce only minor radiological risks to workers or radiological or adverse health impacts on the general public and thus would not disproportionately affect low-income and minority populations. Air emissions from fugitive dust and from construction equipment are expected to be minor, and chemical exposure during reclamation would be limited to airborne toxic air pollutants, would be at less than standard levels, and would not result in any adverse health impacts. No disproportionate impacts on low-income and minority populations would therefore be expected.

The analysis within the Draft EIS for Roca Honda Mine did not separate impacts from construction with those of operations. Therefore, potential impacts associated with the Roca Honda Mine are discussed below under operation.

Operation

The ULP PEIS (DOE, 2014) stated that operational impacts could include unique radiological exposure pathways (such as subsistence fish, vegetation, or wildlife consumption or well water use) that could potentially result in adverse health and environmental impacts on minority and low-income populations. Mining facilities would not result in any significant radiological risks to underground or surface mine workers or any radiological or adverse health impacts on the public during operations and therefore would not disproportionately affect low-income and minority populations. Air emissions from fugitive dust and the operation of mine facility equipment are expected to be minor. Chemical exposure during mine operations would be limited to airborne toxic air pollutants, which would be at less than standard levels and would not result in any adverse health impacts. No disproportionate impacts on low-income or minority populations would therefore be expected.

In general, environmental justice impacts as described in the Draft Environmental Impact Statement for Roca Honda Mine include socioeconomic benefits, adverse physical health impacts from working conditions, and traffic delays. Traffic delays could result in restricted or delayed access to recreation and youth facilities; safety risks to recreationist, restricted or delayed access to hospital or healthcare facilities; and institutional places of worship or traditional locations for spiritual activities. In addition, impacts could occur from diminished quality of religious, spiritual, or cultural sites, and disturbance and health risks to children from increased fugitive dust and tailpipe emissions. Impacts to communities with environmental justice concerns were assessed as significant in the Draft EIS. This EIS is currently on hold while the operator waits for better market conditions. A Supplement to the EIS is being prepared to add an alternative to address the communities' concerns.

1.3.16 Summary of Potential Mining and Milling Impacts from Proposed Action Activities

Section 1.3.1, *Land Use* through Section 1.3.15, *Environmental Justice*, provide a summary of potential impacts of uranium mining and milling that would be required to support the Proposed Action based off previous NEPA documentation for similar types of activities. As the Leidos Team does not know the specific locations or methods (i.e., convention mining/milling versus ISR) that would be used to produce uranium for the Proposed Action, site-specific impacts cannot be quantified. Private industry and market conditions will dictate the locations and methods used to support the Proposed Action. As previously discussed in Section 1.1, *Description of the Activity*, the Leidos Team assumes existing permitted mines would be used to support the Proposed Action and the single operational conventional mining milling site in White Mesa, Utah, would be used. Table 1-4 provides a summary of anticipated effects from uranium mining and milling in support of the Proposed Action.[14]

[14] Impacts are for the production of 25 MT of HALEU annually, the assumed production rate for a total of 145 MT associated with one enrichment contract.

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	Impact Indicator	Existing NEPA			Uranium Mining for HALEU
		In-Situ Recovery	Conventional Mining	Milling	
General	Annual production	1,260 MT U_3O_8	1.32 million MT ore	1,260 MT U_3O_8	1,260 MT U_3O_8
General	Type of infrastructure	Well fields (injection, production, monitoring) Pipelines Buildings (central uranium processing facility, header houses, satellite facilities, admin) Surface impoundments Road network	Buildings (offices, storage, maintenance) Stockpile areas (e.g., topsoil) Treatment ponds Waste containment areas (e.g., mine waste-rock pile) Road network	Mill building Process tanks Tailings impoundment Evaporation ponds	See stages considered as part of Proposed Action below for each activity.
General	Operational area of impact	2,500 – 16,000 acres (full landscape-scale ISR facility); total disturbance area of individual wells over the landscape is much smaller	Up to 210 acres, depending on the size of the mine in operation	Impoundments are limited to 40 acres in size; however, a facility can have multiple impoundments and typically total on the order of hundreds of acres.	Smaller-scale operational area of impact for ISR Similar-scale operational area for conventional mining No new areas for milling (See stages considered as part of the Proposed Action below for each activity.)
General	Stages considered as part of the Proposed Action	Construction Individual well(s) Pipelines Header houses/satellite facilities Supporting access roads Operation Aquifer restoration decommissioning	Exploration Exploratory drilling Temporary roads Construction Mine development buildings Stockpile and waste containment areas Treatment ponds	Operation *The Leidos Team assumes the existing operational milling site in White Mesa would be utilized and no new construction is required.	See columns to the left for activities/stages considered as part of the Proposed Action.

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	Impact Indicator	Existing NEPA			Uranium Mining for HALEU
		In-Situ Recovery	Conventional Mining	Milling	
			Supporting access roads Operation Reclamation		
General	Number of potential sites identified (existing or permitted)	16	13	3 (only 1 currently operational)	Number of sites utilized will be driven by private industry. Based on Proposed Action annual requirements and existing capacity of current mines, the potential exists for only one or two mining sites to be required to fully support the Proposed Action.
Land Use	Dominant land use/setting	Construction & operation Agricultural/rural	Construction & operation Agricultural/rural	Operation Rural	Similar effects as noted in the columns to the left
	Compatibility	Construction & operation Within existing permitted mine	Construction & operation Within existing permitted mine	Operation Within existing milling facility	
	Impact summary	SMALL to MODERATE (site specific) Land disturbance and ongoing activities would occur on a relatively small portion of the site. Mining activities on privately owned lands may require arrangements through leases, mineral rights sales,	SMALL Impacts would occur from land conversion. Construction impacts would be limited due to sizing of the drilling and roads, which would not impact surrounding areas. The development of underground and open-pit	SMALL No additional construction activities would occur other than the potential construction of new tailing impoundments.	

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	***Impact Indicator***	***Existing NEPA***			***Uranium Mining for HALEU***
		In-Situ Recovery	***Conventional Mining***	***Milling***	
		and royalties. Aquifer restoration would be associated with well development. Decommissioning would decrease disturbed land.	mines would necessitate a change in land cover due to land clearing and road development. Construction and operation would occur on a relatively small portion of the site and would not interfere with surrounding land uses.		
Visual and Scenic Resources	Visual impairments	Construction & operation Vertical structures Lighted structures Powerlines, pipes, wells Equipment/dust generation Fencing	Construction & operation Vertical structures Lighted structures Equipment/dust generation Open-pit mines/vegetation clearing Waste storage areas Access road development	Operation Vertical structures Equipment/dust generation Tailing impounds	Similar effects as noted in the columns to the left
	Visual resources	Construction & operation Agricultural/rural landscape Existing permitted mine	Construction & operation Agricultural/rural landscape Existing permitted mine	Operation Rural Existing milling facility	
	Impact summary	SMALL to MODERATE Vegetation clearing and introduction of drilling rigs and roads would result in visual contrast with the baseline landscape. Mine and associated road development could introduce strong visual contrasts.	SMALL to MODERATE Vegetation clearing and introduction of drilling rigs and roads would result in visual contrast with the baseline landscape. Mine and associated road development could introduce strong visual contrasts.	SMALL Project area visual and scenic resources have already been impacted through introduction of buildings and tailings cells to the landscape. New tailings impoundments are	

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	***Impact Indicator***	***Existing NEPA***			***Uranium Mining for HALEU***
		In-Situ Recovery	***Conventional Mining***	***Milling***	
				the only construction that would occur.	
Geology and Soils	Ground disturbance	Construction Soil compaction Soil mixing Loss of soils (facility development)	Construction Compaction Mixing of soils Loss of soils (facility development)	Operation None (existing facility with no new ground disturbance anticipated)	Similar effects as noted in the columns to the left
	Erosion	Construction Wind Water	Construction & operation Wind Water	Operation None (existing facility with no new ground disturbance anticipated)	
	Accidental spills	Construction & operation Construction equipment Operational equipment (wells, pipelines, machinery)	Construction & operation Construction equipment Operational equipment (machinery)	Operation Operational equipment (machinery)	
	Geological alteration	Construction & operation Well placement Temporary changes to geological composition and head pressure	Construction & operation Exploratory drilling Open-pit/underground mining	Operation None (existing facility with no new ground disturbance anticipated)	
	Impact summary	SMALL – Potential impacts include disturbance of soils, soil erosion due to ground disturbance, and the potential for spills due to construction and operations. Implementation of BMPs for erosion control and spill prevention would limit impacts.	SMALL to MODERATE – (site specific) – Potential impacts include disturbance of soils, soil erosion due to ground disturbance, and the potential for spills due to construction and operations. Potential impacts from alteration of geology and landscape could result depending on	SMALL – Impacts from continued operations would remain unchanged. Impacts from remediation actions and disposal of soils from previously contaminated locations would continue under	

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	Impact Indicator	Existing NEPA			Uranium Mining for HALEU
		In-Situ Recovery	Conventional Mining	Milling	
			site. Implementation of BMPs for erosion control and spill prevention as well as proper reclamation procedures could limit impacts.	regulatory oversight and would not change.	
Water Resources	Surface water quality	Construction & operation Sedimentation/runoff from disturbed sites (new wells/supporting infrastructure) Wastewater discharge	Construction & operation Sedimentation/runoff from disturbed sites (new mines/supporting infrastructure) Mine water runoff Runoff from waste storage areas	Operation Effluent and tailings management	Similar effects as noted in the columns to the left
	Accidental spills	Construction & operation Construction equipment Operational equipment (wells, pipelines, machinery)	Construction & operation Construction equipment Operational equipment (machinery)	Operation Operational equipment (machinery)	
	Groundwater quality	Construction & operation Well drilling Brine slurries	Construction & operation Exploratory drilling Mining operation	Operation Tailings management	
	Water usage	Construction & operation Uranium extraction Dust suppression methods Wastewater management	Construction & operation Dust suppression methods Operations of machinery Potable water	Operation No changes to existing usage	
	Impact summary	SMALL TO LARGE (site specific) – Adherence to permit conditions and the implementation of BMPs (stormwater infrastructure, spill prevention plans and spill	SMALL – Adherence to permit conditions and the implementation of BMPs (backfilling of exploration boreholes, use of erosion and sediment controls, revegetation of temporary	SMALL – Under the Proposed Action, there would be no change to conditions and procedures at the White Mesa Mill, where conventionally	

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	***Impact Indicator***	***Existing NEPA***			***Uranium Mining for HALEU***
		In-Situ Recovery	***Conventional Mining***	***Milling***	
		response procedures, etc.) would minimize impacts to water resources associated with this activity. Impacts would be anticipated to be MODERATE to LARGE in the event that a leak or spill of lixiviant occurs in a shallow groundwater aquifer, an aquifer of importance to the region, or an aquifer that is hydraulically connected to other important aquifers (NRC, 2009a).	access roads when no longer in use, stormwater infrastructure, etc.) would minimize impacts on water resources associated with this activity (DOE, 2014).	mined uranium in the United States. Is milled. The EIS analyzing operational impacts from the mill determined impacts on water resources would be SMALL (NRC, 1997a).	
Air Quality	NAAQS, emissions of criteria pollutants, hazardous air pollutants, radiological compounds, and greenhouse gases	Construction Air quality impacts due to clearing and grading, access road construction, drilling wells, trenching and laying pipelines, and building evaporation pond impoundments would occur from combustive emissions due to the use of fossil-fuel-powered equipment, trucks, and worker commuter vehicles and fugitive dust emissions due to the operation of equipment and vehicles on exposed soil. Operation	Exploration Air quality impacts due to exploration would occur from combustive emissions due to the use of fossil-fuel-powered equipment, such as drilling rigs and trucks, and fugitive dust emissions due to the operation of equipment and vehicles on exposed soils. Construction & operation Air quality impacts due to construction and operations would occur from combustive emissions due to the use of fossil-fuel-powered equipment, such	Operation Air quality impacts from milling operations would occur from fugitive dust from handling uranium ore, ore stockpiles, ore tailings piles, and road dust from on-site vehicle operations; volatile organic compounds from the uranium extraction processes; natural gas- or propane-fired	Similar effects as noted in the columns to the left

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	***Impact Indicator***	***Existing NEPA***			***Uranium Mining for HALEU***
		In-Situ Recovery	***Conventional Mining***	***Milling***	
		Air quality impacts due to operations would occur from nonradiological emissions and radon from pipeline system venting, resin transfer, and elution processes; natural gas-fired heaters used to dry yellowcake; releases of uranium particles from yellowcake drying and packaging and the filling of sodium bicarbonate storage containers; on-site vehicles and associated road dust; the transport by truck of supplies and finished product; and worker commuter vehicles.	as scrapers, bulldozers, and production drills; fugitive dust emissions due to the operation of equipment and vehicles on exposed soils; and combustive and fugitive dust emissions from the use of explosives. NO_x emissions from the largest mines would be relatively large and would have the potential to exceed the 1-hour NO_2 NAAQS.	heaters used to dry yellowcake; the transport by truck of feedstock and finished product; and worker commuter vehicles. The transport, handling, storage, and processing of uranium ore and tailings piles would emit uranium particles and the tailings piles would emit minor amounts of radium and radon.	
	Impact summary	SMALL Construction With the implementation of BMPs and action practices to minimize fugitive dust and equipment combustive emissions, construction activities would not contribute to an exceedance of any NAAQS. Operation Nonradiological emissions from yellowcake drying (the	SMALL Construction & operation Implementation of compliance measures, mitigation measures, and BMPs presented in ULP PEIS Section 4.6 would minimize emissions from exploration and construction and operation and would result in minor impacts to ambient air quality and climate change.	SMALL Operation The facility licensing conditions require implementation of control measures and environmental and radiation monitoring that would minimize facility air quality impacts to regulatory levels.	

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	***Impact Indicator***	***Existing NEPA***			***Uranium Mining for HALEU***
		In-Situ Recovery	***Conventional Mining***	***Milling***	
		main source of emissions) would be controlled with high-efficiency particulate air (or HEPA) filters. Airborne uranium emissions from yellowcake drying and packaging and the filling of sodium bicarbonate storage containers would be controlled with vacuum drying equipment, wet scrubbers, or dust collection systems. The site would operate an environmental monitoring program that would measure concentrations of radioactive and nonradioactive materials released to the environment from facility operations. These measures would minimize emissions to relatively low rates.			
Ecological Resources	Removal or degradation of vegetation and wildlife habitats Adverse effects on protected and listed Federal and state species	Construction Land-clearing activities may cause loss of native or undeveloped vegetation increased erosion and stormwater runoff; wildlife habitat fragmentation,	Construction & operation Land-clearing activities may cause loss of native or undeveloped vegetation; increased erosion, stormwater runoff, and turbidity to streams; generation of fugitive dust;	Operation Wildlife disturbance due to noise and human activity	Similar effects as noted in the columns to the left

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	Impact Indicator	Existing NEPA			Uranium Mining for HALEU
		In-Situ Recovery	Conventional Mining	Milling	
		disturbance, and injury or mortality to species long-term reduction in wildlife abundance and richness; spread and introduction of invasive plant species; and wildlife disturbance due to noise and human activity impacts to special status species would require agency consultations.	wildlife habitat fragmentation; changes to fire regimes; disturbance and injury or mortality to species; long-term reduction in wildlife abundance and richness; and spread and introduction of invasive plant species. Wildlife disturbance due to noise and human activity impacts to special status species would require agency consultations.		
	Wetland loss or degradation	Construction Alteration of surface water runoff patterns, soil compaction, or groundwater flow Impacts to wetlands, streams, lakes, ponds, and other waters would require a permit.	Construction Alteration of surface water runoff patterns, soil compaction, or groundwater flow Impacts to wetlands, streams, lakes, ponds, and other waters would require a permit.	None (existing facility with no new ground disturbance anticipated)	
	Accidental spills	Construction & operation Exposure to accidental fuel spills or releases of other hazardous materials	Construction & operation Exposure to accidental fuel spills or releases of other hazardous materials	Operation Exposure to accidental fuel spills or releases of other hazardous materials	
	Exposure	Construction & operation Wildlife including migratory birds could be affected by exposure to constituents in	None	Operation Incidental wildlife could be affected by exposure	

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	***Impact Indicator***	***Existing NEPA***			***Uranium Mining for HALEU***
		In-Situ Recovery	***Conventional Mining***	***Milling***	
		evaporation ponds. Mitigation measures such as perimeter fencing, netting, alternative sites, and periodic wildlife surveys would reduce overall impacts.		to/inhalation of fugitive dust from handling uranium ore, ore stockpiles, ore tailings piles, and road dust from on-site vehicle operations. Mitigation measures such as perimeter fencing, netting, alternative sites, and periodic wildlife surveys would reduce overall impacts.	
	Impact summary	SMALL, MODERATE, or LARGE (site specific)	SMALL, MODERATE, or LARGE (site specific)	SMALL – Facility is currently operational.	
Historic and Cultural Resources	Adverse effect to historic property	Construction Land-disturbing activities for new facilities (wells, pipelines, access roads) Increased access to formerly remote or inaccessible resources, traditional cultural properties and culturally significant landscapes, as well as other ethnographically significant cultural resources Operation	Construction Land-disturbing activities for new facilities (pits, facilities, access roads) Increased access to formerly remote or inaccessible resources, traditional cultural properties and culturally significant landscapes, as well as other ethnographically significant cultural resources. Operation	None (existing facility with no new ground disturbance anticipated)	Similar effects as noted in the columns to the left

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	Impact Indicator	Existing NEPA			Uranium Mining for HALEU
		In-Situ Recovery	Conventional Mining	Milling	
		Earth-disturbing activities, new construction, maintenance, and repair	Earth-disturbing activities, new construction, maintenance, and repair		
	Impact summary	SMALL to MODERATE Consultation with, state SHPOs, Tribal representatives, and the other agencies to determine whether significant cultural resources would be avoided or mitigated as part of the site-specific review. As needed, establishment and adherence to procedures for the discovery of previously undocumented cultural resources during initial construction, operation, aquifer restoration, and decommissioning (NRC, 2009a)	SMALL to MODERATE Consultation with, state SHPOs, Tribal representatives, and the other agencies to determine whether significant cultural resources would be avoided or mitigated as part of the site-specific review. As needed, establishment and adherence to procedures for the discovery of previously undocumented cultural resources during initial construction and operation	SMALL Facility is currently operational.	
Infrastructure	Disrupted utilities service during construction activities or an increase or decrease in demand for utility services during construction or operation.	Construction & operation Operation would occur in existing permitted mining areas. Expansion of mining operations may require additional wells, utility lines, and pipelines.	Construction & operation Operation would occur in existing permitted mining areas. Expansion of mining operations may require additional utility lines to any new support buildings associated with new mine pits.	Operation Operation would occur in the existing White Mesa milling facility.	Similar effects as noted in the columns to the left
	Impact summary	SMALL	SMALL	NONE	

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	***Impact Indicator***	***Existing NEPA***			***Uranium Mining for HALEU***
		In-Situ Recovery	***Conventional Mining***	***Milling***	
Waste Management	Disposal pathways and relative volume	SMALL	SMALL	SMALL	SMALL
	Impact summary	SMALL	SMALL	SMALL	
Noise	Increase of noise to sensitive receptors Violation of local ordinances	Construction Sensitive receptors within 300 m (1,000 feet) from use of heavy equipment (e.g., bulldozers, graders, drill rigs, compressors), during construction Traffic to and from the construction site Operation Groundwater pumps Truck traffic transport of uranium-loaded resins to central processing facility and shipments of yellowcake	Construction Sensitive receptors within 500 m (1,650 feet) from use of heavy equipment (e.g., loaders, haul or support trucks, drills, bulldozers, graders, scrapers, and power generators), during exploration and construction of new mine pits Traffic to and from the construction site Blasting, if necessary Operation Mining equipment Over-the-road heavy haul trucks for transport of uranium ore from mine	Operation Operation would occur in the existing White Mesa milling facility.	Similar effects as noted in the columns to the left
	Impact summary	SMALL to MODERATE	SMALL	NONE	
Public and Occupational Health – Normal Operations	Exposure to radiation	Construction Fugitive dust bearing radioactive material Operation Radiological exposures to workers of 713 mrem/yr. Chemical risks would be minimal. Public doses would range from 0.4 to 31.7 mrem/yr	Operation Radiological impacts to miners: average miner dose 350 to 433 mrem/yr; 5 occupational injuries over 10 years of operation; potential chemical hazard health risks (hazard index of just over 1 primarily due to vanadium exposures)	Operation Radiological impacts to workers of between 700 and 1,200 mrem/yr. There is a small risk from exposure to chemicals. Individual doses to members of the	Operation Individual worker doses would fall within the range of doses for the 3 activities (between 350 and 1.25 mrem/yr). Total dose for workers would include

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	Impact Indicator	Existing NEPA			Uranium Mining for HALEU
		In-Situ Recovery	Conventional Mining	Milling	
		and population doses would be less than 1 mrem, due primarily to the release of radon gas from the ISR facilities.	Radiological impacts to the public: individual doses drop below NESHAP levels (10 mrem/yr) at distances of 500, 1,500, 2,500 m from a small, medium, and large mine, respectively. Population doses ranged from 16 to 93 person-rem. Reclamation Worker doses of between 14 and 32 mrem for entire duration of reclamation	public range up to 23 mrem/yr, below dose limits for uranium fuel cycle facilities.	annual doses for 6 years. Average dose to workers and total worker doses (person-rem) would depend on mix of ISR and conventional mines/mills and foreign sources. Use of conventional mines would result in possible chemical health hazards, although lower required production rates could lower hazard index to below 1. Public impacts: if all mining and milling occurred at conventional mines/ mills individual doses of up to 0.6 mrem/yr (mines) and 10 mrem/yr (mills). Population doses from mine operations should be less than 54

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	Impact Indicator	Existing NEPA			Uranium Mining for HALEU
		In-Situ Recovery	Conventional Mining	Milling	
					person-rem. If all mining is from ISR facilities, individual doses range from 0.4 to 31.7 mrem/yr, and population dose would be less than a person-rem.
	Impact summary	SMALL	SMALL	SMALL	SMALL
Public and Occupational Health – Facility Accidents (see Section 1.3.12)	Radiological accidents	Spill – 25 mrem at 100 m, 1 mrem at 500 m Radon-222 – 1.3 rem to worker Dryer Explosion – 8.8 rem to worker, < 100 mrem off-site.	No accident would cause an exposure greater than normal operation.	Fire – 25 mrem/yr Explosion – 3×10^{-4} mrem CEDE to nearest resident Tornado – 6.6×10^{-5} mrem to nearest resident	SMALL to MODERATE impact – No fatalities, dryer explosion gives the greatest radiation exposure. Radon exposure in enclosed area affects workers. Radiation exposure to public is low. Facility design and application of controls would reduce the risk of an accident. Chemical accidents could have SMALL to LARGE impacts to the public if they were to occur, although the chance of occurrence is low.
	Chemical accidents	Significant hazards to workers and the public – Application of controls reduces risk to an acceptable level	Accidental spills have negligible to minor impact.	Similar to or less than impacts from ISR	
	Impact summary	SMALL to MODERATE	SMALL	SMALL	

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	***Impact Indicator***	***Existing NEPA***			***Uranium Mining for HALEU***
		In-Situ Recovery	***Conventional Mining***	***Milling***	
Traffic	Daily traffic volumes from additional worker vehicles and truck shipments	Construction 400 daily worker commuter trips 1 daily truck shipment (or 2 vehicle trips per day) Operation 5 daily truck shipments (or 10 vehicle trips per day) for operation 40–400 daily worker commuter trips	Construction & operation 458 daily worker commuter trips 80 daily truck shipments (or 160 vehicle trips per day) from the mines to a mill (estimates associated with Alternative 4 of the 2014 ULP PEIS)	Operation 40 daily truck shipments (or 80 vehicle trips per day) 300 daily worker commuter trips	Similar effects as noted in the columns to the left
	Impact summary	SMALL to MODERATE (site specific)	SMALL to MODERATE (site specific)	SMALL	
Socioeconomics	Workforce estimates	Construction 200 workers for total peak construction employment (12–18 months) Influx of 480 to 560 workers and their families into region of influence (ROI) Operation 50–80 workers, resulting in potential influx of 35 to 56 workers and 160 total population (workers and their families)	Mine development and operation: Up to 150 workers for a large mine Assumed 229 (direct), 115 of which would in-migrate to the ROI (based on Alternative 4 evaluated in the ULP PEIS)	No new construction Operation 150 workers (full operation workforce) 50 workers (current workforce)	Similar effects (SMALL to MODERATE) as noted in previous columns with the following additional qualifications: Impacts dependent on how many workers in-migrate into the ROI (and bring families) and their distribution within the ROI. Smaller impacts expected if all workers obtained from within an ROI (no change in population).
	Impacts (construction and operation) on ROI and local communities, with respect to population, employment,	SMALL for construction, given relatively small population influx (and assumption that most construction workers will not bring families).	SMALL, given small population influx and sufficient labor in the ROI. the Leidos Team reasoning as follows: (1) employment would likely be distributed across more than one	NONE to SMALL The White Mesa Milling EA did not identify or analyze any adverse impacts on socioeconomics, presumably because	

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	Impact Indicator	Existing NEPA			Uranium Mining for HALEU
		In-Situ Recovery	Conventional Mining	Milling	
	housing, community services	SMALL for operation. Potential MODERATE impacts (construction and operation) expected on some local communities if in-migrating population concentrates in select communities with small population and limited housing. Potential LARGE impacts in certain areas (e.g., Dawes County, Nebraska) where the existing labor force is smallest in the ROI.	county, (2) the impacts would be absorbed across multiple governments and many municipalities, and (3) the employment pool would come from a larger population group than if all employment originated from any one county. Mining workers could live in larger population centers in the ROI. But there is also potential for MODERATE impacts in some communities. Impacts would be greatest where in-migrating population choose to live in local communities with a small population.	none were expected given it was for license renewal with no projected change in the workforce.	Greater (MODERATE) impacts if in-migrating population concentrate in local community with small population. As the Proposed Action would utilize existing facilities, the anticipated impacts on socioeconomics would likely have lesser effects than those analyzed in past NEPA documents that considered new mining sites. For example, existing workers in the area could be transitioned in, or pulled from other nearby established mining sites or recently decommissioned facilities.

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	*Impact Indicator*	*Existing NEPA*			*Uranium Mining for HALEU*
		In-Situ Recovery	*Conventional Mining*	*Milling*	
					In addition, the potential impacts (including economic benefits) would likely be spread out through the multiple locations and more than one ROI, further reducing the impacts on a single community, county or ROI. Increased operations would generate direct and indirect tax revenues and increased spending, which would result in SMALL to MODERATE beneficial impacts on local and regional economies.
	Beneficial impacts (e.g., job opportunities, reduced unemployment, income, tax revenues)	SMALL to MODERATE – Could have MODERATE impacts on local finances, which would be affected through additional taxation and purchase of goods and services (dependent on the	$4.7 million in direct income; $4 million in indirect income These beneficial impacts would be SMALL for the ROI as a whole but could be	Not applicable	

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	Impact Indicator	Existing NEPA			Uranium Mining for HALEU
		In-Situ Recovery	Conventional Mining	Milling	
		number of new jobs created and size and distribution of the in-migrating workforce and their families to the ROI). Also, variation between sites/ROIs depending on existing tax structure and revenue generation from mineral production.	MODERATE for smaller host counties or municipalities that receive a larger percentage of the population influx.		
Environmental Justice (EJ)	Disproportionate and adverse effects on minority and low-income populations	The NRC concluded that environmental reviews for facilities located in the Wyoming East Uranium Milling Region do not need an EJ analysis, because demographic data failed to identify a minority or low-income population that has the potential to receive disproportionately high and adverse environmental or health impacts compared to the general population in the area. Minority populations and Tribal lands were identified in Wyoming West, Nebraska-South Dakota-Wyoming, and Northwestern New Mexico Uranium Milling Regions. The NRC recommended an EJ analysis be conducted in these three regions.	DOE determined that minority and low-income populations are present within a 50-mile radius. Construction No disproportionately high and adverse impacts on low-income and minority populations. Air emissions from fugitive dust and the operation of construction equipment is expected to be minor, and chemical exposure during exploration would be limited to airborne toxic air pollutants, which would be at less than standard levels and would not result in any adverse health impacts. Diversion of water from domestic, cultural, religious, or agricultural uses that might disproportionately	No EJ analysis	Construction and operation impacts from mining and milling to support HALEU production would be similar to those described for ISR and conventional mining if mining and milling were to be conducted at an existing facility.

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	*Impact Indicator*	*Existing NEPA*			*Uranium Mining for HALEU*
		In-Situ Recovery	*Conventional Mining*	*Milling*	
			affect low-income and minority populations is not expected based on water usage for exploration. Operation Mining facilities would not result in any significant radiological risks to underground or surface mine workers or any radiological or adverse health impacts on the general public during operations and therefore would not disproportionately affect low-income and minority populations. Air emissions from fugitive dust and the operation of mine facility equipment are expected to be minor. Chemical exposure during mine operations would be limited to airborne toxic air pollutants, which would be at less than standard levels and would not result in any adverse health impacts. No disproportionate impacts on low-income or minority populations would therefore be expected.		

Table 1-4. Summary of Impacts for Uranium Mining and Milling

Resource Area	Impact Indicator	Existing NEPA			Uranium Mining for HALEU
		In-Situ Recovery	Conventional Mining	Milling	
			Unique radiological exposure pathways (such as subsistence fish, vegetation, wildlife consumption, or well water use) that could potentially result in adverse health and environmental impacts on minority and low-income populations; however, no radiological impacts are expected during the reclamation of uranium mining facilities. Reclamation would generate only minor radiological risks to workers or radiological or adverse health impacts to the general public and thus would not disproportionately affect minority and low-income populations.		

Key: < = less than; BMPs = best management practices; CEDE = committed effective dose equivalent; EA = Environmental Assessment; EIS = Environmental Impact Statement; EJ = environmental justice; HALEU = high-assay low-enriched uranium; ISR = in-situ recovery; m = meters; mrem = millirem; mrem/yr = millirem per year; MT = metric tons; NAAQS = National Ambient Air Quality Standards; NEPA = National Environmental Policy Act; NESHAP = National Emission Standards for Hazardous Air Pollutants; NO_2 = nitrogen dioxide; NO_x = nitrogen oxide; PDEIS = Preliminary Draft EIS; PEIS = Programmatic EIS; ROI = region of influence; SHPO = State Historic Preservation Officer; the Leidos Team= U.S. Department of Energy; U_3O_8 = uranium oxide; ULP PEIS = *Final Uranium Leasing Program Programmatic Environmental Impact Statement*

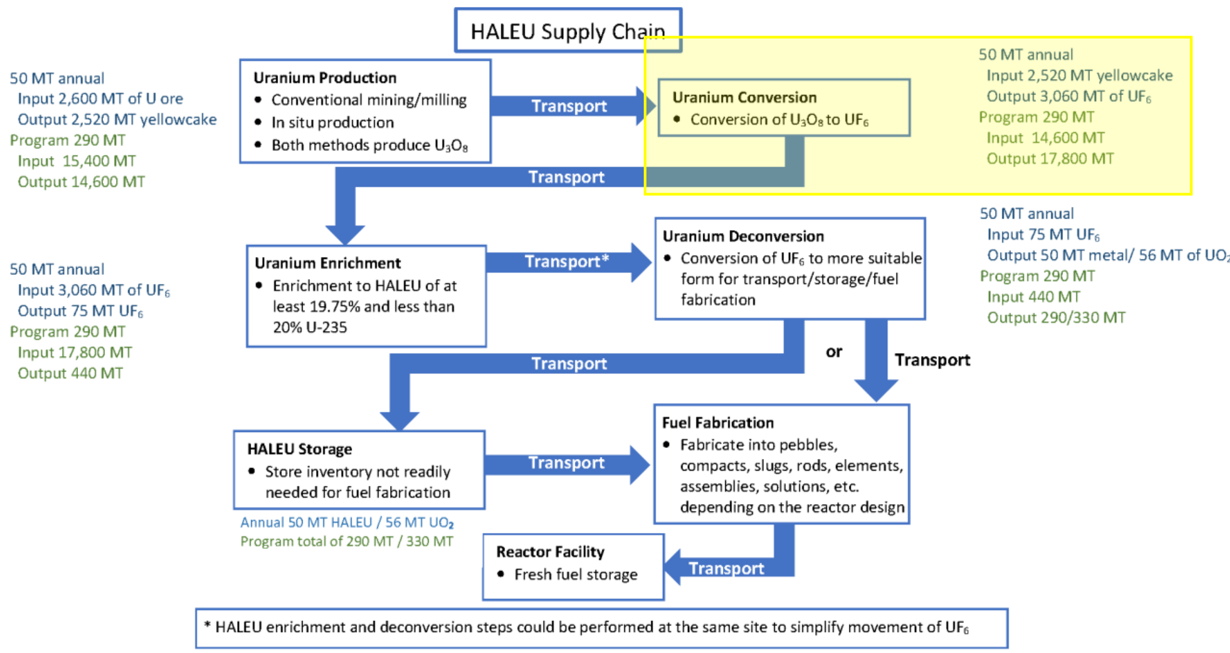
This page intentionally left blank.

2 Uranium Conversion

2.1 Description of the Activity

2.1.1 General Description

Conversion is the second step of the high-assay low-enriched uranium (HALEU) fuel cycle (see Figure 2-1). In the conversion process, yellowcake (primarily triuranium octoxide [U_3O_8]) produced during uranium milling or in-situ recovery is converted in a series of steps to uranium hexafluoride (UF_6). The annual Proposed Action demand of 50 metric tons (MT) of HALEU would require the conversion of 2,520 MT of yellowcake to 3,060 MT of UF_6. The 2,520 MT of yellowcake could be stored in 5,920 55-gallon (gal) drums and the 3,060 MT of UF_6 could be stored in 256 48Y cylinders. The total project demand of 290 MT of HALEU fuel would require the conversion of 14,600 MT of yellowcake to 17,800 MT of UF_6.



Key: % = percent; HALEU = high-assay low-enriched uranium; MT = metric ton; U = uranium; U_3O_8 = triuranium octoxide; UF_6 = uranium hexafluoride; UO_2 = uranium oxide

Figure 2-1. HALEU Fuel Cycle

2.1.2 Description of the Process

The following describes the main steps involved in the conversion process, as performed at ConverDyn's Metropolis Works Plant in Metropolis, Illinois (NRC, 2019a).

Uranium oxide ore storage, sampling, and preparation – Uranium oxide ore concentrates, often referred to as yellowcake, are shipped to a conversion facility via truck in 55-gal drums and stored on asphalt pads. At the ore sampling building, a representative sample from each drum is collected to determine the general composition of the ore and characterize impurities. After sampling, the drum lid is replaced, and the drum is moved to a storage area until needed. Feed material may require treatment with sulfuric acid if it contains high levels of sodium or potassium. Uranium feed is removed from the rinse solution by filtration and transferred to the ore preparation system. The filtered rinse solution is pumped to uranium settling ponds and some particulates are released to the atmosphere. Ore with an acceptable purity level is calcined, crushed, and sized to produce uniform solid particles, which are processed in fluidized bed reactors.

Ventilation air from the feed preparation building is filtered before release to the atmosphere to control uranium particulates by at least 95%. Solid waste filter bags are produced in this operation. The contaminated liquid stream produced in drum washing is routed to a uranium settling pond.

Reduction – The initial step in the conversion process is the reduction of yellowcake to solid uranium oxide, which is accomplished by contacting feed yellowcake with hydrogen gas in a fluidized bed reactor at 565 degrees Celsius (°C) (1,050 degrees Fahrenheit [°F]) in the Feed Materials Building (FMB). A liquid hydrogen system is used as a source of hydrogen. The liquid hydrogen system is located within a gated enclosure south of the maintenance building and consists of a 18,000-gal cryogenic storage tank and vaporizers. A nitrogen and hydrogen mixing station, located outside the liquid hydrogen system fence, provides fluidizing and reactive gas mixtures to the reactor. Reduction off-gases consist of hydrogen sulfide, hydrogen, nitrogen, and metallic sulfides. These are processed through a gas-fired incinerator to burn off the excess hydrogen and convert hydrogen sulfide and other sulfides. The off-gas is run through a sintered metal filter bowl to remove the particulates from the stream. The stream is processed through a gas-fired incinerator to produce carbon dioxide, which then exits the incinerator stack.

Hydrofluorination – In the next step of the conversion process, solid uranium oxide in the FMB is converted to solid uranium tetrafluoride (UF_4) by contacting the uranium oxide with gaseous hydrogen fluoride (HF) in two series-arranged fluidized bed reactors. The hot (455°C [851°F]) reactor off-gas is filtered and scrubbed with water, then scrubbed with potassium hydroxide solution before release to the atmosphere. The spent scrubber liquid is processed through the environmental protection facility for neutralization and recovery of fluorine as calcium fluoride. The UF_4 solids filtered from the off-gas are combined with the UF_4 product stream for transfer to fluorination reactors.

Fluorination – The final chemical reaction in the conversion process is fluorination of solid UF_4 in the FMB using fluorine gas to generate gaseous and then liquid UF_6. The gaseous fluorine is produced by decomposition of HF in electrolytic cells located in a building near the FMB. The fluorination reaction is accomplished at a temperature of 480 °C (900 °F) in a fluidized bed containing calcium fluoride bed material. The bed material, which gradually becomes too fine and contaminated with uranium, is continuously removed along with residual uranium deposits from the process, while fresh bed material is continuously added. Contaminated bed material may either be processed on-site or shipped off-site for uranium recovery. The reactor effluent gas stream containing the UF_6 product is passed through two filters in series and three cold traps in series. The UF_6 is condensed in the cold traps to create liquefied crude UF_6 that is transferred to the distillation area.

Gases exiting the cold traps are scrubbed with potassium hydroxide solution in series-arranged spray and packed towers. Potassium fluoride mud is removed from the scrubber solution, washed, and recycled to the uranium recovery system. The spent scrubber solution is transferred to the environmental protection facility for neutralization, recovery of potassium hydroxide, and recovery of fluorine as calcium fluoride. Filtered and scrubbed off-gases (primarily HF) are released to the atmosphere.

Distillation and Packaging – After the creation of liquid UF_6 in the FMB, impurities are removed from the liquefied crude UF_6 in two series-arranged distillation columns. Crude UF_6 is fed to the first column and impurities with high vapor pressure are removed as the overheads from this column. The bottoms from the first column are fed to the second column, where impurities with low vapor pressure are removed as the bottoms, and the purified UF_6 product that meets or exceeds American National Standards Institute C787, *Standard Specification for Uranium Hexafluoride for Enrichment*, purity requirements are collected in the overheads. Gaseous effluents from the distillation process are fed back to the fluorination system and treated with the fluorination off-gas. The purified product UF_6 vapor is condensed and transferred as liquid to cylinders for storage and subsequent shipment to an enrichment facility. Flow meters are used to measure the amount of UF_6 transferred to the cylinders, and the UF_6 entering the cylinders is continuously sampled. On occasion, filled cylinders are heated in a steam chest for vaporization and sampling. The filled cylinders are moved to cooling and storage areas.

UF_6 is a solid below a temperature of 57 °C (134 °F) and a gas at temperatures above 134 °F. Solid UF_6 is a white, dense, crystalline material that resembles rock salt.

2.1.3 Potential Facilities

There is only one facility in the United States that performs commercial-scale uranium conversion—the Metropolis Works Plant in Metropolis, Illinois, along the Ohio River, which ConverDyn (formerly Honeywell International) owns and operates. The U.S. Nuclear Regulatory Commission (NRC) completed the *Environmental Assessment for the Proposed Renewal of Source Material License SUB-526 Metropolis Works Uranium Conversion Facility (Massac County, Illinois)* (referred to as the "Metropolis EA") that evaluated the impacts of renewing the operating license for 40 years (NRC, 2019a). In 2020, the NRC approved an extension of the facility license to March 2060 (NRC, 2020c). This facility is licensed to produce up to 15,000 MT per year (MT/yr) of UF_6. Therefore, the Metropolis facility has sufficient conversion capacity to support HALEU fuel production needs in addition to other low-enriched uranium (LEU) fuel production demands.

The Metropolis facility is currently in standby mode, awaiting more favorable market conditions to re-start its operations. It is estimated that from an initial decision to restart operations, it would require 18 to 24 months for the facility to reach full production.

2.1.4 Existing NEPA Documentation

As discussed previously, the Metropolis facility has sufficient conversion capacity to support the needs of the Proposed Action and the Metropolis Environmental Assessment (EA) (NRC, 2019a) provides National Environmental Policy Act (NEPA) coverage for all of the activities associated with uranium conversion. Therefore, this Technical Report relies on that NEPA document as much as possible to provide NEPA coverage for all affected resources.

The Metropolis EA (NRC, 2019a) evaluated a proposed action and two alternatives to the proposed action:

- Under the proposed action, Metropolis would continue conversion of uranium ore concentrates (yellowcake) to gaseous fluorine and UF_6 at an authorized capacity not to exceed 15,000 MT (16,535 tons) for a 40-year period.
- Under the reduced duration alternative, Metropolis would continue conversion activities for a period of less than 40 years. The Metropolis EA provided minimal analysis of this alternative, stating that the potential environmental impacts from the reduced duration alternative are bounded by those analyzed for the Proposed Action.
- Under the no action alternative, the NRC would discontinue activities under the Metropolis facility operating license SUB-526. If this were to occur, the facility would move into a decontamination and decommissioning phase. This alternative is not applicable to the Proposed Action.

The Metropolis EA (NRC, 2019a) states on page 2-1 that Chapter 2 describes the Metropolis facility site and ongoing activities at the facility that comprise the Proposed Action and that unless otherwise referenced, the primary source of information is the Environmental Report submitted as part of the license application (ENERCON, 2017). The Environmental Report provides additional information about conversion activities at the Metropolis facility.

2.2 Approach to NEPA Analyses

The proposed conversion activity for the Proposed Action includes operation of a conversion facility for about 6 years. This could be at either a new facility or the Metropolis facility. The Metropolis facility requires no modifications to meet the project conversion demands. Also, since the facility would continue to support LEU fuel production for other demands, decommissioning is not the responsibility of the Proposed Action. Therefore, decommissioning of the Metropolis facility does not require analysis in the Technical Report.

No conversion facility has been constructed in the United States since the construction of the Metropolis facility, built in 1958. As this is well before NEPA, little to no environmental information is available for the construction of a conversion facility. However, a new conversion facility would be a new chemical processing facility. The effort, materials, and impacts of its construction would not be significantly different from a comparably sized facility that performs a different but similar chemical processing function. The Technical Report assesses impacts associated with the construction of several types of facilities: enrichment, deconversion, and storage. For the assessment of the impacts of constructing a conversion facility, the construction of the deconversion facility could be used as a surrogate. The proposed fluorine extraction process and depleted uranium deconversion plant in Lea County, New Mexico, is sized to process 3,400 MT of depleted uranium per year (NRC, 2012a). A conversion facility producing enough UF_6 to support the production of 290 MT of HALEU would operate with an annual production capacity of approximately 2,520 MT/yr of yellowcake (assuming 6 years of operation). As a first approximation, the new conversion facility would be slightly smaller than the proposed deconversion facility and the impacts of constructing the conversion facility should be bound by those of constructing the deconversion facility.

The affected environment discussions and environmental impact analyses for the operation of a HALEU conversion facility are adopted by reference from the Metropolis EA (NRC, 2019a) for the Metropolis facility, with additions to update the discussions to current conditions where needed. The impact analyses take into consideration that the annual conversion demand for the Proposed Action would be about 20% of the annual conversion production and resulting impacts evaluated in the Metropolis EA. In other words, annual impacts identified in the Metropolis EA would substantially bound annual impacts expected from the Proposed Action. However, short-term impacts, such as a daily period, could be similar between the Proposed Action and the activities evaluated in the Metropolis EA (although most of the impacts identified in the Metropolis EA are expressed as annual impacts). The analyses consider project and environmental controls, and if needed, mitigations that would minimize impacts.

The impact analyses for conversion in the Technical Report include the same impact conclusion statements as those stated in the Metropolis EA section, such as the project impact "would not be significant" or "would have no significant impacts."

2.3 Affected Environment and Environmental Consequences

2.3.1 Construction and Operation of a New Facility

The *Environmental Impact Statement for the Proposed Fluorine Extraction Process and Depleted Uranium Deconversion Plant in Lea County, New Mexico – Final Report* (NRC, 2012a) (referred to as the "Fluorine/DU EIS") identified the environmental impacts of this facility for most resource areas as being SMALL (see Section 4, *HALEU Deconversion*). Only two resource areas were identified as having potential MODERATE impacts during construction: historic and cultural resources and socioeconomics. In addition, impacts on ecological resources were assessed to be SMALL to MODERATE. The severity of impacts would be dependent on the current ecological conditions of the selected site, in comparison to the disturbance footprint associated with the facility designs. The facility accident impacts were also identified as potentially MODERATE, but these accidents only apply during facility operation.

The relatively small size of the physical facility both in terms of area and height (i.e., developed or disturbed area of 40 acres with a buffer and structures of two to three stories high) contribute to the SMALL impact assessments. The effort to construct the facility would be relatively small and occur over a relatively short period requiring a workforce that measures in the tens not hundreds.

Based on the assessment of the impacts of the construction of a HALEU deconversion facility:

- Impacts on ecological resources from the construction of a new conversion facility could occur from removal or degradation of vegetation, wildlife habitats, wetlands, and Federal- and state-listed species, as well as by contamination by radioactive or hazardous materials via air- or water-borne pathway. However, construction of a new conversion facility at an existing industrial site would likely occur on previously disturbed areas and have the potential to impact up to 40 acres. Impacts on ecological resources would be SMALL if new construction were to occur entirely within previously developed and disturbed lands. For construction of a new conversion facility on undeveloped lands, the degree of impact, while limited due to the relatively small size of the facility and the implementation of best management practices (BMPs), would be dependent upon the ecological characteristics of the selected site. Any new construction occurring within undeveloped lands could have SMALL to MODERATE impacts on ecological resources depending on the resources disturbed. An inventory of threatened or endangered species would be developed during site-specific reviews to identify unique or special habitats, and Endangered Species Act consultations conducted with the U.S. Fish and Wildlife Service would assist in reducing/avoiding adverse impacts.
- The impacts on historic and cultural resources of construction of a new conversion facility at an existing uranium fuel cycle facility or industrial site on previously disturbed land would likely be SMALL. Construction of a new conversion facility at an undeveloped new location has the potential to impact historic and cultural resources. The degree of impact, while limited due to the relatively small size of the facility and the implementation of BMPs, would be dependent upon the historical and cultural characteristics of the selected site. Because of this, the impacts of construction at a previously undeveloped site are expected to be SMALL to MODERATE.
- Given the small in-migrating population expected to move into the area and the fact that all the potential sites are well-established industrial sites, the socioeconomic impacts associated with a new conversion facility usually would be expected to be SMALL in the region of influence (ROI). In addition, the economic impacts (e.g., increased jobs, income, and tax revenues) would be considered beneficial to the local and regional economy. In the event a larger (than analyzed)

workforce moved into the ROI and a majority of workers chose to reside in the host county, particularly at one of the sites where the host county is more rural in nature and has lower population numbers (and a low population density), the potential impacts could be SMALL to MODERATE, as the higher numbers could adversely affect housing availability and community services such as education, fire protection, law enforcement, and medical resources. At the same time, however, the corresponding increases in income, spending, and tax revenues that would result from a larger workforce would help benefit the local economy, and the increased revenues could be used to enhance existing public services that might be deficient.

The basic chemistry of converting yellowcake (i.e., U_3O_8) utilized in a new facility would be similar to that used at ConverDyn's Metropolis facility. Assuming that a new facility would be built with similar siting parameters (i.e., size of the facility itself, similar buffer zones between the site and the public) and capacity, impacts from the operation of a new conversion facility should be comparable to the impacts from operation of the Metropolis facility. In the EA for the continued operation of the Metropolis facility (NRC, 2019a), the NRC concluded that continued operation had no significant impacts. Operation of a new conversion facility should result in similar impacts, although several local environmental conditions could affect the impact determination. Among these:

- Existing land use and visual characteristics of the potential location – impacts would be smaller if the new conversion facility were to be built in an existing industrial area.
- Water use impacts would depend on the availability of excess (unused) ground or surface water.
- Air quality impacts could be larger for areas close to or in nonattainment of an ambient air quality standard.
- Socioeconomic characteristics of the location – smaller populations (population size, distribution, and demographics) and smaller economies could be impacted to a greater extent by the influx of workers.

Site-specific environmental impacts would need to be addressed by both the licensee and the NRC during the licensing of a new facility. That documentation would need to verify that the parameters that resulted in a SMALL impact assessment would be applicable to the new facility and provide an assessment of the resource areas identified as having a potential MODERATE impact.

2.3.2 Metropolis Facility Operations

2.3.2.1 Land Use

Impacts on land use were considered for the operation of the Metropolis facility in the Metropolis EA (NRC, 2019a). The land use affected environment presented in Section 3.1 of the Metropolis EA discusses the site and site vicinity and is adequate for describing the affected environment for the proposed conversion activities analyzed in the Technical Report. The dominant land cover is undeveloped deciduous forest, with 16% of the site classified as being developed. Table 3-1 of the Metropolis EA details land use and land cover of the site. The facility is on a land parcel owned by ConverDyn and located in Massac County, which does not have land use zoning or an economic development office (ENERCON, 2017, pp. 2-16). Land in a 2-mile vicinity of the site is mainly agricultural or undeveloped, with the exception of Metropolis and industrial areas, such as the Tennessee Valley Authority Shawnee Steam Plant, which is about 1 mile to the south across the Ohio River (NRC, 2019a, pp. 3-2). Metropolis is located 0.8 km (0.5 miles) from the site and utilizes zoning and mapped zoning districts to control land use (ENERCON, 2017, pp. 2-16). Since the development of the Metropolis EA, more medium- and high-intensity development has occurred in Metropolis (MRLC, 2019).

In March 2016, the Illinois Environmental Protection Agency (IEPA) approved an environmental land use control (ELUC) for portions of facility, and the ELUC would be attached to the property deed. The ELUC contains limitations on how the property could be used in the future. The boundary of the ELUC is shown in Figure 3.4-3 of Honeywell's 2018 Responses to Environmental Report Request for Additional Information (Honeywell, 2018). Land use for the facility and to support the facility is not anticipated to increase or decrease through the duration of the 40-year license term, and any land use changes would be limited to the ELUC boundary (Honeywell, 2018, p. 13).

In Section 4.1.1 of the Metropolis EA (NRC, 2019a), it was concluded that impacts on land use resulting from continued operations at the Metropolis facility would not be significant, as the facility operations would be consistent with current land use and no major construction or expansion of the facility would occur such that additional acreage would be needed (NRC, 2019a, pp. 4-1). The Metropolis EA concluded that no impacts from the continued operations of the facility over the 40-year lease were anticipated to the surrounding area.

No new construction or major modifications to existing facilities would be required to meet the conversion demands of the Proposed Action at the Metropolis facility. Conversion throughput for HALEU production would comprise approximately 20% of the licensed capacity of the Metropolis facility. Therefore, it is anticipated that impacts on land use associated with uranium conversion in support of the Proposed Action at this location would be similar or less than the impacts described in the Metropolis EA (NRC, 2019a). Accordingly, impacts on land use associated with uranium conversion for HALEU production would be expected to be SMALL.

Impact Summary

Future operations at the Metropolis facility would be consistent with current land uses and would not require any major construction or expansion of the facility. Impacts on land use associated with uranium conversion in support of the Proposed Action would be similar or less than the impacts described in the Metropolis EA (NRC, 2019a). Therefore, impacts on land use associated with uranium conversion for HALEU production would be expected to be SMALL.

2.3.2.2 Visual and Scenic Resources

Impacts on visual and scenic resources were considered for the operation of the Metropolis facility in the Metropolis EA (NRC, 2019a). The visual and scenic resources affected environment presented in Section 3.9 of the Metropolis EA discusses the characteristics of the landscape, including visually sensitive areas, and is adequate for describing the affected environment for the proposed conversion activities analyzed in the Technical Report. U.S. Highway 45 and a railroad right-of-way run along the north side of the site. The area surrounding the facility is a mix of swampy, forested bottomlands, low clay and gravel hills, rural residences, agricultural land, and deciduous forests. High-value scenic views can be found along the banks of the Ohio River, including Fort Massac State Park, east of Metropolis. However, the immediate vicinity of the facility site contains substantial industrial and urban development, including the coal-fired Joppa Power Station, the American Electric Power Cook Coal Terminal, and smokestacks from the Tennessee Valley Authority Shawnee Steam Plant (NRC, 2019a, pp. 3-31). High chain-link and barbed-wire security fences, approximately 50 feet (15.2 meters) apart, surround the facility buildings, ponds, and operational areas. Figure 3-6 of the Metropolis EA shows an aerial view of the site across U.S. Highway 45.

The facility currently operates under a Title V Clean Air Act Permit Program (CAAPP) permit issued by the IEPA, which requires the facility to minimize fugitive particle emissions and maintain a maximum opacity of 30% for smoke and other particulate matter. The facility complies with these permit conditions during normal operation. Since the previous license renewal, there have been no significant process modifications or construction activities that have altered the aesthetic or visibility impacts of the site (NRC, 2019a, pp. 4-17 to 4-18). The facility is not easily visible from locations outside the facility site, and it is surrounded by forested areas, which limit its impact on scenic and visual resources. Therefore, the Metropolis EA (NRC, 2019a) concluded that the continued operations of the Metropolis facility would not have significant impacts on scenic and visual resources within the site or surrounding area.

In Honeywell's 2017 License Renewal Application, minor modifications were proposed to the existing facility (ENERCON, 2017). The Environmental Report indicated that system modifications would not alter the current aesthetics of the facility and it would not alter or adversely affect existing visual features or scenic views (ENERCON, 2017, pp. 4-22).

No new construction or major modifications to existing facilities would be required to meet the conversion demands of the Proposed Action at the Metropolis facility. Conversion throughput for HALEU production would comprise approximately 20% of the licensed capacity of the Metropolis facility. Therefore, it is anticipated that impacts on visual and scenic resources associated with uranium conversion in support of the Proposed Action at this location would be similar or less than the impacts described in the Metropolis EA (NRC, 2019a) and 2017 License Renewal Application Environmental Report (ENERCON, 2017). Accordingly, impacts on visual and scenic resources associated with uranium conversion for HALEU production would be expected to be SMALL.

Impact Summary

The Metropolis facility is not easily visible from locations outside the facility site, and it is surrounded by forested areas, which limits its impact on scenic and visual resources. The Metropolis EA concluded that continued operation of the Metropolis facility would not have significant impacts on scenic and visual resources within the site or surrounding area. Impacts on visual and scenic resources associated with uranium conversion in support of the Proposed Action would be similar or less than the impacts described in the Metropolis EA. Therefore, impacts associated with uranium conversion for HALEU production would be expected to be SMALL.

2.3.2.3 Geology and Soils

Impacts on geology and soils were considered for the operation of the Metropolis facility in the Metropolis EA (NRC, 2019a). No major modifications to existing facilities or construction of new facilities were proposed in the license renewal application so impacts on geological features, soil erosion, subsidence, or landslides were considered minimal.

The Metropolis facility performs semiannual fluoride and uranium sampling at on-site and off-site locations, which are summarized in Table 2-8 of the Metropolis EA (NRC, 2019a). Additionally, soil uranium sampling at the nearest residence and off-site locations occurred between 2006 to 2018 and 1999 to 2018, respectively (Marschke & Gorden, 2019). The average on-site soil uranium concentration for sampling performed from 2010 to 2018 was 32 parts per million (ppm), which is 10.7 times the background value of 3.0 ppm and 2 times higher than the 4-year average reported in 1995 (NRC, 2019a). The average off-site soil uranium concentration was 2.3 ppm and less than the background level. Elevated soil uranium concentrations at the nearest off-site residence in 2015 were suspected to be from an unplanned release that occurred in 2014. Health effects of soil uranium concentrations are described in Section 4.1.11.1 of the Metropolis EA and in Section 2.3.2.11, *Public and Occupational Health – Normal Operations,* of the Technical Report.

The NRC reviewed soil sampling results and concluded that there were no temporal trends or correlations with air emissions from the Metropolis site. The licensee has addressed contaminated areas and complies with Resource Conservation and Recovery Act requirements in treating contamination from past operations and implementation of IEPA ELUC protective measures. Additionally, the Metropolis EA (NRC, 2019a) cites new spill prevention, cleanup procedures, and active IEPA oversight at the facility. As a result, the impacts on soil contamination from license renewal were considered not significant.

Conversion throughput to support HALEU production would comprise approximately 20% of the licensed capacity and would not require any new construction or modifications to the Metropolis facility. Therefore, the geology and soils impacts due to production of UF_6 for the Proposed Action would be not significant and would be similar or less than the impacts described in the Metropolis EA (NRC, 2019a).

Impact Summary

Since no major modifications to existing facilities or construction of new facilities would occur from the Proposed Action, impacts on geological features would be minimal. The Metropolis facility complies with Resource Conservation and Recovery Act requirements in treating contamination from past operations and implementation of IEPA ELUC protective measures. Additionally, the Metropolis EA (NRC, 2019a) cites new spill prevention, cleanup procedures, and active IEPA oversight at the facility. As a result, the impacts on soil contamination from license renewal were considered not significant. Therefore, impacts on geology and soils associated with uranium conversion in support of the Proposed Action would be not significant and would be similar or less than the impacts described in the Metropolis EA.

2.3.2.4 Water Resources

Impacts on water resources were considered for operation of the Metropolis facility in the Metropolis EA (NRC, 2019a). The water resources affected environment presented in Section 3.4 of the Metropolis EA discusses nearby surface and groundwater resources and is adequate for describing the affected environment for the proposed conversion activities analyzed in the Technical Report (slightly more recent surface water quality data is provided in this section). The main water resource features present in this area are the Ohio River, which forms the southern border of the site, and the Mississippian Salem Limestone aquifer, which is the groundwater source for the three industrial water supply wells and one sanitary water-supply well located on-site (NRC, 2019a, pp. 3-13 to 3-16).

The Ohio River Valley Water Sanitation Commission's most recent biennial assessment of Ohio River designated uses, which considers river conditions between the years 2014 and 2018, found that the segment of the Ohio River that includes the site of the Metropolis facility is fully supporting the river's designated uses for warm water aquatic life, public water supply, contact recreation, and fish consumption, when considering mercury as a parameter. This segment of river is partially supporting its use for fish consumption when considering polychlorinated biphenyls and dioxin parameters (ORSANCO, 2020).

In Section 4.1.4.1 of the Metropolis EA (NRC, 2019a), it was concluded that impacts on surface waters resulting from continued operations at the Metropolis facility would not be significant, due to adherence to release limits and monitoring requirements of existing permits that address stormwater and wastewater effluents on-site. Surface water sampling data for the years 2010 to 2014 are presented in Table 2-6 of the Metropolis EA (NRC, 2019a, pp. 2-17, 4-6, 4-7).

The NRC likewise concluded that impacts on groundwater resulting from continued operations at this location would not be significant, in part due to the great depth of the Mississippian Salem Limestone aquifer and the low permeability clays in the overlying formations, which help prevent contaminants from reaching groundwater resources, and also due to four groundwater monitoring programs on-site that require mitigation when elevated contaminant levels are identified (NRC, 2019a, pp. 4-7 to 4-8). These groundwater monitoring programs are described in Section 2.3.9.2 of the Metropolis EA (NRC, 2019a) and a summary of ongoing activities under these programs is presented in Section 4.1.4.2 of the Metropolis EA (NRC, 2019a, pp. 2-23, 2-24, 4-7, 4-8).

No new construction or major modifications to existing facilities at the Metropolis facility would be required to meet the conversion demands of the Proposed Action. Conversion throughput for HALEU production would comprise approximately 20% of the licensed capacity of the existing Metropolis facility. Therefore, it is anticipated that impacts on water resources associated with uranium conversion in support of the Proposed Action at this location would be similar or less than the impacts described in the Metropolis EA (NRC, 2019a). Accordingly, such impacts would not be significant.

Impact Summary

The Metropolis EA concluded that impacts on surface waters resulting from continued operations at the Metropolis facility would not be significant, due to adherence to release limits and monitoring requirements of existing permits that address stormwater and wastewater effluents on-site. The NRC also concluded that impacts on groundwater would not be significant, in part due to the great depth of the Mississippian Salem Limestone aquifer, the overlying formations that limit contaminants from reaching groundwater resources, and due to a groundwater monitoring program, which requires mitigation when elevated contaminant levels are identified. Therefore, it is anticipated that impacts on water resources associated with uranium conversion in support of the Proposed Action would be similar or less than the impacts described in the Metropolis EA (NRC, 2019a).

2.3.2.5 Air Quality

The following section discusses potential air quality impacts that would occur due to uranium conversion activities performed to support the Proposed Action at the Metropolis facility in Metropolis, Illinois (described in Section 2.1, *Description of the Activity*). The analysis of impacts relies on analyses from the Metropolis EA that evaluated impacts of renewing the operating license of this conversion facility for 40 years (NRC, 2019a).

Conversion activities would result in air emissions of criteria pollutants, hazardous air pollutants, radiological compounds, and greenhouse gases. The following evaluates projected emissions relative to air quality conditions within the region and applicable air pollution standards and regulations. Section 2.3.2.11, *Public and Occupational Health – Normal Operations* presents estimates of health effects due to radiological air emissions that would occur from the Proposed Action.

Under the Clean Air Act (CAA), the U.S. Environmental Protection Agency (EPA) establishes National Ambient Air Quality Standards (NAAQS) for common air pollutants known as criteria pollutants. The NAAQS represent the maximum allowable atmospheric concentrations that may occur and still protect public health and welfare. The CAA establishes air quality planning processes and requires states to develop a State Implementation Plan that details how they will maintain the NAAQS or attain a standard in nonattainment within mandated time frames. Under the CAA, states are allowed to develop their own ambient air quality standards so long as they are at least as stringent as the NAAQS.

In addition to criteria pollutants, EPA also regulates hazardous air pollutants that are known or are suspected to cause serious health effects or adverse environmental effects. EPA sets Federal regulations to reduce hazardous air pollutant emissions from stationary sources in the *National Emission Standards for Hazardous Air Pollutants* (EPA, 2023a).

EPA designates all areas of the United States as having air quality better than (attainment) or worse than (nonattainment) the NAAQS. Former nonattainment areas that have attained the NAAQS are designated as maintenance areas. Presently, EPA categorizes Massac County, which surrounds the Metropolis site, and adjacent McCracken County in Kentucky as in attainment of all NAAQS (EPA, 2023b) The IEPA regulates sources of air pollution in Illinois. Additional descriptions of the air quality resource within the Metropolis facility ROI are presented in the Metropolis EA, Section 3.6 (NRC, 2019a).

Air quality impacts from conversion activities would occur from (1) the transport of yellowcake (primarily U_3O_8) feed material, UF_6 product, and waste material by truck; (2) uranium compounds, HF, and other gaseous and particulate effluents released from rooftop vents; (3) natural gas-fired process heaters, dryers, and boilers; (4) a 755-horsepower diesel engine for the air compressor system; and (5) worker commuter vehicles. In addition, trains would access the Metropolis site to deliver and to ship supplies, UF_6 product, byproducts, and waste. The ROI for the air quality analysis includes the area surrounding the Metropolis facility and within a few miles of a proposed emission source.

Sources of nonradiological air emissions at the Metropolis facility would operate under a CAAPP permit issued by the IEPA. Due to the emission controls and regulatory compliance required by the CAAPP permit, the Metropolis EA (NRC, 2019a) concluded that continued conversion operations at the facility would not have a significant impact on nonradiological air quality (NRC, 2019a, p. § 4.1.6.1). In addition, mobile sources (trucks, worker commuter vehicles, and trains) that operate in association with the conversion activities would produce dispersed and minor impacts on nonradiological air quality. The annual HALEU conversion demand would be about 20% of the maximum licensed conversion production and resulting impacts evaluated in the 2019 Metropolis EA. Therefore, air quality impacts from the Proposed Action conversion activities at the Metropolis facility also would not have a significant impact on nonradiological air quality.

Uranium would be the primary radiological constituent released from the Metropolis facility. Uranium processing areas within buildings that produce dusts, mists, or fumes containing uranium or other toxic materials would be ventilated to stacks that include dust collectors or scrubbers to reduce pollutant exposure to employees and the environment to acceptable levels. The conversion activities would be subject to the NRC regulations for radionuclide emissions and radiological dose or release limits in Title 10 Code of Federal Regulations (CFR) Part 20 (10 CFR 20) and 40 CFR 190. The Metropolis facility implements gaseous effluent control systems and monitoring programs to protect human health and the environment from radiological emissions (NRC, 2019a, p. § 2.3.8.1 and 2.3.9).

Impact Summary

Due to the emission controls and regulatory compliance required by an IEPA permit, the Metropolis EA (NRC, 2019a) concluded that continued conversion operations at the facility would not have a significant impact on nonradiological air quality. Uranium processing areas within buildings that produce dusts, mists, or fumes containing uranium or other toxic materials would be ventilated to stacks that include dust collectors or scrubbers to reduce pollutant exposure to employees and the environment to acceptable levels. Therefore, impacts on air quality associated with uranium conversion in support of the Proposed Action at the Metropolis facility would be similar or less than the impacts described in the Metropolis EA.

2.3.2.6 Ecological Resources

Impacts on ecological resources could occur from removal or degradation of vegetation, wildlife habitats, wetlands, and Federal- and state-listed species, and contamination by radioactive or hazardous materials via airborne or waterborne pathway.

Detailed descriptions of terrestrial and aquatic ecology and threatened and endangered species at the Metropolis site are presented in Section 3.5 of the Metropolis EA (NRC, 2019a). Under the 2019 analysis, the NRC concluded that continued operations at the Metropolis facility would not have a significant impacts on the ecological resources in the action area (defined as the entire Metropolis site, as well as the Ohio River directly adjacent to the Metropolis site, including discharge areas). This conclusion was based on continued compliance with environmental regulations and permits controlling the operation of the Metropolis facility and lack of significant additional site development. Minimal terrestrial resources impacts are expected from continued plant operation because no major expansion of existing facilities would take place. The primary potential impact on the terrestrial resources as part of continued operations would be from the nonradiological constituents released to the environment. The NRC previously examined the effects of these releases (NRC, 2006a) and concluded that continued operation of the facility would not result in significant adverse impacts on terrestrial biota near the facility. The NRC concluded that potential impacts from the proposed action on aquatic species in the water column would not be significant, and that potential impacts from contaminants in the sediments on benthic organisms or on species that feed on these organisms could be noticeable, but not significant.

Additional conversion throughput for the Proposed Action would not require any new construction or major modifications to the Metropolis facility. Additionally, all actions associated with the Proposed Action would occur in previously developed areas and they would not impact undeveloped lands. As such, impacts on ecological resources would not occur.

Impact Summary

The Metropolis EA (NRC, 2019a) concluded that continued operations at the Metropolis facility would not have a significant impacts on the ecological resources in the action area (defined as the Metropolis site, as well as the Ohio River directly adjacent to the Metropolis site, including discharge areas). This conclusion was based on continued compliance with environmental regulations and permits controlling the operation of the Metropolis facility and lack of significant site development. Potential impacts from the proposed action on aquatic species in the water column would not be significant, but potential impacts from contaminants in the sediments on benthic organisms or on species that feed on these organisms could be noticeable, but not significant. All actions associated with the Proposed Action would occur in previously developed areas and would not impact undeveloped lands. Therefore, impacts on ecological resources would not occur.

2.3.2.7 Historic and Cultural Resources

Construction and Operation

The NRC has previously analyzed the potential impacts of continued conversion of uranium ore concentrates at the Metropolis Works Plant in Metropolis, Illinois (NRC, 2019a), which is incorporated by reference and used as the comparative basis for this analysis. Although the proposed action did not include any construction or ground disturbance, the area of potential effects (APE) was defined as the entire 1,000-acre plant site, including the 59-acre restricted area (NRC, 2019a). Investigators previously identified five cultural resources sites in the APE, none of which were recommended as eligible for the National Register of Historic Places. The NRC staff also initiated consultation with 11 American Indian Tribes to assess the presence of places of religious or traditional cultural importance for Tribes within the APE. The NRC did not receive information from Tribes concerning specific resources of cultural importance on or near the Metropolis property (NRC, 2019a).

Based on the nature of the proposed continued conversion activities, with no construction or ground disturbance, the NRC determined under 36 CFR 800.3(a)(1) that the proposed action would have no potential to cause adverse effects on historic or cultural resources on the Metropolis facility property, assuming such historic properties are present.

Because the Proposed Action does not include construction or ground disturbance, similar to the Metropolis EA (NRC, 2019a), the potential impacts on historic or cultural resources would be the same as previously determined by NRC (Table 2-1). Therefore, continued uranium ore conversion at the Metropolis facility for the Proposed Action is expected to have no impacts on historic and cultural resources.

Table 2-1. Metropolis Works Plant: Summary of Historic and Cultural Resources Impacts for Historic and Current Uranium Conversion Activities

Metropolis EA Impact Determination	*2023 Technical Report Impact Determination*
No impact	No impact

Key: EA = Environmental Assessment

Impact Summary

The APE was defined in the Metropolis EA as the entire 1,000-acre Metropolis site, including the 59-acre restricted area. Based on the proposed continued conversion activities, the NRC determined under 36 CFR 800.3(a)(1) that the proposed action would have no potential to cause adverse effects on historic or cultural resources at the Metropolis facility. Because the Proposed Action also does not include construction or ground disturbance, potential impacts on historic or cultural resources would be the same or smaller as previously determined by the NRC. Therefore, uranium conversion in support of the Proposed Action at the Metropolis facility is expected to have no impacts on historic and cultural resources.

2.3.2.8 Infrastructure

While infrastructure was not specifically analyzed in the Metropolis EA (NRC, 2019a), demand on utilities due to conversion in support of the Proposed Action would comprise approximately 20% of the licensed capacity of the Metropolis facility. Therefore, no new construction or major modifications to existing infrastructure would be required to meet the utility demands of the Proposed Action. As such, demand on local service providers from the Proposed Action would be less than the demand of an existing facility operating at full capacity and extension of service lines would not be required. Additionally, the Metropolis EA noted that several upgrades and modifications to the process facilities and site infrastructure have occurred since the NRC issued the previous license renewal EA in 2006 (NRC, 2019a).

Impacts on infrastructure could occur if an action caused an increase in demand for utility services during construction or operations. A significant adverse effect to infrastructure could occur if construction and/or operation of the proposed HALEU conversion activities caused long-term disruption of utility operations, negatively affected the ability of local and regional utility suppliers to meet customer demands, or required substantial public utility system updates.

All existing electrical, natural gas, potable water, and wastewater infrastructure would be sufficient to serve the Proposed Action. As such, no significant impacts on infrastructure would be anticipated due to performing uranium conversion for the Proposed Action at the Metropolis facility.

Impact Summary

Based on upgrades and modifications to the site infrastructure noted in the Metropolis EA (NRC, 2019a) and considering that the Proposed Action's demand on utilities would be substantially lower than allowable levels under its license, it is expected that all existing electrical, natural gas, potable water, and wastewater infrastructure would be sufficient to serve the Proposed Action. Therefore, the increased demand in utility needs of uranium conversion in support of the Proposed Action at the Metropolis facility would have SMALL impacts on infrastructure.

2.3.2.9 Noise

The Proposed Action would not require any changes to operations at the Metropolis facility. In the Metropolis EA (NRC, 2019a), the NRC concluded that continued operations at the Metropolis facility would not result in significant noise impacts because of protective measures in place to minimize impacts on workers and the fact that noise attenuates over the distance between the facility and off-site receptors. Workers at the facility would continue to use hearing protection as required by Occupational Safety and Hazard Administration, and off-site noise would not reach any off-site receptors at levels exceeding Federal Highway Administration Noise Abatement Criteria Levels or Illinois emission standards in 35 Illinois Administrative Code 901, *Sound Emission Standards and Limitations for Property Line Noise Source*. Therefore, the Proposed Action would not result in significant noise impacts.

Impact Summary

The Metropolis EA (NRC, 2019a) concluded that continued operations at the Metropolis facility would not result in significant noise impacts because of protective measures in place to minimize impacts on workers and noise levels reaching any off-site receptor would not exceed Federal Highway Administration Noise Abatement Criteria Levels or Illinois sound emission standards. Therefore, uranium conversion in support of the Proposed Action at the Metropolis facility would not result in significant noise impacts.

2.3.2.10 Waste Management

Industrial (i.e., construction debris), hazardous, and radioactive wastes would be generated. All wastes generated have a disposal path forward. The generated wastes do not have any unique or problematic characteristics that would preclude use of the existing disposition paths. All wastes would be managed in accordance with applicable regulatory requirements. The waste quantities generated are a small portion of the totals quantities of waste generated annually by all generators. Available commercial facilities' capacities can accommodate the lifecycle disposition requirements for all the waste categories.

Impact Summary

Impacts would be SMALL since all wastes generated have a disposal path forward and represent a fraction of the available capacities of the commercial facilities.

2.3.2.11 Public and Occupational Health – Normal Operations

This section discusses the human health impacts associated with uranium conversion at the Metropolis facility in Metropolis, Illinois. Health impacts on the public and workers from exposure to radiological and hazardous nonradiological materials are presented.

The primary radioactive release from the Metropolis facility is uranium (releases ranging from 0.05 to 0.255 curies [Ci] from 2010 to 2014 (NRC, 2019a, pp. 2-7)) although minor amounts of thorium-230 and radium-226 are also released. The analysis in the Metropolis EA used the 2014 emission data as the basis for escalating emissions values covering the 40-year license extension, based on estimates of demand for enriched uranium. The estimate bounds the releases for operation at the licensed limit. Both the feed and product at the Metropolis facility is natural uranium; releases would have the isotopic content of natural uranium. Fluoride is the primary hazardous nonradiological release from the facility (ranging from 1.1 MT to 4.2 MT between 2010 and 2014) (NRC, 2019a, pp. 2-8).

The dose to the maximally exposed individual (MEI), located about 1,800 feet from the fuel manufacturing building stack, was estimated to be 2.17 millirem (mrem) per year. This value is less than the regulatory limits of 100 mrem per year from 10 CFR 20.1301(a) (dose limits for individual members of the public), 25 mrem per year in 40 CFR 190.10 (standards for normal operations [fuel cycle facility]), and the 10 mrem per year limit for dose from airborne emissions in 10 CFR 20.1101. The expected population dose, based on the 2057 population, was estimated to be 4.52 person-rem. This is a small percentage of the dose from natural background radiation for this population.

Doses from liquid effluents are expected to remain well below regulatory limits. The dose information provided in the EA was from analyses performed in the 1990s. At that time, the maximum individual dose was estimated to be 0.0013 mrem per year, and the population dose to be 0.003 person-rem. The maximum individual dose is well below all regulatory criteria, the NRC limit of 100 mrem per year in 10 CFR 20, the EPA 25 mrem limit in 40 CFR 190 and less than the 4 mrem drinking water standard in 40 CFR 141. Measurements of effluent release and concentrations in the Ohio River show a declining trend in both, and uranium concentrations in the Ohio River have remained at or below detection limits (NRC, 2019a, pp. 4-21 to 4-22).

Direct radiation doses to a member of the public are dominated by the dose resulting from the storage of material in an ore concentrate storage area. The average annual dose measured at a restricted site boundary (east fence) was 83 mrem for the years 2010 to 2014. The closest site boundary from this location is about 1 kilometer (km) or 0.6 miles. The EA estimated that the dose at the site boundary would be roughly four orders of magnitude lower than the dose at the restricted area boundary. The dose at the restricted area boundary is a significant portion of the 100 mrem dose to a member of the public (10 CFR 20.1301). However, the dose at the site boundary, a more realistic location for a member of the public, would be significantly lower than this value (NRC, 2019a, pp. 2-22).

The Metropolis facility maintains a radiation protection program to ensure worker exposures are below NRC criteria. Average individual and maximum individual occupational doses to workers for the years from 2010 to 2014 was 127 mrem per year and 1.48 rem per year, respectively. The NRC limits worker doses to 5 rem per year (10 CFR 20.1201(a)) (NRC, 2019a, pp. 3-40).

Occupational hazards include exposure to radioactive and hazardous nonradioactive materials, primarily HF. Radiation exposure to workers can occur via external exposure to radioactive material and the inhalation or ingestion of material. At the Metropolis facility, the dominant exposure is from inhalation of material during the conversion process.

The various forms of fluorine (e.g., fluorine gas, HF, and hydrofluoric acid) are all potentially harmful either through exposure in the air or inhalation (ingestion is not a typical form of exposure). While not as dangerous as fluorine, HF can have impacts similar to those of fluorine. HF is a very irritating gas. Exposure to high concentrations of fluorine gas can make it hard to breathe, cause lung and heart damage, and be fatal. At lower levels, it is still very irritating and very dangerous to the eyes, skin, nose, and lungs. Exposure to hydrofluoric acid is typically through skin contact and it can burn the eyes and skin; deep, painful wounds can develop over several days. When not treated properly, serious skin damage and tissue loss can occur. A large amount of hydrofluoric acid on the skin can affect the heart and lungs or lead to death. The Occupational Safety and Health Administration (OSHA) has set a legally enforceable limit of 0.2 milligrams per cubic meter (mg/m^3) for fluorine, 2.0 mg/m^3 for HF, and 2.5 mg/m^3 for fluoride in workroom air to protect workers during an 8-hour shift over a 40-hour work week. The National Institute for Occupational Safety and Health recommendations for air concentrations are the same as the OSHA limits, except in the case of HF—it recommends a level of 2.5 mg/m^3. (ATSDR, 2003)

Exposure to uranium is known to result in kidney damage in humans mostly due to high acute exposures, whether inhaled or ingested. There is evidence that kidney damage due to high occupational exposures can eventually heal after the exposure ends. Non-malignant respiratory diseases (e.g., fibrosis, emphysema) have been observed in human and animal studies. Extremely high exposure may be lethal (may cause renal or respiratory failure). Uranium exposure to children is expected to have the same impacts as on adults, but there is no evidence that children are more susceptible than adults. Neurobehavioral changes have been observed in animal studies of high exposures and conflicting evidence suggests a potential decrease in fertility among the subject animals. However, human studies have not confirmed these same effects. OSHA limits for insoluble and soluble airborne uranium in the workplace are 0.25 and 0.05 mg/m^3 for an 8-hour time weighed average. (ATSDR, 2012)

In addition to risks associated with worker exposures to radiological and hazardous nonradiological materials, industrial accidents pose a risk to workers. The Metropolis facility has had no occupational fatalities and the reportable work injury rate was 2.5 per year for the period of 2010 to 2014 (NRC, 2019a, pp. 3-39,3-40,4-22).

The Metropolis EA (NRC, 2019a) discusses releases of fluorine but does not quantify the impact of either airborne or liquid releases. Liquid waste streams are treated to remove fluorine and meet discharge permits limits. Airborne release of fluorine, ranging from 1.1 to 4.2 MT/yr from 2010 to 2014, are within permitted levels (NRC, 2019a, pp. 2-8 to 2-9).

There are no differences in the processes used to convert natural uranium into HALEU from those used to produce LEU. Therefore, the impacts from the conversion of the approximately 2,500 MT of natural uranium per year (concerted to about 3,100 MT of UF_6) to produce 50 MT of HALEU can be approximated by scaling based on the quantity of material converted. The 3,100 MT of uranium fluoride product represents about 20% of the licensed capacity of the Metropolis facility. Therefore, airborne and liquid effluent impacts on workers and the public should be about 20% of the values presented in the 2019 Metropolis EA (NRC, 2019a). The direct dose is more dependent upon the amount of ore stored at the ore concentrate storage area. As the amount of material stored here may not be dependent upon process capacity, it is assumed the direct exposure dose to the MEI would not change. The industrial accident rate may not scale with production capacity. Operating at 20% of capacity may require more than 20% of the full capacity workforce. However, the 2.5 injuries per year reported for the Metropolis facility should bound the injuries for operations supporting HALEU production.

Impact Summary

The Metropolis EA (NRC, 2019a) evaluated human health impacts on the public and workers from exposure to radiological and hazardous nonradiological materials due to ongoing uranium conversion at the Metropolis facility. The primary radioactive release from the Metropolis facility is uranium, in addition to minor amounts of thorium-230 and radium-226. The analysis determined that radiological doses to workers and the public would be well below regulatory limits. Direct radiation doses to the public are dominated by the storage of material in a uranium ore concentrate storage area. The dominant radiation exposure to workers is from inhalation of material during the conversion process. The Metropolis facility maintains a radiation protection program to ensure worker exposures are below NRC criteria. Fluoride is the primary hazardous nonradiological release from the facility. The Metropolis EA discusses releases of fluorine but does not quantify the impact of either airborne or liquid releases. Liquid waste streams are treated to remove fluorine and meet discharge permits limits. Regarding the risk of industrial accidents to workers, the Metropolis facility has had no occupational fatalities and the reportable work injury rate was 2.5 per year for the period of 2010 to 2014.

The production of about 3,060 MT of UF_6 per year[15] for the Proposed Action represents about 20% of the licensed capacity of the Metropolis facility. Airborne and liquid effluent impacts on workers and the public should be about 20% of the values presented in the Metropolis EA (NRC, 2019a). However, the direct dose is more dependent on the amount of ore stored at the ore concentrate storage area and since the amount of material stored might not be dependent on process capacity, it is assumed the direct exposure dose to

[15] Required to produce 50 MT of HALEU per year, or 290 MT over the 6-year operational period for HALEU enrichment.

the MEI would equate that associated with full operation of the facility. The industrial accident rate might not scale with production capacity, as operating at 20% of capacity could require more than 20% of the full capacity workforce. The 2.5 injuries per year reported for the Metropolis facility should bound the injuries for operations supporting HALEU production. In conclusion, human health impacts on the public and workers from the HALEU conversion activities would be SMALL.

2.3.2.12 Public and Occupational Health – Facility Accidents

After the uranium ore concentrate is produced at the mill (where it becomes U_3O_8 or yellowcake), it is packaged in 55-gal drums and sent to the uranium conversion plant. At the conversion facility, the yellowcake is processed and then reacted with fluorine to create UF_6. Uranium, in the chemical form of UF_6, is the desired product for use in enrichment operations. The UF_6 exits the process as a gas that is then cooled to a liquid and drained into 14-ton storage and transport cylinders. As the UF_6 cools over the course of 5 days, it transitions from a liquid to a solid. The cylinder, with UF_6 in the solid form, can then be shipped to an enrichment plant.

The primary risks associated with conversion are more chemical than radiological. The process to convert uranium ore concentrate (U_3O_8) powder to UF_6 involves a number of volatile and soluble chemicals including fluorine, hydrofluoric acid, and uranyl fluoride. These chemical forms contribute to risks associated with inhalation if a release occurred. In addition, the conversion process uses hydrogen gas (a gas that is flammable and could create an explosion hazard). Nuclear criticality is not a hazard at conversion facilities because the material consists of natural uranium throughout the process. Therefore, criticality is not possible.

Accidents could potentially release radioactive materials or chemicals to the environment and potentially affect workers and members of the public. To assess the risks associated with accidents involving licensed materials as required by 10 CFR 40.31(j)(3), Honeywell conducted and maintains an integrated safety analysis (ISA) for the Metropolis facility. In preparing the ISA, Honeywell compared accident consequences to the requirements of Subpart H of 10 CFR 70, "Domestic Licensing of Special Nuclear Material." The ISA identifies potential accident sequences and designates the Metropolis facility features and procedures to either prevent such accidents or mitigate their consequences to an acceptable level. The ISA further describes management measures to provide reasonable assurance of the availability and reliability of the Metropolis facility features and procedures. The ISA uses a hazard analysis method to identify the relevant hazards. The hazard identification process results in the identification of physical, radiological, and chemical characteristics, as appropriate, that have the potential for causing harm to site workers, the public, or the environment. The hazard identification also identifies potentially hazardous conditions that could potentially impact the discrete components of the process systems.

The results of the ISA are intended to give assurances that the potential failures, hazards, accident sequences, and scenarios, as well as Metropolis facility features and procedures have been investigated in an integrated fashion, so as to adequately consider common-mode and common-cause situations. Honeywell evaluated selected high-consequence chemical accident sequences that were found to bound all consequences from credible accidents at the Metropolis facility. The accidents analyzed include the following (NRC, 2019a, pp. 4-23, 4-24):

- Rupture of the HF unloading hose
- Failure of the nitrogen pressure supply line to the delivery railcar
- Failure of the process gas incinerator system
- Failure of the redactors from overheating
- Contact of hydrocarbons (oil) with gaseous fluorine or UF_6

- Potential UF_6 releases due to the overpressure failure of a UF_6 product cylinder

Possible initiators for these accidents include personnel activities, seismic events, tornadoes, tornado missile and high winds, snow and ice, flooding, heavy rain, transportation, aircraft, pipelines, highway traffic, railroads, on-site natural gas, and the effects of operations of other nearby facilities. Honeywell tabulated the radiological and chemical consequences of these events and further evaluated those considered to be credible. For credible events with a potential for high consequences, the ISA provided a detailed evaluation of plant features and procedures that would mitigate those consequences. The impacts of accidents with the potential to release radioactive materials or chemicals and affect public health and the environment would be mitigated by the protective measures identified in the ISA (NRC, 2019a, pp. 4-23 to 4-24). The NRC regulations require that licensees identify and maintain controls to make high-consequence accidents highly unlikely.

Accident Consequences

Because the ISA for the Metropolis facility is not publicly available, the accident consequences for the planned but canceled Eagle Rock Enrichment Facility are used as a surrogate for accidental releases of UF_6 from a conversion facility. The accidents of concern for an enrichment facility also involve releases of UF_6.

The performance requirements in 10 CFR 70, Subpart H, define acceptable levels of risk for accidents at nuclear fuel cycle facilities such as enrichment and conversion facilities. The regulations in Subpart H require reduction of the risks of credible high-consequence and intermediate-consequence events, and assure that under credible abnormal conditions all nuclear processes are subcritical. Threshold consequence values, based on the requirements of 10 CFR 70.61 and the EPA's Acute Exposure Guideline Levels for chemical exposure to HF that define the high- and intermediate-consequence events, except for criticality events, are described in Table 2-2.

Table 2-2. Definition of High- and Intermediate-Consequence Events

Receptor	*Intermediate Consequence* [a]	*High Consequence*
Worker – radiological	> 25 rem	> 100 rem
Worker – chemical (10-minute exposure)	> AEGL-2 for UF_6 > AEGL-2 for HF (> 19 mg U/m^3)[b] (> 78 mg HF/m^3) = (95 ppm)	> AEGL-3 for UF_6 > AEGL-3 for HF (> 147 mg U/m^3) (> 139 mg HF/m^3) = (170 ppm)
Environment at the Restricted Area Boundary	5.4 mg U/m^3 or 24-hour average release greater than 5,000 times the values in Table 2 of Appendix B of 10 CFR 20	NA
Individual at the controlled area boundary – radiological	> 5 rem	>25 rem
Individual at the controlled area boundary – chemical (30-minute exposure)	> 4.06 mg soluble U intake > AEGL-1 for HF (> 2.4 mg U/m^3) (> 0.8 mg HF/m^3) = (0.98 ppm)	> 21 mg soluble U intake > AEGL-2 for HF (> 13 mg U/m^3) (> 28 mg HF/m^3) = (34.23 ppm)

Source: NRC (2011c), pp. 4-118, Table 4-30

Key: > = greater than; AEGL = acute exposure guideline levels; CFR = Code of Federal Regulations; HF = hydrogen fluoride; m^3 = cubic meter; mg = milligram; NA = not applicable; ppm = parts per million; U = uranium; UF_6 = uranium hexafluoride

Note:

[a] AEGL are public and private sector derived consensus values intended to describe the risk to humans resulting from once-in-a-lifetime, or rare, exposure to airborne chemicals (https://www.epa.gov/aegl/about-acute-exposure-guideline-levels-aegls).

The consequences of five accident scenarios involving a release of UF_6 from the enrichment facility vary widely. Worker consequences are intermediate (between 5 and 25 rem) for the scenario involving a hydraulic rupture of a feed vessel and high for the scenario involving a sampling cylinder release (greater than [>] 25 rem). Consequences to the maximally exposed member of the public located at the controlled area boundary would be low for the hydraulic rupture of a feed vessel scenario and for the sampling manifold release scenario (less than [<] 2.5 mg/m^3 uranium and < 0.8 mg/m^3 HF). Consequences to this receptor are intermediate for the earthquake and facility-wide fire scenarios on the basis of HF exposure (between 0.8 and 28 mg/m^3), but low for uranium exposure (< 2.4 mg/m^3). Consequences to this receptor are high for the sampling cylinder release on the basis of uranium exposure (> 13 mg/m^3) and intermediate for HF exposure (between 0.8 and 28 mg/m^3). All the accident scenarios predict less than one lifetime cancer fatality in the off-site population (NRC, 2011c, pp. 4-118, 4-119).

Of the accident scenarios analyzed, the most significant accident consequences are those associated with the release of UF_6 caused by rupturing an overfilled or overheated cylinder. The accidents and consequences from a UF_6 release at the conversion facility would be similar to those from the enrichment facility. The product from the conversion facility is feed for the enrichment facility. Sampling and processing activities at either facility would require handling UF_6 as a solid, liquid, or gas. Both facilities would store UF_6 in Type 48Y cylinders. In 2007, the capacity of the Metropolis facility was increased to 15,000 MT/yr (16,535 tons per year) (NRC, 2019a, pp. 1-4). At full production, the proposed Eagle Rock Enrichment Facility would receive up to 17,518 MT/yr (19,310 tons per year) of UF_6 feed material in up to 1,424 Type 48Y cylinders (NRC, 2011c, pp. 2-15).

Facility design would reduce the likelihood of the rupture event by using redundant heater-controller trips. In addition, the facility emergency plan would address other low-, high- and intermediate-consequence events. Through the combination of facility design, passive and active engineered controls (including items relied on for safety [IROFS]), administrative controls, and management of these controls, accidents at an enrichment facility would pose an acceptably low risk to workers, the environment, and the public. The consequences of accidents at the enrichment facility (NRC, 2011c, pp. 4-119) are summarized in Table 2-3.

Table 2-3. Summary of Radiological and Nonradiological Health Effects Resulting from Accidents [(a)]

Accident	*Worker [(b)]*		*Environment at Restricted Area Boundary [(d)]*	*Individual at Controlled Area Boundary [(d)]*		*Collective Dose to Off-Site Population [(e)]*		
	U [(f)] mg/m³ (rem)	*HF mg/m³*	*µCi/mL*	*U [(f)] mg/m³ (rem)*	*HF mg/m³*	*Direction*	*Person-rem [(f)]*	*LCFs*
Hydraulic rupture of a feed vessel [(c)]	2.03×10^4 (14.2)	6.83×10^3	4.23×10^{-9}	1.43 (0.006)	0.54	ESE	0.632	4×10^{-4}
Earthquake	9.59 (0.136)	32.2	1.28×10^{-9}	0.274 (0.001)	2.08	ESE	0.47	3×10^{-4}
Sampling manifold release	89 (0.062)	29.9	2.85×10^{-10}	4.07×10^{-2} (< 0.001)	1.54×10^{-2}	ESE	4.27×10^{-2}	3×10^{-5}
Facility-wide fire	13 (0.805)	4.36	2.57×10^{-9}	0.549 (0.002)	2.08	ESE	0.94	6×10^{-4}
Sampling cylinder release	1.74×10^5 (122)	5.85×10^4	4.82×10^{-7}	69.8 (0.293)	26.4	ESE	72	4×10^{-2}

Source: NRC, (2011c), pp. 4-119, Table 4-31

Table 2-3. Summary of Radiological and Nonradiological Health Effects Resulting from Accidents [(a)]

Accident	Worker [(b)]		Environment at Restricted Area Boundary [(d)]	Individual at Controlled Area Boundary [(d)]		Collective Dose to Off-Site Population [(e)]		
	U [(f)] mg/m^3 (rem)	HF mg/m^3	µCi/mL	U [(f)] mg/m^3 (rem)	HF mg/m^3	Direction	Person-rem [(f)]	LCFs

Key: < = less than; µCi/mL = microcuries per milliliter; HF = hydrogen fluoride; LCF = latent cancer fatality; mg/m^3 = milligrams per cubic meter; U = uranium

Notes:

[a] A safety evaluation is conducted as part of the facility licensing process to identify items relied on for safety (IROFS). Health effect impact estimates are based on calculations assuming the current design prior to any IROFS determinations. These results are used to identify which IROFS are to be incorporated into facility designs or procedures to reduce the risks to workers, the public, and the environment to acceptably low levels.

[b] Worker exits after 5 minutes in all cases but the earthquake. The exit is assumed to occur in 2.5 minutes for the earthquake.

[c] Though the consequences of the rupture of a liquid-filled uranium hexafluoride (UF_6) vessel would be high, redundant heater-controller trips would make this event highly unlikely to occur.

[d] Distance to restricted area boundary is 0.47 miles and the distance to the controlled area boundary is 0.7 miles.

[e] The off-site population includes 0 people within 8 km (5 miles) and 267,256 people within 80.5 km (50 miles).

[f] Radiation dose from HALEU would be somewhat greater than the radiation dose from low-enriched uranium (LEU) due to the greater concentration of uranium-234.

Impact Summary

Because the ISA for the Metropolis facility is not publicly available, the accident consequences for an enrichment facility, which would be similar to the accident consequences for a conversion facility, were used to identify the potential physical, radiological, and chemical harm to site workers, the public, or the environment. Of the accident scenarios analyzed, the most significant accident consequences would be due to the release of UF_6 caused by rupturing an overfilled or overheated sampling cylinder. Facility design would reduce the likelihood of the rupture event by using redundant heater-controller trips. The ISA for the Metropolis facility identifies potential accident sequences and designates features and procedures either to prevent such accidents or to mitigate their consequences to an acceptable level. In addition, the facility emergency plan would address other low-, high- and intermediate-consequence events. Through the combination of facility design, passive and active engineered controls (including IROFS), administrative controls, and management of these controls, accidents at an enrichment facility or a conversion facility would pose an acceptably low risk to workers, the environment, and the public. Therefore, the potential for accidental consequence to impact site workers, the public, or the environment from the HALEU conversion activities would be SMALL.

2.3.2.13 Traffic

This section discusses potential traffic impacts on U.S. Highway 45 and Interstate 24, which are the major roadways that serve the Metropolis facility (as discussed in Section 3.2.1 of the Metropolis EA) (NRC, 2019a). On the western side of the city of Metropolis, U.S. Highway 45 provides direct access to the conversion facility and continues southeast into the city. U.S. Highway 45 provides access to Interstate 24 approximately 7 km (4.5 miles) east of the conversion facility. Potential traffic impacts from the proposed HALEU conversion activities at the Metropolis facility could occur from increased vehicle trips due to personal vehicles of commuting workers and from trucks (transporting materials, supplies, and wastes). A vehicle trip is defined as a one-way trip movement; a round trip is defined as two vehicle trips.

To evaluate changes in baseline traffic conditions near the Metropolis facility since publication of the Metropolis EA (NRC, 2019a), the average annual daily traffic (AADT) volumes on U.S. Highway 45 and Interstate 24 were obtained from the Illinois Department of Transportation. AADT is a measure of the daily average number of vehicles that pass through a given segment of roadway and is indicative of traffic flow conditions (i.e., higher AADT volumes lead to increases in traffic congestion and delays). Based on recent Illinois Department of Transportation data (years 2019 and 2022), U.S. Highway 45 north of the project site experienced a 1% increase in AADT since 2015, while south of the site, U.S. Highway 45 experienced a 10% decrease (IDOT, 2023). Baseline traffic conditions as presented in Section 3.2.1 of the Metropolis EA have not substantially changed and recent AADT volumes on U.S. Highway 45 and Interstate 24 remain well within the operating capacities of each roadway.

Based on the truck shipments presented in Table 3-4 of the Metropolis EA (NRC, 2019a), approximately 10 truck round trips (or 20 vehicle trips) could occur throughout a given workday. The majority of increased traffic volumes would be from employees commuting to and from the Metropolis site and would occur during peak commuting hours (i.e., morning and evening). Section 4.1.2.1 of the Metropolis EA estimated that of the 237 employees, approximately 211 employees commuted northbound on U.S. Highway 45 to the facility, while a portion of the 211 employees would commute from Interstate 24. This would result in 211 daily vehicle round trips (or 422 vehicle trips per day) on U.S. Highway 45 just south of the facility and even fewer vehicle trips on Interstate 24. The incremental increase in vehicle trips represents less than 10% of recent AADT volumes and the total daily traffic volumes would be well within operating capacities of U.S. Highway 45 and Interstate 24. Therefore, it is expected that traffic impacts from conversion activities at the Metropolis facility would be SMALL.

Impact Summary

The 2019 Metropolis EA concluded that continued operations would not result in significant traffic impacts (NRC, 2019a). The Metropolis EA determined that vehicle trips generated during full operations would amount to 10 truck and 237 employee round trips per day. This traffic would result in minimal increases in roadway congestion, delays, and safety hazards to affected roadways and they would remain well within acceptable operating capacities. The annual HALEU conversion demand and resulting traffic generated by the Proposed Action would be less than estimates evaluated in the Metropolis EA. Therefore, traffic impacts from the HALEU conversion activities are anticipated to be SMALL.

2.3.2.14 Socioeconomics

This section discusses the socioeconomic impacts associated with uranium conversion at the Metropolis facility in Metropolis, Illinois. Socioeconomic impacts from operation of the existing Metropolis facility were previously considered in the Metropolis EA (NRC, 2019a).

The Metropolis conversion facility is located in Massac County, Illinois, across the Ohio River from McCracken County, Kentucky. These two counties comprise the ROI for the facility, as identified in the Metropolis EA (NRC, 2019a) and carried forward in this analysis because the majority of past and current facility workers reside in these counties. During full operational mode, the Metropolis facility employed 269 employees and 157 contractor personnel (Honeywell, 2018); approximately 34% of the workforce lived in Illinois, with 27% in Brookport and Metropolis in Massac County. Another 62% lived in Kentucky, with 37% in Paducah and West Paducah in McCracken County. The remaining 4% of the employees are spread among several states (ENERCON, 2017, p. § 3.10.1). Of note is that Paducah, Kentucky, was formerly home to DOE's Paducah Gaseous Diffusion Plant. The plant shut down in 2013 and is now undergoing decontamination, decommissioning, and demolition activities, but previously conducted commercial enrichment activities.

The ROI was described in detail in the Metropolis facility Environmental Report (ENERCON, 2017) and two NRC EAs (NRC, 2006a; NRC, 2019a), relying on data primarily from 2010 and 2015. Relevant information has been updated for this analysis. The Metropolis EA identified a slight decline in population of both counties between 2010 and 2015; more recent data show a slight increase in McCracken County but a continuing, although small, decline in Massac County. Specifically, since 2010, the population of Massac County has decreased by approximately 10% (from 15,429 in 2010 to 13,896 in 2022); while the population of McCracken County has increased by about 3% (from 65,565 in 2010 to 67,490 in 2022), although between 2020 and 2022, McCracken County has seen a small decrease in population (down 0.6%) (USCB, 2023a).

Despite the slight fall in population between 2010 and 2015, the NRC determined that the population projections in the Environmental Report, which showed an overall increase out to 2057 (when the 40-year license period would end) and were based on state data, to be reasonable; the projections showed small increases in both Massac County (4.9%) and McCracken County (2.7%).

The Metropolis EA (NRC, 2019a) showed similar small decreases in employment levels between 2010 and 2016 for both Massac and McCracken Counties, although the unemployment rate in each county also decreased. At the time, Metropolis facility employees accounted for less than 4% of employment in Massac County, and less than 0.7% of employment among the two counties.

Updated U.S. Census data shows an increase in employment levels, accompanied by a continued decline in unemployment rates. In 2021, there were 36,679 in the labor force within the ROI, 35,221 of which were employed. The unemployment rates were at 4.4% and 3.9% in Massac and McCracken Counties, respectively (USCB, 2023b), both lower than the 2010 unemployment rate identified in the Metropolis EA, which exceeded 9% (NRC, 2019a).

Operation

The primary socioeconomic impact of continued operation, as identified in the Metropolis EA (NRC, 2019a), related to local employment and property taxes. The NRC indicated that the Metropolis facility would continue to directly employ about the same number of workers as had worked there previously, and therefore concluded that continued operation of the Metropolis facility would not have a significant adverse impact on existing socioeconomic resources (including housing and community services). Rather, it would continue to have a beneficial impact on the area because of employment opportunities provided to the local area, payment of property taxes, and assistance to emergency responders (e.g., police, fire, medical personnel) in the form of training, emergency drills, and emergency response equipment provided by Honeywell that could be applied to other local industries.

The Metropolis EA (NRC, 2019a) acknowledged that the Metropolis facility was in a "ready-idle" state, with 29 Honeywell employees remaining on-site, but that the Metropolis facility employed 193 employees and 105 contractor personnel as of February 2017. The Metropolis facility currently remains in this steady-state condition. Compared to 2021 employment levels, this operations workforce would account for approximately 0.8% of employment in the two-county ROI, and 5.1% in Massac County, Illinois (USCB, 2023b).

Because the existing Metropolis facility has sufficient conversion capacity to support the needs of the Proposed Action, no new construction would be required. Therefore, there would be no adverse impacts on existing socioeconomic resources from construction activities, nor is it expected that there would be any significant expansion in the operations workforce that was in place when the facility was operating at full capacity, similar to the conclusion reached in the Metropolis EA (NRC, 2019a) for license renewal (when the facility was also in idle-state mode). Rather, it is assumed that the majority of the operations workers required for conversion activities could be filled by the past workforce at the Metropolis facility (now on standby mode) who continue to reside in the area, or could be pulled from existing workers living within the ROI, based on current ROI employment levels, including current or former employees at the Paducah Gaseous Diffusion Plant that possess the necessary skill set. Finally, in the event that operation would require some new workers (and their families) to migrate into the ROI, this influx would be expected to be sufficiently small, estimated at 45 workers and up to 135 total new population, or 0.16% of the ROI population in 2022, if 15% of the 2017 Metropolis facility workforce levels in-migrated and they brought their families. The potential impacts of such a small influx on population, employment, existing housing and social and community services would be expected to be SMALL. Furthermore, any increase in workers and overall population, as a result of the Proposed Action, would result in increased income, spending levels, and tax revenue levels that, while also considered SMALL, would be beneficial to the local and regional economy.

Impact Summary

The Metropolis EA (NRC, 2019a) concluded that continued operations at the Metropolis facility would not result in significant socioeconomic impacts. The facility would continue to directly employ the same number of workers and would have beneficial impacts on the area because of employment opportunities and increased revenue. Similarly, it is assumed that the majority of operations workers necessary to support the HALEU conversion activities would be filled by past facility workers or the existing workforce who live in the area, including current or former employees at the nearby Paducah Gaseous Diffusion Plant. Any influx of new workers that might be required for the Proposed Action would be small. Such a small influx would have SMALL impacts on existing housing inventory and social and community services and also would result in potential beneficial impacts (e.g., increased income, spending, and tax revenues) on the local and regional economy.

2.3.2.15 Environmental Justice

On January 27, 2021, President Biden issued Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*, which established the Justice40 Initiative. This initiative mandates that 40% of the benefits of Federal climate and clean energy investments be provided to disadvantaged communities. As a part of this initiative, DOE has conducted an analysis to identify disadvantaged communities in the United States, which DOE defines as underserved, overburdened, and front-line communities (DOE, 2022a). DOE analysis considers a census tract that ranks in or above the 80th percentile of the cumulative sum of 36 burden indicators for a state and has at least 30% of the households identified as low-income populations (DOE, 2022a) as a disadvantaged community. The cumulative burden includes fossil fuel dependence, energy burden, environmental and climate hazards, and socioeconomic vulnerabilities. Priorities for DOE include a decrease in energy burden and environmental exposures; an increase in clean energy jobs, job training, and contracting opportunities; and access to clean energy and resilience. DOE analysis and rankings for the city of Metropolis, Massac County, Illinois, are shown in Table 2-4. As shown, the city is considered disadvantaged.

Table 2-4. The Leidos Team Energy Justice Dashboard Rankings for the City of Metropolis, Illinois

City, County, State	*National Ranking*	*State Ranking*	*DAC Score*
Metropolis, Massac, IL	92%	88%	21

Shading indicates a disadvantaged community ranking.
Key: % = percent; DAC = disadvantaged community; IL = Illinois

The ROI for environmental justice is the area within a 4-mile radius of the Metropolis facility. This ROI was based on NRC guidelines from the Office of Nuclear Material Safety and Safeguards for facilities located outside of city limits or in a rural area. The potentially affected area includes parts of two counties in Illinois and Kentucky. The analysis of minority and low-income populations focuses on census data for geographic units (i.e., block groups) that represent, as closely as possible, the potentially affected areas. Table 2-5 shows the minority and low-income composition of the potentially affected area surrounding the existing Metropolis facility.

Table 2-5. Communities Within Four Miles of Metropolis Works Plant in Metropolis, Illinois

Area Name		***Total Population***	***Minority***	***% Minority***	***Population for Whom Poverty is Calculated***	***Low-Income Population***	***% Low Income***
United States		333,036,755	136,997,971	41.1%	325,180,754	42,062,633	12.9%
Illinois		12,821,813	5,100,531	39.8%	12,529,291	1,483,378	11.8%
Massac County		14,280	1,868	13.1%	13,961	1,956	14.0%
Census Tract 9701		4,529	467	10.3%	4,514	538	11.9%
Census Tract 9702		3,990	548	13.7%	3,854	553	14.3%
Census Tract 9703		3,558	609	17.1%	3,520	569	16.2%
Census Tract 9704		2,203	244	11.1%	2,073	296	14.3%
Kentucky		4,494,141	735,062	16.4%	4,359,181	709,140	16.3%
McCracken County		67,394	11,737	17.4%	65,943	9,947	15.1%
Census Tract 314.01		1,868	182	9.7%	1,830	570	31.1%
Census Tract 315.01		2,360	248	10.5%	2,240	217	9.7%
Block Groups		***Total Population***	***Minority***	***% Minority***	***Population for Whom Poverty is Calculated***	***Low-Income Population***	***% Low Income***
Census Tract 9701	Block Group 2	1,222	56	4.6%	1,207	168	13.9%
	Block Group 3	1,077	65	6.0%	1,077	165	15.3%
	Block Group 4	1,490	293	19.7%	1,490	198	13.3%
Census Tract 9702	Block Group 1	1,209	171	14.1%	1,189	127	10.7%
	Block Group 2	1,119	80	7.1%	1,003	157	15.7%
	Block Group 3	1,273	89	7.0%	1,273	135	10.6%
	Block Group 4	389	208	53.5%	389	134	34.4%
Census Tract 9703	Block Group 1	1,374	200	14.6%	1,374	60	4.4%
	Block Group 2	1,328	327	24.6%	1,291	470	36.4%
Census Tract 9704	Block Group 1	481	0	0.0%	481	8	1.7%
	Block Group 2	1,722	244	14.2%	1,592	288	18.1%
Census Tract 314.01	Block Group 1	745	95	12.8%	707	205	29.0%
	Block Group 2	1,123	87	7.7%	1,123	365	32.5%
Census Tract 315.01	Block Group 1	620	33	5.3%	500	0	0.0%
	Block Group 2	1,740	215	12.4%	1,740	217	12.5%

Source: (USCB, 2023d)

Key: % = percent

Note: Green shading = greater than 50% minority; yellow shading = meaningfully greater percentage (20%) of low-income population compared to the state

Minority populations were evaluated using the 50% and meaningfully greater analysis (20%) for potentially affected block groups within 4 miles of the Metropolis facility. If the percentage of minority individuals in the block group was greater than 50% or more than 20% of the percentage of the total minority population within the state percentage (block groups were compared to the state percentage in which they were located), then the block group was identified as having a minority population. The total population of Illinois is 12,821,813, of which 39.8% would be considered minority. The total population of Kentucky is 4,494,141, of which 16.4% would be considered minority. Of the 15 block groups within the ROI, one has a percentage that would meet the meaningfully greater threshold for minority populations (Census Tract 9702, Block Group 4). The Metropolis facility is located adjacent to this block group (Figure 2-2).

The total population of Illinois for whom poverty is determined is 12,529,291, of which 11.83% would be considered members of a low-income population. The total population of Kentucky for whom poverty is determined is 4,359,181, of which 16.3% would be considered members of a low-income population. Of the 15 block groups within the ROI, 7 have percentages that would meet the threshold for low-income populations. Figure 2-2 displays the block groups in the ROI.

Operation

Previous NEPA documentation as well the most recent U.S. Census data were evaluated to determine potential impacts associated with Proposed Action activities at the Metropolis facility. The Metropolis EA (NRC, 2019a) determined that the continued operations would not cause noticeable impacts on populations living near the facility. Given that continued operations would not cause noticeable impacts on any population, there would be no disproportionate and adverse human health and environmental effects on minority or low-income populations. The NRC staff identified 12 block groups within a 4-mile (6.4-km) radius of the center point of the Metropolis site. None of the census block groups within 4 miles (6.4 km) of the Metropolis facility site contained minority populations or households below the poverty level.

The most recent census information (USCB, 2023a; USCB, 2023b) was evaluated to determine if the affected environment had changed since the previous NEPA analysis and additional minority or low-income populations were present in the ROI. As shown in Table 2-5 there is one minority and seven low-income block groups within the ROI. No substantial human health impacts on any population would be expected with operation of a portion of the Metropolis facility to support HALEU production (see Section 2.3.2.11, *Public and Occupational Health – Normal Operations* and Section 2.3.2.12, *Public and Occupational Health – Facility Accidents*). Although there are minority and low-income populations located within the ROI, there would be no disproportionate and adverse impacts.

Impact Summary

The Metropolis EA (NRC, 2019a) determined that the continued operations would not cause noticeable impacts on populations living near the Metropolis facility and therefore would not cause disproportionately high and adverse human health and environmental effects on minority or low-income populations. Census information more recent than the information evaluated in the Metropolis EA shows that there are now one minority and seven low-income block groups within the Metropolis facility ROI. However, full operation of the Metropolis facility would not produce disproportionately high or adverse impacts on these minority and low-income populations. The annual conversion demand to support HALEU production would be about 20% of the maximum licensed conversion production. Therefore, impacts from the HALEU conversion activities to minority or low-income populations would not be disproportionately high and adverse and would be SMALL.

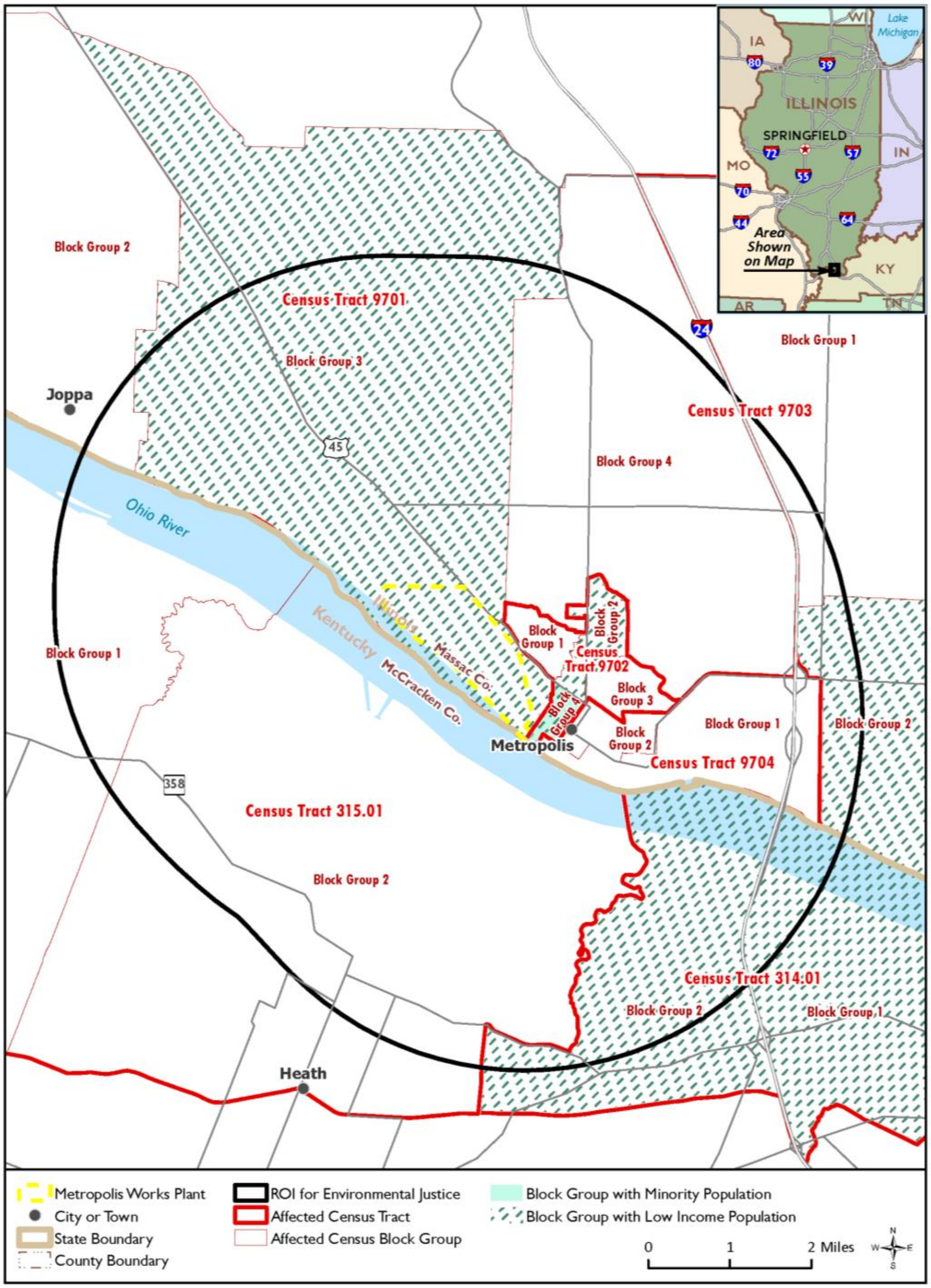


Figure 2-2. Block Groups in the Vicinity of the Metropolis Facility

2.4 Summary of Impacts for Uranium Conversion

For each of the resource areas discussed in this section, impact indicators have been identified. Table 2-6 summarizes the impacts associated with each indicator for the identified facility and the overall impact for a potential HALEU conversion facility.

Table 2-6. Summary of Impacts for Uranium Conversion

Resource Area	***Impact Indicator***	***Impacts from Construction and Operation of a New Uranium Conversion Facility***	***Metropolis Conversion Facility Metropolis, Illinois***	
			Impacts from Uranium Conversion for LEU [a]	***Impacts from Uranium Conversion for HALEU***
General	Annual Production	3,060 MT UF_6	15,000 MT UF_6	3,060 MT UF_6
Land Use	Changes to current land uses, compatibility with zoning, surrounding land uses, and land use plans	SMALL – Land disturbance would alter the physical layout of the site and exclude previous land uses, such as agriculture, grazing, or other industrial uses. Future land use on or near the facility site may be restricted due to potential radiological and chemical contamination. Potential impacts to land use can be mitigated through careful planning, site selection, construction practices, and operation procedures, including strict adherence to safety and environmental regulations.	No significant impact (NSI) – Future operations would be consistent with current land uses and would not require any major construction or expansion of the Metropolis facility.	NSI – Impacts to land use from uranium conversion for the Proposed Action would be similar or less than the impacts described in the Metropolis EA.
Visual and Scenic	Visibility, visual and scenic resources, changes to visual and scenic quality	SMALL – Land clearing, site grading, and building construction. The site's construction would introduce new facilities along with security fencing and lighting along the perimeter and a parking lot. The facility could alter the landscape, especially if the area is currently undeveloped or predominantly natural. It is assumed construction would occur in an area with an	NSI – The Metropolis facility is not easily visible from locations outside the facility site, and it is surrounded by forested areas, which limit its impact on scenic and visual resources. Continued operation of the facility would not have significant impacts on scenic and visual resources within the site or surrounding area.	NSI – Impacts on visual and scenic resources from uranium conversion for the Proposed Action would be similar or less than the impacts described in the Metropolis EA.

Table 2-6. Summary of Impacts for Uranium Conversion

Resource Area	***Impact Indicator***	***Impacts from Construction and Operation of a New Uranium Conversion Facility***	***Metropolis Conversion Facility Metropolis, Illinois***	
			Impacts from Uranium Conversion for LEU [a]	***Impacts from Uranium Conversion for HALEU***
General	Annual Production	3,060 MT UF_6	15,000 MT UF_6	3,060 MT UF_6
		existing low scenic quality, so there would not be a high contrast with the surrounding landscape.		
Geology and Soils	Ground disturbance, soil erosion potential, prime farmlands, and sensitive geological resources	SMALL – Potential impacts include disturbance of up to 65 acres of previously disturbed soils, soil erosion due to ground disturbance, and the potential for spills due to construction and operations. Implementation of BMPs for erosion control and spill prevention would limit impacts.	NSI – Since no major modifications to existing facilities or construction of new facilities would occur from the project, impacts to geological features would be minimal. The Metropolis facility complies with Resource Conservation and Recovery Act requirements in treating contamination from past operations and implementation of Illinois Environmental Protection Agency (IEPA) environmental land use control (ELUC) protective measures. The facility implements new spill prevention, cleanup procedures, and active IEPA oversight.	NSI – Impacts on geology and soils associated with uranium conversion in support of the Proposed Action would be similar or less than the impacts described in the Metropolis EA.
Water Resources	Floodplains, surface water bodies, and groundwater aquifers	SMALL – Discharges would be regulated and monitored in accordance with all necessary permits. BMPs would limit impacts on waters resulting from effluent discharges, but decreases in water quality resulting from erosion, sedimentation, and spills or leaks may occur.	NSI – Impacts on surface waters from continued operations at the Metropolis facility would adherence to release limits and monitoring requirements of existing permits that address stormwater and wastewater effluents on-site. Impacts on groundwater would not occur, due to the underlying formations that limit contaminants from reaching groundwater resources and on-site	NSI – Impacts on water resources from uranium conversion in support of the Proposed Action would be similar or less than the impacts described in the Metropolis EA.

Table 2-6. Summary of Impacts for Uranium Conversion

Resource Area	***Impact Indicator***	***Impacts from Construction and Operation of a New Uranium Conversion Facility***	***Metropolis Conversion Facility Metropolis, Illinois***	
			Impacts from Uranium Conversion for LEU [a]	***Impacts from Uranium Conversion for HALEU***
General	Annual Production	3,060 MT UF_6	15,000 MT UF_6	3,060 MT UF_6
		Increased water use may tax local water sources and impact other nearby users. Anticipated water usage during construction and operation would be calculated and weighed against the existing capacity of the region's water supplies.	groundwater monitoring, which requires mitigation when elevated contaminant levels are identified.	
Air Quality	National Ambient Air Quality Standards, air emissions of criteria pollutants, hazardous air pollutants, radiological compounds, and greenhouse gases	SMALL with effective implementation of fugitive dust control measures during construction and adherence to applicable permit conditions during operations.	NSI – Due to the emission controls and regulatory compliance required by an IEPA permit, continued conversion operations at the Metropolis facility would not have a significant impact on nonradiological air quality. Uranium processing areas within buildings that produce dusts, mists, or fumes containing uranium or other toxic materials would be ventilated to stacks that include dust collectors or scrubbers to reduce pollutant exposure to employees and the environment to acceptable levels.	NSI – Impacts to air quality from uranium conversion in support of the Proposed Action would be similar or less than the impacts described in the Metropolis EA.
Ecological	Disturbance of ecological resources including sensitive habitats or special status species	SMALL to MODERATE – Impacts on ecological resources would be dependent on the resources disturbed and mitigation and minimization measures	NSI – Continued operations at the Metropolis facility would comply with environmental regulations and permits controlling the operation of the facility, which would minimize impacts to ecological resources in	NSI for facility operation – All actions associated with the Proposed Action would occur in previously developed areas and would not impact undeveloped lands. Impacts on ecological

Table 2-6. Summary of Impacts for Uranium Conversion

Resource Area	***Impact Indicator***	***Impacts from Construction and Operation of a New Uranium Conversion Facility***	***Metropolis Conversion Facility Metropolis, Illinois***	
			Impacts from Uranium Conversion for LEU [a]	***Impacts from Uranium Conversion for HALEU***
General	Annual Production	3,060 MT UF_6	15,000 MT UF_6	3,060 MT UF_6
		employed. Follow-on NEPA will be required to determine the site-specific impacts.	the action area (defined as the Metropolis site, as well as the Ohio River directly adjacent to the site, including discharge areas). Potential impacts from contaminants in the sediments on benthic organisms or on species that feed on these organisms could be noticeable.	resources from uranium conversion in support of the Proposed Action would be similar or less than the impacts described in the Metropolis EA.
Historic and Cultural	Archaeological resources and sites; historic structures and districts; and traditional cultural properties	SMALL to MODERATE – Impacts could occur if known NRHP-eligible cultural resources are in the area of potential effects. Impacts could occur if ground disturbance resulted in the discovery of previously unrecorded NRHP-eligible cultural resources.	NSI – Continued operations of the Metropolis facility would not include any construction or ground disturbances and therefore would have no potential to cause adverse effects on historic or cultural resources on the facility property.	NSI for facility operation – Because uranium conversion in support of the Proposed Action would not include additional construction or ground disturbance, the Proposed Action would be expected to have no impacts to historic and cultural resources.
Infrastructure	Disrupted utility service during construction activities or an increase or decrease in demand for utility services during construction or operations.	SMALL – Construction of a new HALEU conversion facility would require extension of existing utility service to accommodate new structures and to support operations of the proposed deconversion facilities. However, any needed infrastructure improvements or installation of additional utilities would comply with all applicable permits, service	NSI – Although the Metropolis EA did not analyze impacts to infrastructure, the EA noted that upgrades and modifications to process facilities and infrastructure have occurred since 2006; therefore, all existing electrical, natural gas, potable water, and wastewater infrastructure would be sufficient to serve the continued operation of the Metropolis facility.	NSI – Impacts to infrastructure from uranium conversion in support of the Proposed Action would be similar to or less than the impacts described in the Metropolis EA. The anticipated increase in utility usage is expected to result in a SMALL infrastructure impact.

Table 2-6. Summary of Impacts for Uranium Conversion

Resource Area	***Impact Indicator***	***Impacts from Construction and Operation of a New Uranium Conversion Facility***	***Metropolis Conversion Facility Metropolis, Illinois***	
			Impacts from Uranium Conversion for LEU [a]	***Impacts from Uranium Conversion for HALEU***
General	Annual Production	3,060 MT UF_6	15,000 MT UF_6	3,060 MT UF_6
		agreements, and regulatory requirements.		
Noise	Baseline noise levels, changes to day-night levels, proximity to sensitive receptors, compatibility with adjacent land uses	SMALL – Noise levels above ambient levels are unlikely.	NSI – Noise levels reaching any off-site receptor from continued operations at the Metropolis facility would not exceed Federal Highway Administration Noise Abatement Criteria Levels or Illinois emission standards. Workers would use protective measures to minimize occupational impacts.	NSI – Noise impacts from uranium conversion in support of the Proposed Action would be similar or less than the impacts described in the Metropolis EA.
Waste Management	Solid (nonhazardous), hazardous, and radioactive waste/materials	SMALL	NSI – Continued operations at the Metropolis facility would not require any new waste streams. Multiple upgrades have been made to the facility waste management systems.	NSI – Impacts to waste management from uranium conversion in support of the Proposed Action would be similar or less than the impacts described in the Metropolis EA.
Public and Occupational Health – Normal Operations	Worker and public exposure to radiological and chemical hazards	SMALL – Industrial accidents are possible during construction, but impacts are limited by short duration of construction and small workforce. Operational impacts would be similar to impacts at Metropolis facility.	NSI – Continued operations at the Metropolis facility would produce radiological doses to workers and the public that would be well below regulatory thresholds. Direct radiation doses to the public are dominated by the storage of material in a uranium ore concentrate storage area. The dominant radiation exposure to workers is from inhalation of material during the conversion process. The facility maintains a radiation protection program to ensure worker exposures	NSI – Public and occupational health impacts during normal operations from uranium conversion in support of the Proposed Action would be similar or less than the impacts described in the Metropolis EA.

Table 2-6. Summary of Impacts for Uranium Conversion

Resource Area	***Impact Indicator***	***Impacts from Construction and Operation of a New Uranium Conversion Facility***	***Metropolis Conversion Facility Metropolis, Illinois***	
			Impacts from Uranium Conversion for LEU [a]	***Impacts from Uranium Conversion for HALEU***
General	Annual Production	3,060 MT UF_6	15,000 MT UF_6	3,060 MT UF_6
			are below U.S. Nuclear Regulatory Commission criteria. Liquid waste streams are treated to remove fluorine to meet discharge permits limits. Regarding the risk of industrial accidents to workers, the Metropolis facility has had no occupational fatalities and the reportable work injury rate was 2.5 per year for the period of 2010 to 2014.	
Public and Occupational Health – Facility Accidents	Physical, radiological, and chemical risks to site workers and the public	SMALL – Similar to operational impacts associated with Metropolis facility.	SMALL – Because the integrated safety analysis (ISA) for the Metropolis facility is not publicly available, the accident consequences for an enrichment facility were used to identify potential physical, radiological, and chemical risks to site workers and the public. The most significant accident consequences would be due to the release of UF_6 caused by rupturing an overfilled or overheated sampling cylinder. The integrated safety analysis for the Metropolis facility identifies potential accident sequences and designates features and procedures either to prevent such accidents or to mitigate their consequences to an acceptable level. The facility emergency plan also would address other consequence	NSI – Public and occupational health impacts from facility accidents due to uranium conversion for the Proposed Action would pose an acceptably low risk to workers and the public.

Table 2-6. Summary of Impacts for Uranium Conversion

Resource Area	***Impact Indicator***	***Impacts from Construction and Operation of a New Uranium Conversion Facility***	***Metropolis Conversion Facility Metropolis, Illinois***	
			Impacts from Uranium Conversion for LEU [a]	***Impacts from Uranium Conversion for HALEU***
General	Annual Production	3,060 MT UF_6	15,000 MT UF_6	3,060 MT UF_6
			events. Through the combination of facility design, passive and active engineered controls (including items relied on for safety), administrative controls, and management of these controls, accidents at an enrichment facility or a conversion facility would pose an acceptably low risk to workers and the public and associated impacts would be SMALL.	
Traffic	Roadway capacity, annual average daily traffic and new vehicle trips during operation	SMALL – New AADT volumes should be within daily design capacity of roadways; siting criteria of a new facility would take into consideration surrounding traffic conditions.	NSI – Vehicle trips generated during full operation of the Metropolis facility would result in minimal increases in roadway congestion, delays, and safety hazards to affected roadways and they would remain well within acceptable operating capacities. The Metropolis EA determined that traffic impacts would be less than significant.	NSI – The annual Proposed Action uranium conversion demand and resulting traffic generated by the project would be less than impact levels evaluated in the Metropolis EA.
Socioeconomics	Regional income, employment levels, local tax revenue housing availability, area community services	SMALL to MODERATE – Impacts on local community/host county that is more rural/less populated, and majority of workers choose to live there (higher numbers could adversely affect housing and social services, although increased revenue generated by project	NSI – Continued operations of the Metropolis facility would directly employ the same number of workers and would have beneficial impacts on the area because of employment opportunities and increased tax revenues.	NSI – A potential small influx of workers and families for uranium conversion in support of the Proposed Action would have small impacts on housing and community services.

Table 2-6. Summary of Impacts for Uranium Conversion

Resource Area	***Impact Indicator***	***Impacts from Construction and Operation of a New Uranium Conversion Facility***	***Metropolis Conversion Facility Metropolis, Illinois***	
			Impacts from Uranium Conversion for LEU [a]	***Impacts from Uranium Conversion for HALEU***
General	Annual Production	3,060 MT UF_6	15,000 MT UF_6	3,060 MT UF_6
		could help address deficiencies).		
Environmental Justice	Disproportionate and adverse effects on minority and low-income populations	Site-specific analysis would be required.	NSI – Continued operation of the Metropolis facility would not cause noticeable impacts on populations living near the facility and therefore would not cause disproportionately high and adverse human health and environmental effects on minority or low-income populations. Census information more recent than the information evaluated in the Metropolis EA show that there are now one minority and seven low-income block groups within the Metropolis facility ROI. However, full operation of the facility would not produce disproportionately high and adverse impacts to these minority and low-income populations.	NSI – The annual uranium conversion demand in support of the Proposed Action would be about 20% of the licensed production capacity evaluated in the Metropolis EA. The resulting impacts to minority or low-income populations from uranium conversion to support the Proposed Action would be similar or less than the impacts described in the Metropolis EA.

Key: % = percent; AADT = annual average daily traffic; BMP = best management practice; EA = Environmental Assessment; ELUC = environmental land use control; HALEU = high-assay low-enriched uranium; IEPA = Illinois Environmental Protection Agency; ISA = integrated safety analysis; LEU = low-enriched uranium; MT = metric tons; NEPA = National Environmental Policy Act; NRHP = National Register of Historic Places; NSI = no significant impact; ROI = region of influence; UF_6 = uranium hexafluoride

Notes:

[a] Source: (NRC, 2019a)

[b] Water and wastewater are discussed in Section 2.3.2.4, *Water Resources*; solid waste, hazardous waste, and radioactive waste are addressed in Section 2.3.2.10, *Waste Management*; and transportation infrastructure is addressed in Section 2.3.2.13, *Traffic*.

3 Uranium Enrichment

3.1 Description of the Activity

3.1.1 General Description

Uranium enrichment is one of the major steps in the high-assay low-enriched uranium (HALEU) fuel cycle (Figure 3-1). For the purposes of the Technical Report, the enrichment process would use uranium hexafluoride (UF_6) produced during the conversion process as feed stock and process the UF_6 to incrementally increase the concentration of fissionable uranium-235 (U-235) molecules present to 19.75%. Uranium ore usually contains approximately 0.72 weight percent U-235, and therefore must be enriched to 19.75% U-235 for use in HALEU fuel. Enriched UF_6 with a U-235 concentration of 19.75% can then be used as the feed material for the deconversion process, and ultimately for HALEU fuel fabrication.

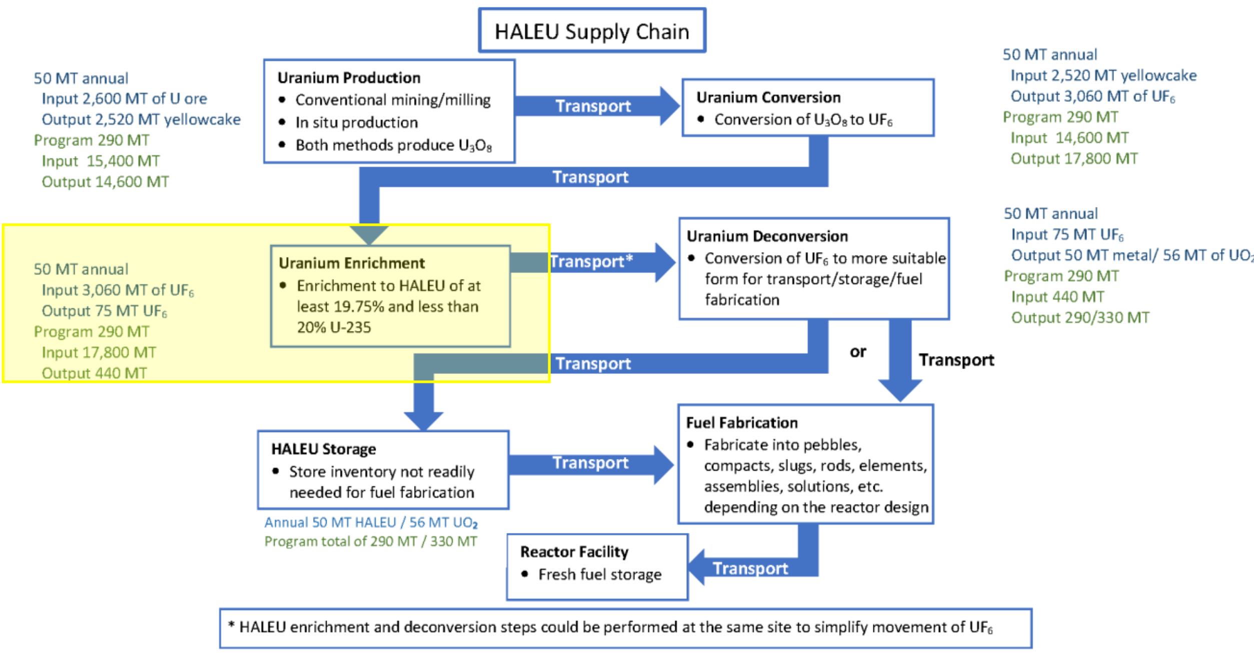


Figure 3-1. HALEU Fuel Cycle

3.1.2 Description of the Enrichment Process

There are several technologies that have been used for the enrichment of uranium, including gaseous diffusion, gaseous centrifuge, and molecular laser isotope separation. Gaseous diffusion, which uses porous membranes to separate uranium isotopes, was the first commercial uranium enrichment technology used in the United States. However, due to its large energy demand, gaseous diffusion has become obsolete. The current commercial process used in the United States is gaseous centrifuge enrichment, which involves the use of spinning cylinders or centrifuges to concentrate U-235 isotopes up to the desired level. Separation of isotopes by laser excitation (SILEX), developed by Silex Systems Ltd, is a variant of the molecular laser isotope separation technology that is in the commercial demonstration phases, and involves separating uranium isotopes by increasing the energy of the electrons in a specific isotope with laser light.

Gaseous centrifuge and SILEX enrichment technologies are discussed further in the following sections, followed by descriptions of three potential sites where these technologies may be deployed for uranium enrichment to support HALEU production. The Technical Report considers these sites as they are currently used for uranium enrichment or the demonstration of these enrichment technologies and were proposed sites for commercial uranium enrichment facilities. Each of these sites were evaluated for a commercial uranium enrichment facility in EISs prepared by the U.S. Nuclear Regulatory Commission (NRC).

The quantities of uranium, byproducts, and supporting materials required for an enrichment facility to support the Proposed Action would be similar across the technologies and are summarized in Table 3-1. These values are based on an enrichment facility that would produce 38 metric tons (MT) per year (MT/yr) of HALEU hexafluoride required for the production of 25 MT of HALEU.[16] Based on the requirement for the production of 50 MT/yr of HALEU metal, multiple enrichment facilities would be needed to produce the 290 MT of HALEU uranium hexafluoride identified in the Proposed Action as the maximum quantity U.S. Department of Energy (DOE) would acquire.

Table 3-1. Quantities of Uranium, Byproducts, and Supporting Materials Required for an Enrichment Facility Supporting the Production of 145 MT of HALEU

Item	***Quantity***
Natural UF_6 needed	1,530 MT/yr (delivered) Type 48Y cylinders Up to 128 cylinders/yr *Note: 2021 Centrus EA (NRC, 2021c) assumed 30B.
HALEU UF_6 at 19.75% uranium-235	Estimated 1.1 million SWUs /yr 38 MT/yr (UF_6 produced) Type 31 cylinders/yr 8 shipments
DUF_6 produced	1,492 MT/yr Stored in 48Y cylinders Up to 124 cylinders/yr Stored on-site 124 stored/yr (or) Shipped off-site 124 shipped

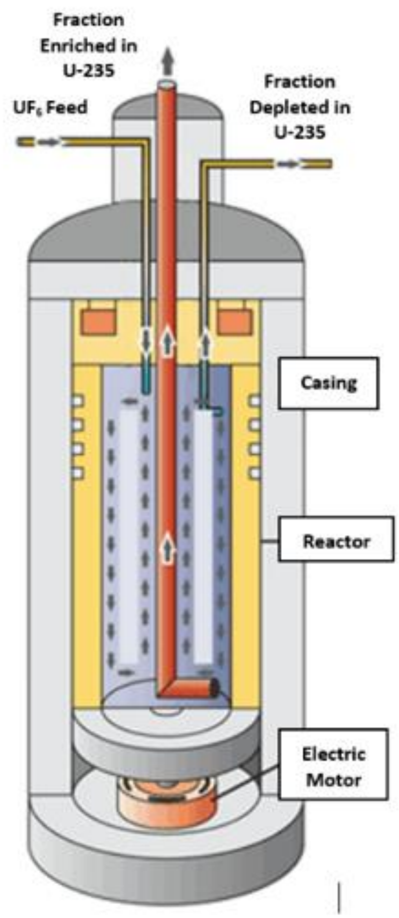
Key: % = percent; DU = depleted uranium; DUF_6 = depleted uranium hexafluoride; EA = Environmental Assessment; HALEU = high-assay low-enriched uranium; MT = metric ton; SWUs = separative work units; HALEU UF_6 = high-assay low-enriched uranium hexafluoride; UF_6 = uranium hexafluoride; yr = year

3.1.2.1 Gaseous Centrifuge Enrichment

Gaseous centrifuge enrichment is a proven technology, that employs a configuration of centrifuges to produce the desired U-235 concentration. Each centrifuge (see Figure 3-2) contains an encased rotating cylinder (rotor) that spins at a high circumferential rate of speed inside a protective casing. The casing

[16] The Draft Enrichment Request for Proposal (DOE, 2023a) identifies 145 MT as a maximum quantity of HALEU to be produced under any agreement between DOE and a uranium enrichment company. This Technical Report has assumed an annual production rate of 25 MT per year to meet this total production. DOE could contract multiple companies for enrichment services, up to a maximum of 290 MT (50 MT per year assumed for analysis purposes).

maintains a vacuum around the rotor and provides physical containment of the rotor in the event of a catastrophic rotor failure (NRC, 2005a). UF_6, which primarily contains uranium-238 (U-238) hexafluoride ($^{238}UF_6$) and U-235 hexafluoride ($^{235}UF_6$) molecules, is fed into the centrifuge, where the gas is spun at a high rate of speed. This spinning creates centrifugal forces that results in the heavier $^{238}UF_6$ molecules concentrating toward the outer wall of the rotor, with the lighter $^{235}UF_6$ collecting closer to the rotor axis. Due to thermal conditions, axial separation where hotter gas streams rise in the rotor and cooler gases sink also occurs. UF_6 is removed from the rotor using scoops, with enriched $^{235}UF_6$ being extracted from a scoop at the top of the rotor and depleted $^{238}UF_6$ extracted from a scoop at the bottom of the rotor.



Source: https://www.nrc.gov/materials/fuel-cycle-fac/ur-enrichment.html#centrifuge

Figure 3-2. Example Illustration of Gaseous Centrifuge

A single centrifuge does not concentrate $^{235}UF_6$ to desired concentrations, and therefore the enrichment process consists of multiple centrifuges that are connected in series with each step incrementally increasing $^{235}UF_6$. In addition, to produce sufficient volumes, multiple configurations of centrifuges are connected in parallel. The arrangement of centrifuges connected in series to achieve higher enrichment and parallel for increased volume is called a “cascade” (see Figure 3-3 and Figure 3-4). A full cascade contains hundreds of centrifuges connected in series and in parallel (NRC, 2005a). Multiple cascades can be grouped and contained in what is referred to as a “cascade hall.”

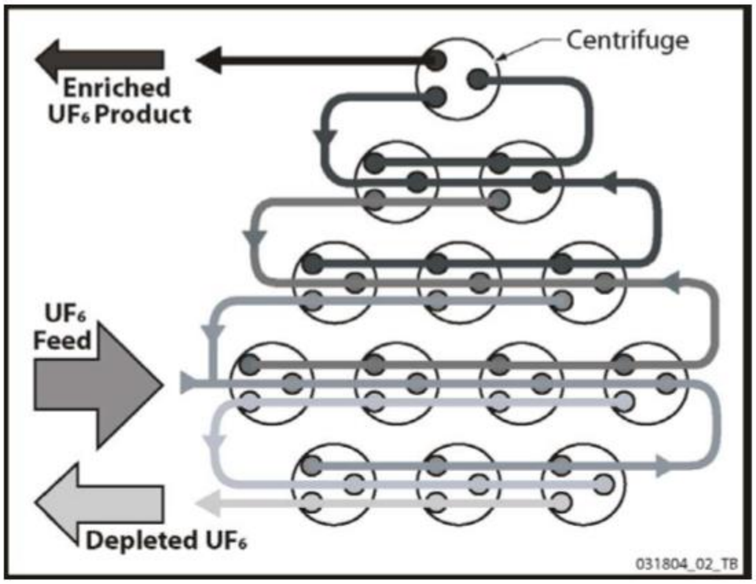
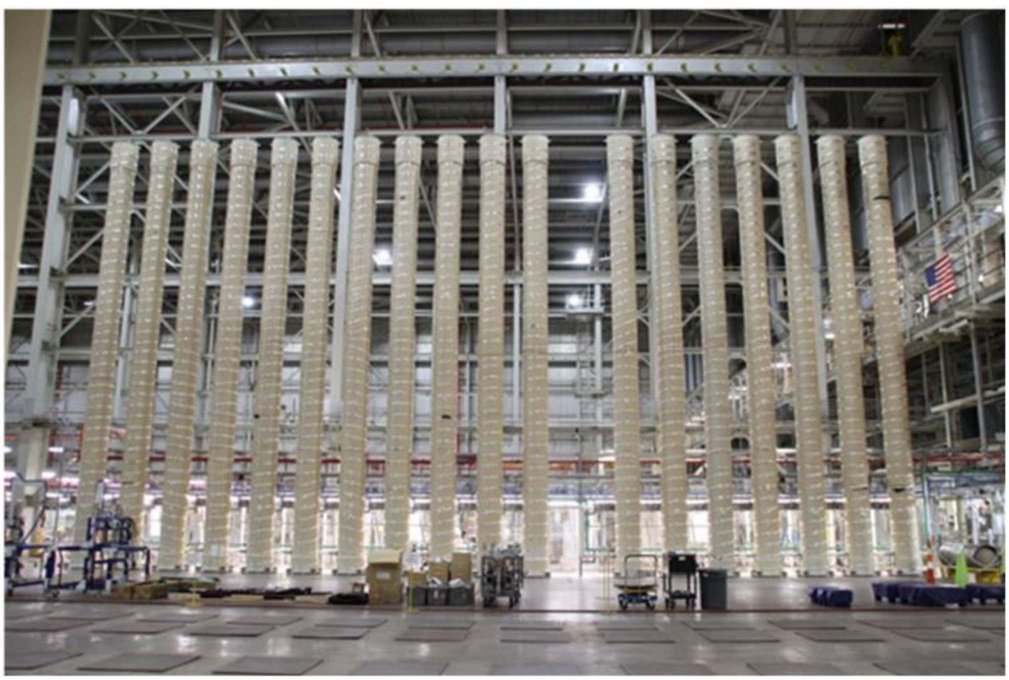


Figure 3-3. Diagram of Enrichment Cascade



Source: (Centrus Energy Corp, 2023).

Figure 3-4. HALEU Demonstration Cascade Hall Photo (photo: Centrus)

3.1.2.2 Separation of Isotopes by Laser Excitation (SILEX)

Sources for this section include the SILEX description taken primarily from the 2012 NRC *Environmental Impact Statement for the Proposed GE-Hitachi Global Laser Enrichment, LLC Facility in Wilmington, North Carolina* (NRC, 2012b) (referred to as the "GLE EIS") and the *Resubmittal of Revision 7 to Global Laser Enrichment License Application – Public Version (ML12256A682)* (GEH GLE, 2012).

The SILEX process is a third-generation laser-based technology for enriching natural uranium that was developed by Silex Systems Ltd, in partnership with Global Laser Enrichment, LLC (GLE). Isotopes of the same element, though chemically identical, have different electronic energies and absorb different colors of laser light. The isotopes of most elements can be separated by a laser-based process if they can be vaporized efficiently into individual atoms. In laser excitation enrichment, UF_6 vapor is illuminated with a tuned laser of a specific wavelength that is absorbed only by U-235 atoms while leaving other isotopes unaffected.

The major steps for SILEX enrichment involve vaporization of the UF_6 feed, cascade and gas handling where enrichment takes place, and product and tails withdrawal. Purified UF_6 feed gas is UF_6 in gaseous form is enriched by exposure to laser-emitted light and separation into two streams (one enriched in U-235 and one depleted in U-235). Except for the actual step in the enrichment process that involves the use of lasers, the processes that would be used for receipt and handling of the feed stock, enriched, and depleted UF_6 streams are very similar to those used for other enrichment processes. These processes include the movement of uranium feed stock from its solid UF_6 form in cylinders to gaseous form used in the enrichment cascade via vaporization techniques, the filling of UF_6 cylinders with UF_6 gas condensed into solid UF_6 form after the enrichment process, and the blending of UF_6 gas of different enrichments to create specific, desired product enrichments. Technical details for the SILEX enrichment technology are proprietary with limited public access due to United States export controls and security safeguards (GEH GLE, 2012).

3.1.3 Potential Facilities

Currently, the only gas centrifuge commercial production plant in the United States is the Urenco USA (UUSA) facility, initially licensed (SNM-2010) to Louisiana Energy Services (LES). The UUSA facility is currently operating in Eunice, New Mexico. The NRC granted licenses for two other commercial gas centrifuge facilities, including Centrus' American Centrifuge Plant (ACP) in Piketon, Ohio, and Eagle Rock Enrichment Facility near the city of Idaho Falls, Idaho. The license for the Eagle Rock Enrichment Facility (SNM-2015) was terminated in 2018 and no further activities have occurred for this location. The license for the ACP (SNM-2011) is still active, but construction of the facility as initially proposed was not completed. However, the ACP site has been used for demonstration of centrifuge enrichment technologies, including ongoing demonstration efforts for DOE to enrich uranium and produce HALEU fuel using centrifuges.

Only one license has been issued for a laser enrichment facility—the full-scale General Electric Company (GE)-Hitachi GLE Uranium Enrichment Facility (SNM-2019) was issued one in 2012, but it was terminated in 2021. However, GLE was licensed for a test loop in 2008 and continues to conduct demonstrations at the Wilmington, North Carolina site (also referred to as the Wilmington site). The Wilmington site is also the proposed location for a Natrium™ fuel facility, to produce HALEU metallic fuel, that will be jointly funded by TerraPower and DOE through the Advanced Reactor Demonstration Program.

The Technical Report considers construction and operation of HALEU enrichment facilities at the UUSA, Centrus, and GLE sites. Each of these sites is described in more detail below. The Technical Report also considers construction and operation of HALEU enrichment facilities at other industrial or previously undeveloped sites.

3.1.3.1 Urenco USA (UUSA) – Eunice, New Mexico (Gaseous Centrifuge)

The UUSA facility, formerly known as the National Enrichment Facility (NEF), is located near Eunice in Lea County, New Mexico. The facility is located within a 543-acre parcel of land, of which approximately 394 acres have been disturbed (see Figure 3-5 and Figure 3-6).

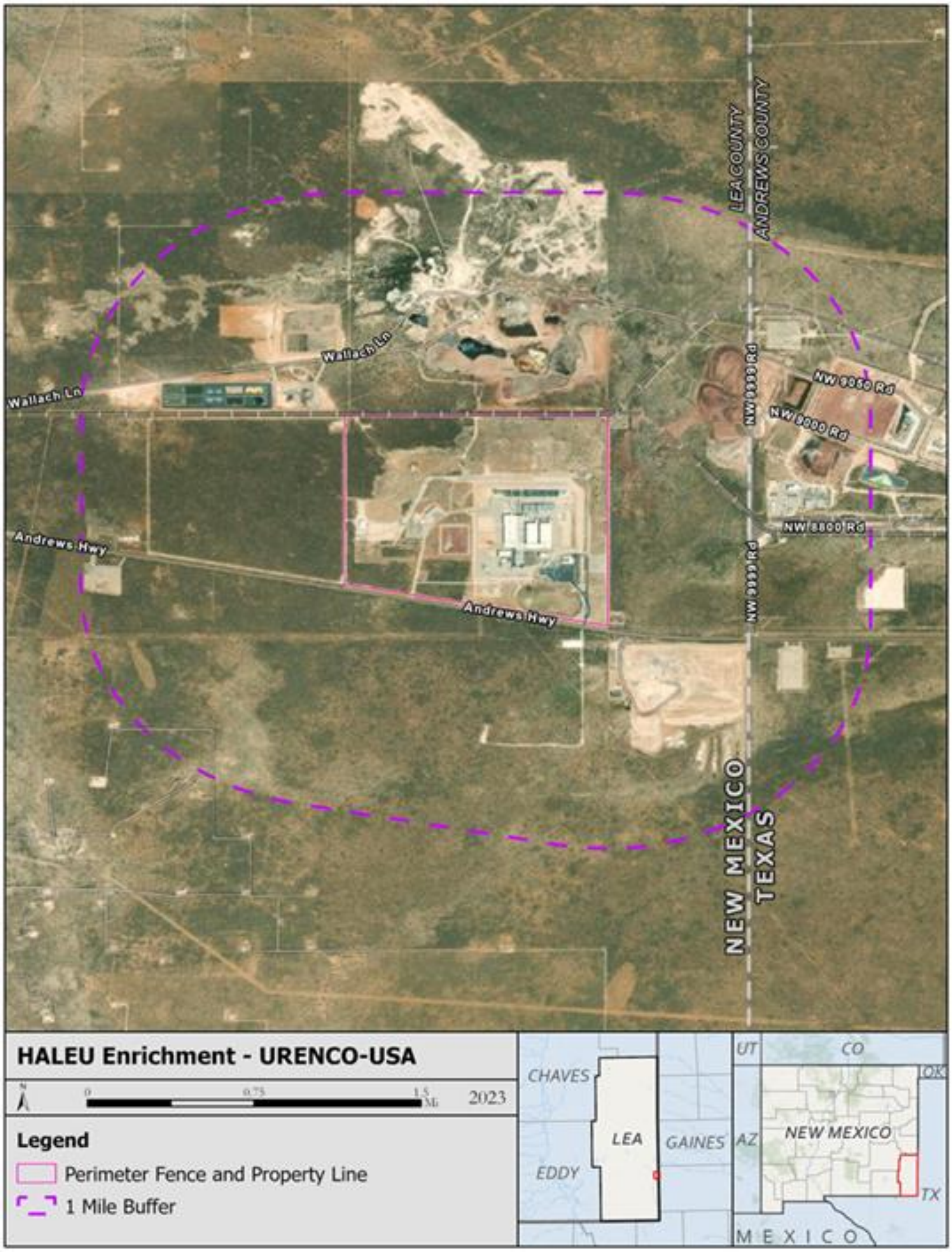


Figure 3-5. Existing UUSA Site – Eunice, New Mexico (1-Mile Buffer)

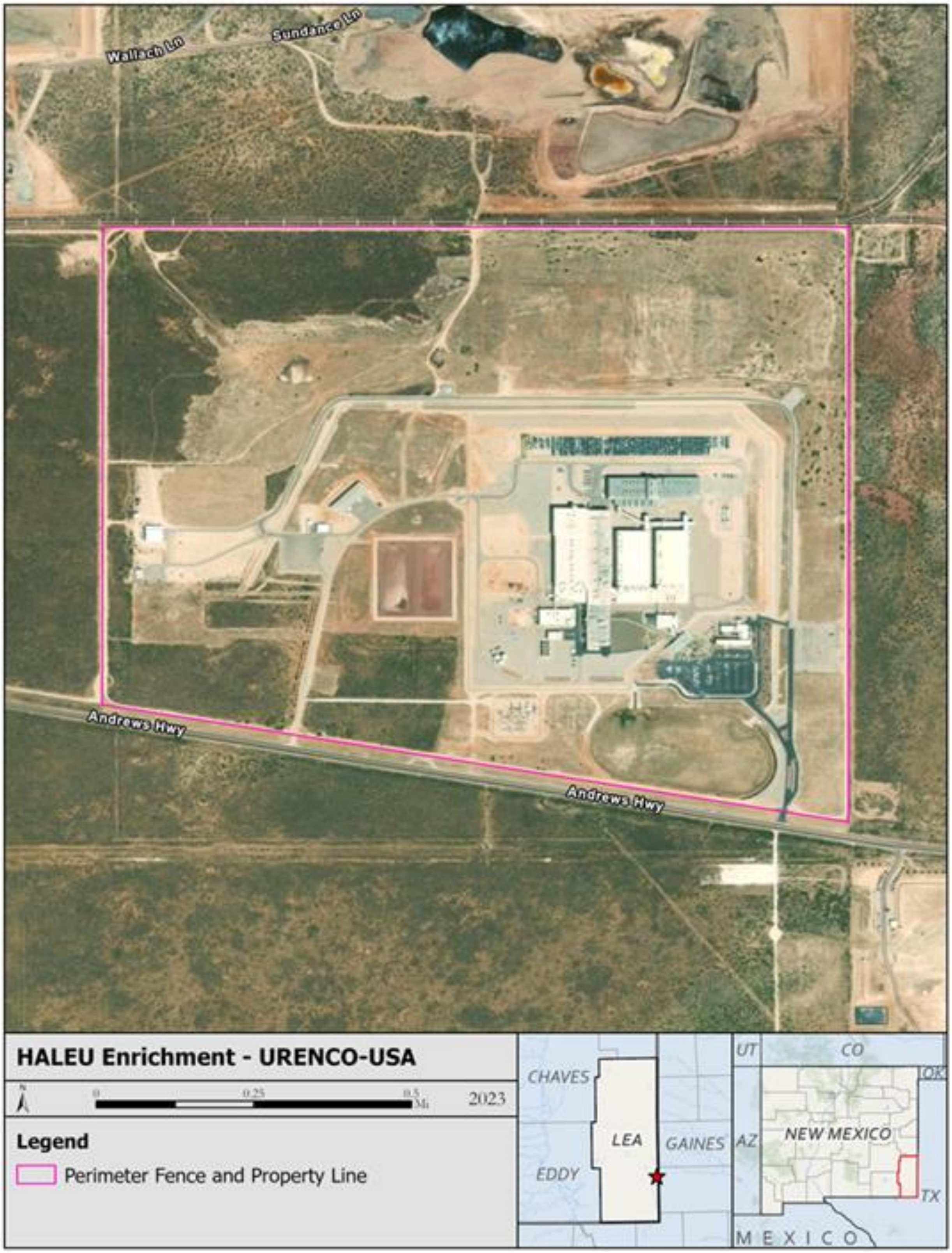


Figure 3-6. Existing UUSA Site – Eunice, New Mexico

Buildings and structures within the UUSA facility, as depicted in Figure 3-7, include the following:

- Separations Building Modules (SBMs)
- Centrifuge Assembly Building
- Cylinder Receipt and Dispatch Building
- Uranium Byproduct Cylinder Storage Pad
- Technical Services Building
- Gaseous Effluent Vent Systems
- Liquid Effluent Collection and Transfer System
- Central Utilities Building
- Security Building
- Uranium Byproduct Cylinder Storage Pad Stormwater Retention Basin

Facility operation includes the following primary activities:

- Receipt and storage of UF_6 feed cylinders
- UF_6 enrichment via gas centrifugation
- Collection of enriched and depleted UF_6 streams
- Shipment of enriched UF_6
- On-site storage of depleted UF_6
- Waste management

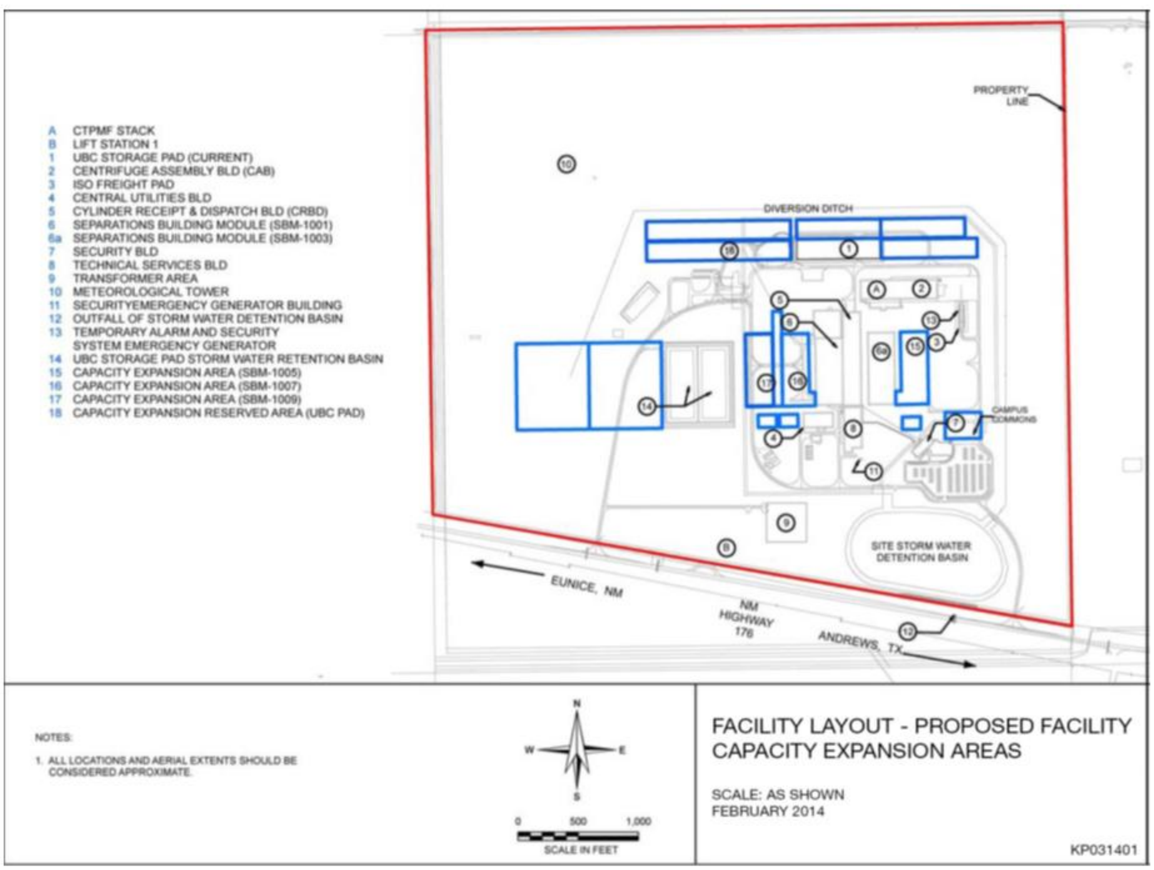


Figure 3-7. 2014 Proposed Expansion to 10 Million SWUs (NRC, 2015)

3.1.3.1.1 Initial Facility (3 Million SWUs)

The UUSA facility uses a gas centrifuge process to separate natural UF_6 feed material containing approximately 0.71 weight percent of U-235 into (1) a product stream enriched up to the license limit in isotope U-235 of 5.5 weight percent, and (2) a depleted UF_6 stream containing approximately 0.1 to 0.5 weight percent U-235. The existing facility initially had a nominal capacity of 3 million separative work units (SWUs) per year for the production of enriched uranium. The UUSA received NRC authorization, began enrichment activities in June 2010, and is now fully operational based on that authorization (NRC, 2015).

The facility as initially licensed produces special nuclear material (SNM) in three SBMs, designated as SBM-1001, SBM-1003, and SBM-1005. The UUSA facility has expanded the facility production capacity to approximately 3.7 million SWUs per year, with ability to increase the capacity to 10 million SWUs per year, authorized under a license amendment as described below.

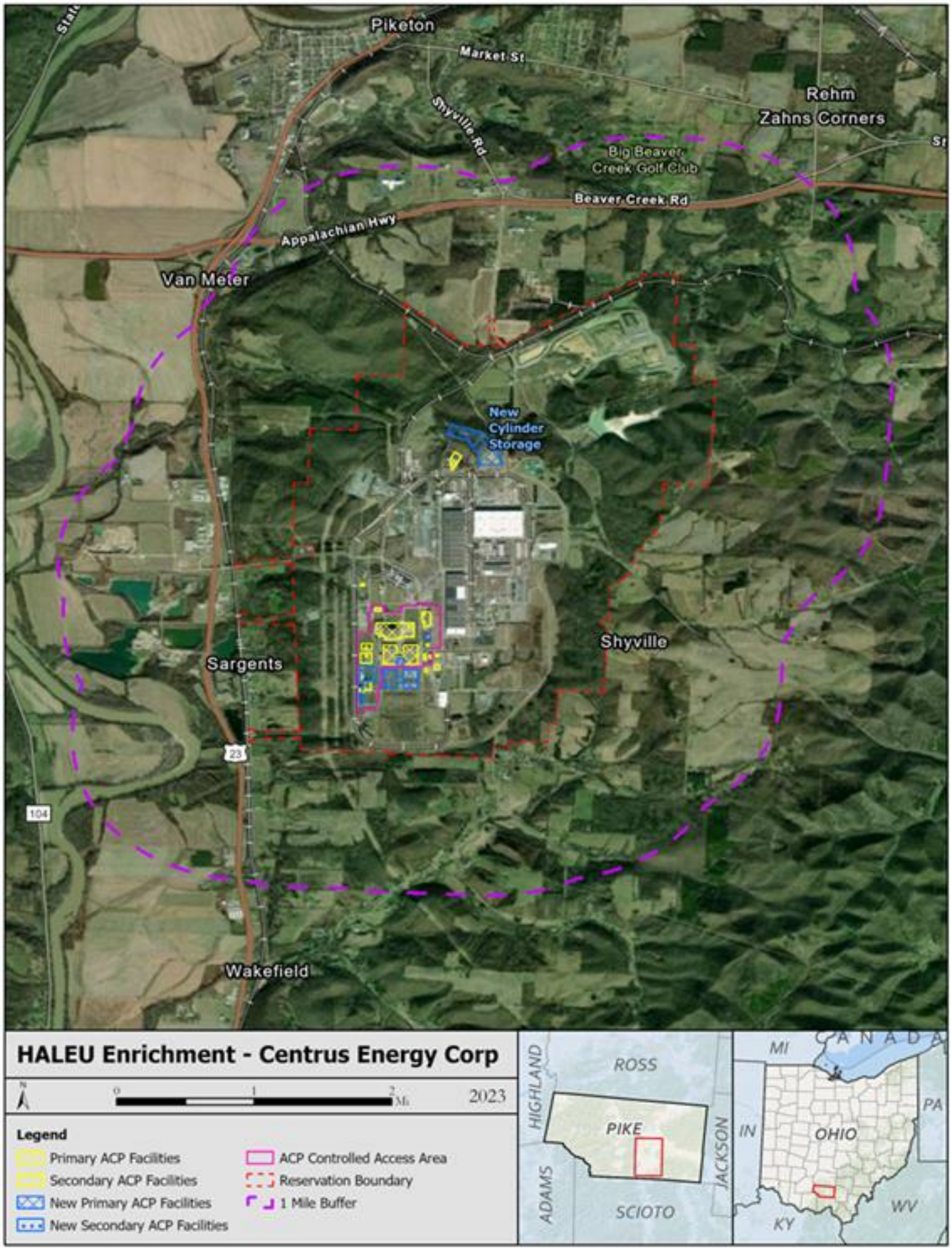
3.1.3.1.2 License Amendment to 10 Million SWUs

In November 2012, a license Amendment Request was submitted to the NRC seeking to expand its SNM production capacity from 3.7 million SWUs to 10 million SWUs per year, by adding three new SBMs. These SBMs were designated as SBM-1005, SBM-1007, and SBM-1009 (see Figure 3-7). Adding the proposed SBMs and support facilities would increase the UUSA's total SNM production capacity. In addition, the requested expansion included the use of newer model TC21 centrifuges that were previously approved by the NRC and used in SBM-1003 (NRC, 2015). Construction of the first cascade in SBM-1005 has been completed and was authorized for operation in February of 2015. At the time of the amendment request, construction of SBM-1007 and SBM-1009 was expected to take place in phases and be completed by 2020. These facilities do not appear to have been constructed. UUSA has indicated that only previously disturbed areas on the site of its existing facility will be used during preconstruction and construction of the expanded facility (NRC, 2015).

3.1.3.2 Centrus Energy Corp (Centrus) – Piketon, Ohio (Gaseous Centrifuge)

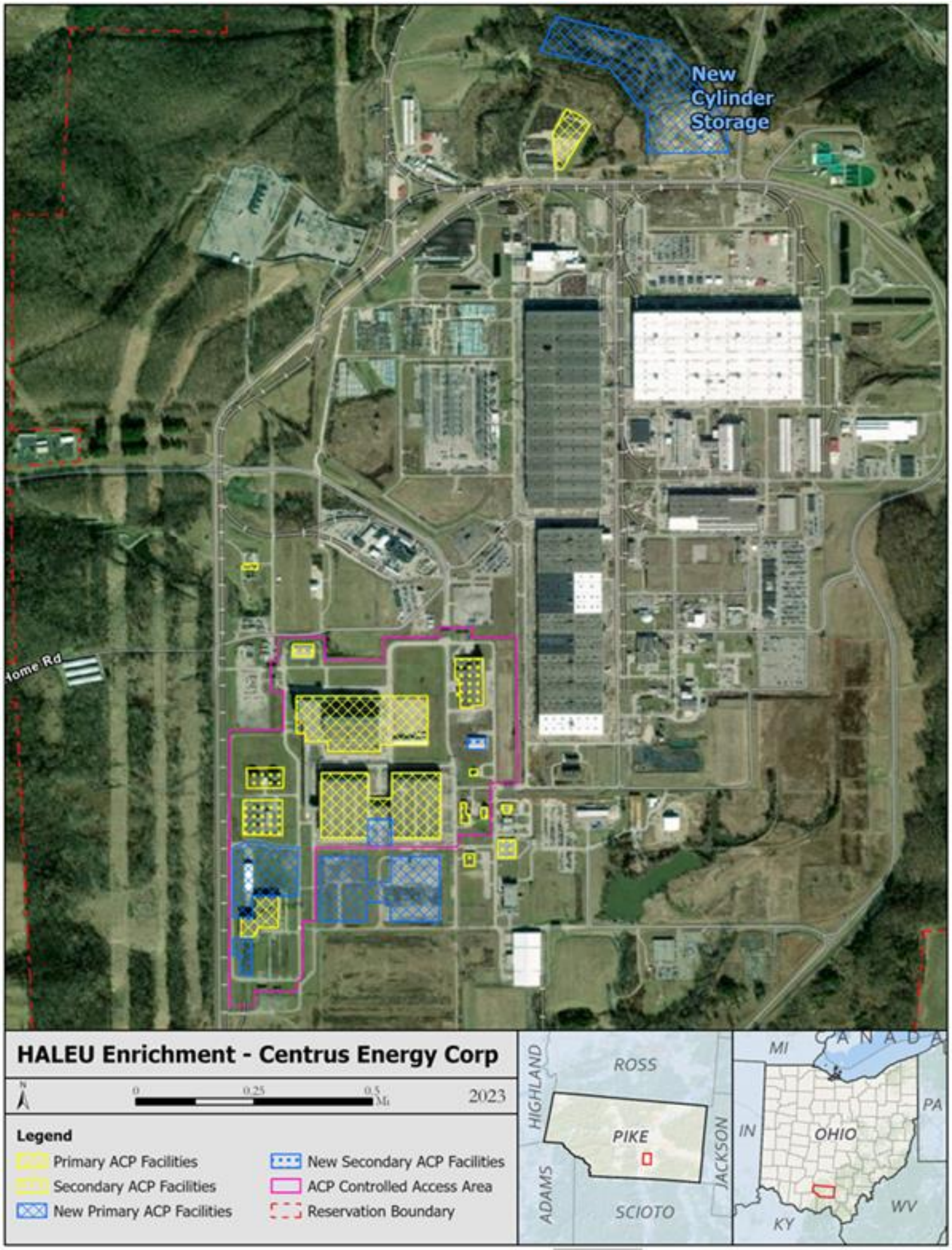
American Centrifuge Plant (ACP) – As evaluated in NRC's 2006 *Environmental Impact Statement for the Proposed American Centrifuge Plant in Piketon, Ohio* (NRC, 2006b) (referred to as the "ACP EIS"), the ACP in Piketon, Ohio, initially involved the proposed construction and operation of a plant to enrich uranium up to 10%, with an initial production capacity of 3.5 million SWUs potentially expandable to 7 million SWUs. The ACP would be located at the same site as DOE's Portsmouth Gaseous Diffusion Plant, which has been shut down since May 2001. The ACP would consist of refurbished existing buildings, newly constructed facilities, and adjacent grounds owned by DOE and leased by American Centrifuge Operating, LLC (ACO) (a wholly owned subsidiary of Centrus Energy Corp). In April 2007, a 30-year license (SNM-2011) was issued to USEC (now Centrus Energy Corp) to construct, operate, and decommission the ACP, a commercial-scale gas centrifuge uranium enrichment facility. The license is now held by ACO. Existing and proposed facilities for the ACP are depicted in Figure 3-8 and Figure 3-9. Centrus did not undertake construction or operational activities under the ACP (NRC, 2006b).

The Lead Cascade Facility – The Lead Cascade Facility was a separate facility authorized in 2004 to operate up to 240 centrifuges demonstrating the production of low-enriched uranium (LEU) using centrifuge technology under NRC License SNM-7003 at the same site as DOE's Portsmouth Gaseous Diffusion Plant. The Lead Cascade Facility was designed to provide information about reliability, performance, cost, and other parameters to determine whether to construct and operate a full-scale enrichment facility, the ACP (DOE, 2004a). The license allowed for enrichment of U-235 up to 10%. The facility was decommissioned and dismantled in 2018; however, the license was not terminated and remains in effect.



Adapted from the 2006 ACP EIS (NRC, 2006b)

Figure 3-8. Existing Centrus Site – Piketon, Ohio (1-Mile Buffer)



Adapted from the 2006 ACP EIS (NRC, 2006b)

Figure 3-9. Existing Centrus Site – Piketon, Ohio (Facilities Proposed for the American Centrifuge Plant)

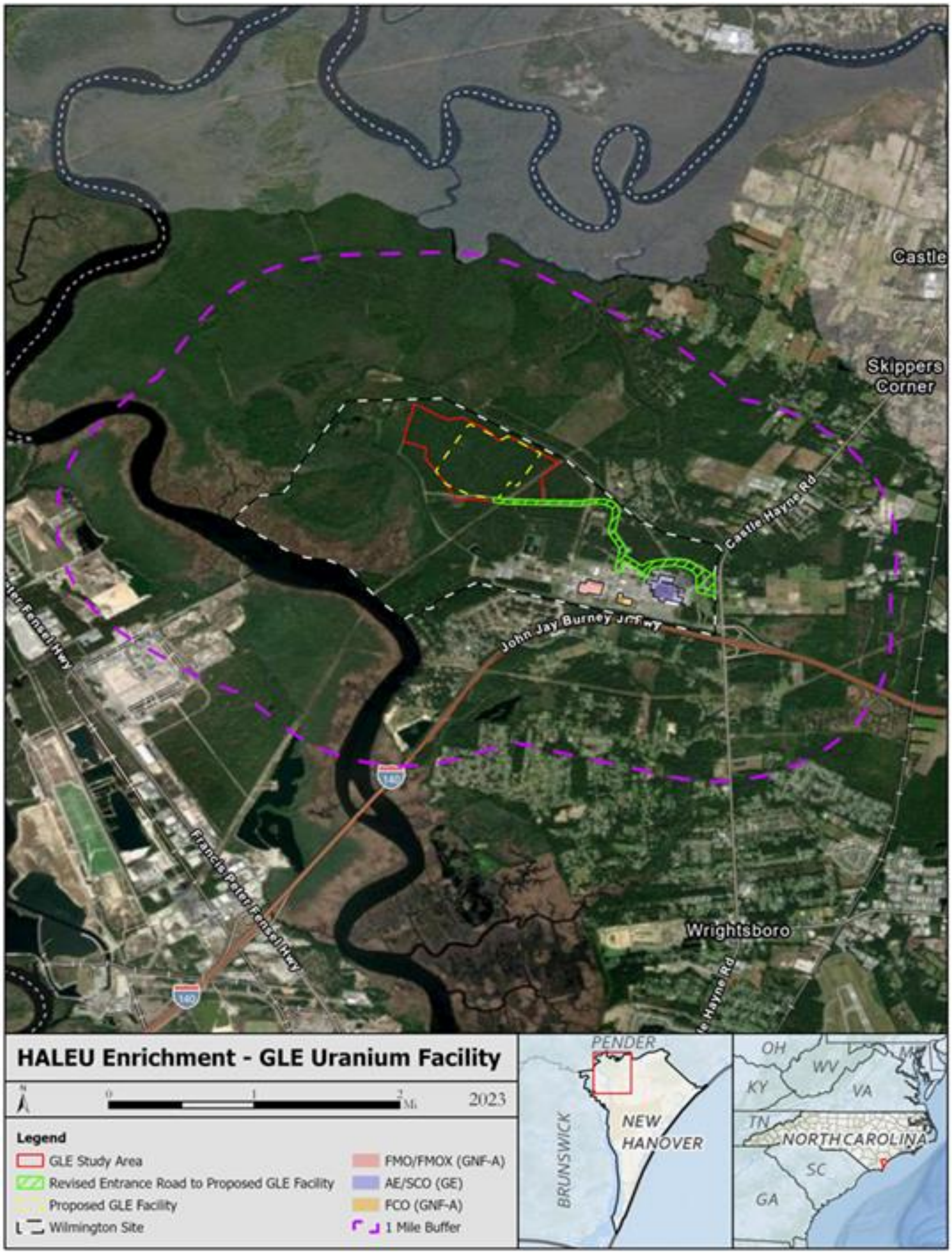
DOE HALEU Demonstration – In 2021, ACO applied to amend SNM-2011 for possession of licensed material to support the contract with DOE to produce HALEU. ACO entered into a contract agreement with DOE to enrich uranium and produce HALEU for nuclear reactor fuel development. This amendment was evaluated by NRC in the 2021 *Environmental Assessment for the Proposed Amendment of US. Nuclear Regulatory Commission License Number SNM-2011 for the American Centrifuge in Piketon, Ohio* (referred to as the "2021 ACP Amendment EA") and approved in 2021 (NRC, 2021c) (see Section 3.1.4, *Existing NEPA Documentation*). The HALEU license amendment authorizes ACO to enrich U-235 up to 25% (to allow for anticipated process fluctuations when producing less than 20% U-235). Enrichment activities would occur primarily in a portion of Building X-3001, an approximately 28,242 square-meter (303,994 square-foot) building leased from DOE (NRC, 2006b). Building X-3001 and the other buildings leased from DOE provide process and administrative support; centrifuge training and testing; centrifuge storage, handling, and assembly; and transporter storage and maintenance. The HALEU cascade demonstration period is 3 years; however, the 2021 ACP Amendment EA evaluates operations for an additional period of up to 10 years based on ACO's stated plans. At the time, ACO also indicated that it would consider the modular addition of one or more 120 centrifuge HALEU and/or LEU cascades within Building X-3001 to accommodate demand; however, this was not evaluated as part of the license application review (see Figure 3-3).

3.1.3.3 GE-Hitachi Global Laser Enrichment (GLE) – Wilmington, North Carolina

GLE Project Background – The GLE project consists of multiple phases: (1) test loop operations; (2) a license for a commercial-scale enrichment plant in Wilmington, North Carolina; and (3) agreement with DOE to purchase high-assay uranium tails for re-enrichment at a proposed Paducah Laser Enrichment Facility, in Paducah, Kentucky.

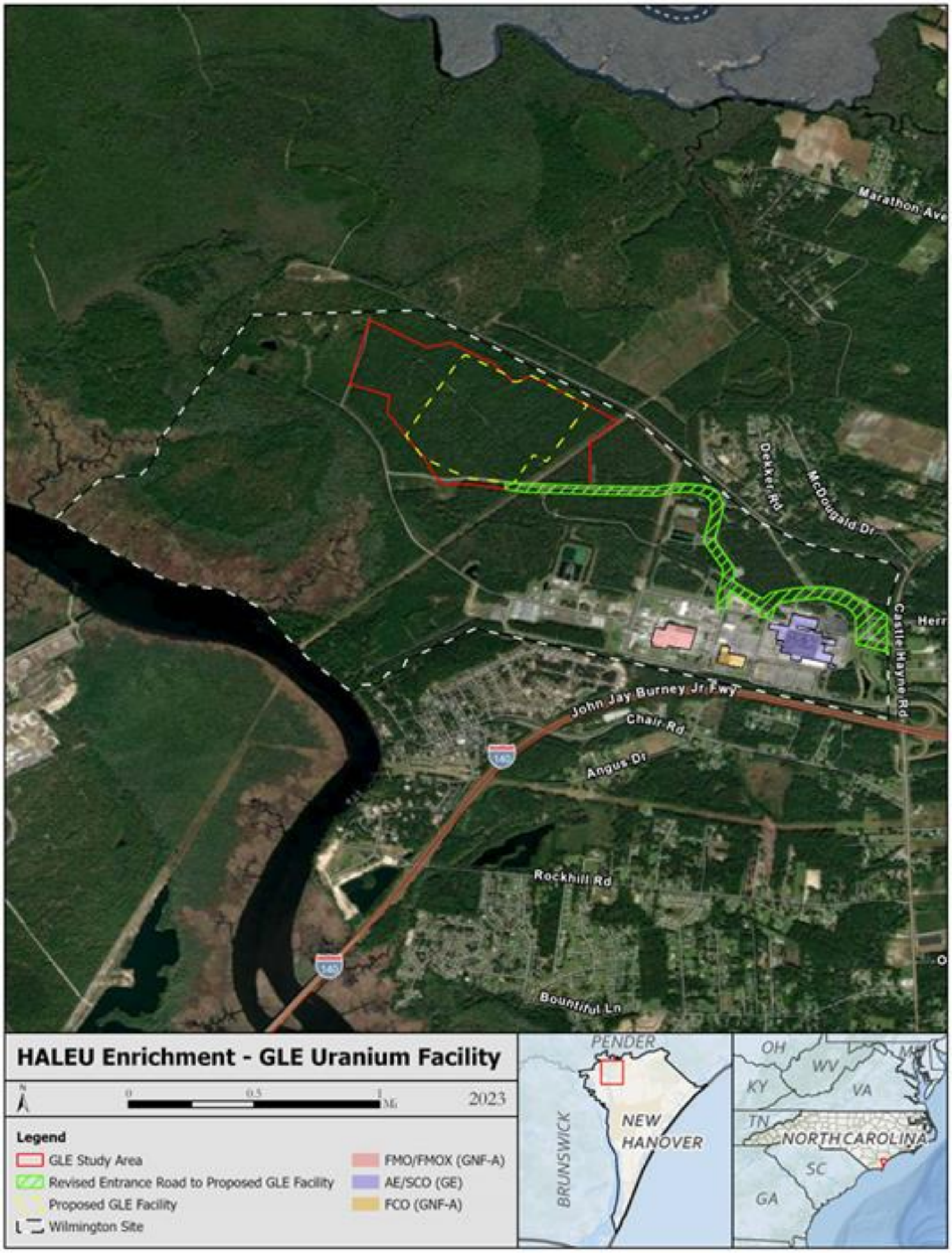
- **Phase I** – For Phase I, the test loop was built at GE-Hitachi's nuclear fuel fabrication facility in Wilmington, North Carolina. This facility is being used to advance the performance and reliability of the process and equipment to be used for commercial laser enrichment. The test loop is licensed under the Global Nuclear Fuel – Americas (GNF-A) fuel fabrication license (SNM-1097).
- **Phase II** – For Phase II, GLE submitted a license application in June 2009 for a commercial-scale plant enrichment plant in Wilmington, North Carolina. On September 25, 2012, the NRC staff issued a construction and operating license for the facility. Due in part to the forecasted pressure on the price of uranium and the announcement from GE-Hitachi of plans to withdraw from GLE, GLE placed development of the commercial enrichment facility on hold.
- **Phase III** – For the third phase, GLE considered submitting to the NRC a license application to build and operate the Paducah Laser Enrichment Facility in Paducah, Kentucky. In November 2016, DOE and GLE signed a 40-year agreement for the sale and purchase of depleted uranium hexafluoride (DUF_6). The agreement, which facilitates the sale of approximately 300,000 MT of high-assay DUF_6 to GLE, supports the potential construction of a SILEX laser enrichment facility to re-enrich the tails inventory to natural uranium for commercial resale. The submittal of a license for this project is also on hold.

The GLE Site – The GLE commercial facility (Phase II), the subject of the GLE EIS (NRC, 2012b), is located on an existing GE industrial site in Wilmington, North Carolina. The Wilmington site is a 1,621-acre tract of land, located west of North Carolina Route 133 (also known as Castle Hayne Road). The Wilmington site is approximately 6 miles north of the city of Wilmington in New Hanover County, North Carolina (see Figure 3-10). The location of GE's existing principal manufacturing facilities (namely, the GNF-A Fuel Manufacturing Operation [FMO] Facility and the GE Aircraft Engines/Services Components Operation Facility) are depicted in Figure 3-11. The Phase I Test Loop is in the GNF-A/FMO facilities.



Adapted from GLE EIS (NRC, 2012b)

Figure 3-10. GLE – Proposed GLE Uranium Facility (1-Mile Buffer)



Adapted from the GLE EIS (NRC, 2012b)

Figure 3-11. GLE Site – Proposed GLE Uranium Facility

The GLE commercial facility that was evaluated in the GLE EIS is located on approximately 100 acres of the Wilmington site. The GLE facilities were proposed to occupy approximately 100 acres of the North-Central Site Sector. A north access road was proposed to be built along the northeast portion of the Eastern Site Sector to connect the proposed GLE facility to North Carolina Route 133, using existing site road service where practical. The GLE commercial facility that was evaluated in the GLE EIS would have a capacity of 6 million SWUs per year for the production of enriched uranium.

3.1.4 Existing NEPA Documentation

The NRC has prepared EISs for all three facilities and, with the exception of GLE, has prepared additional National Environmental Policy Act (NEPA) documentation in the form of Environmental Assessments (EAs). EAs were prepared for the Centrus facility for a centrifuge demonstration project (at the Lead Cascade Facility) in 2004, and for an amendment to the facility license to demonstrate HALEU production in 2021 (NRC, 2021c). An EA was also prepared for the UUSA facility (NRC, 2015) for the expansion of the facility from 3 million SWUs per year to 10 million SWUs per year. These documents and other NEPA resource documents include:

- **UUSA** – *Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico, Final Report, NUREG-1790*. (NRC, 2005a)

  Environmental Assessment for the Proposed LES Uranium Enrichment Facility Expansion, Lea County, New Mexico. (NRC, 2015)
- **Centrus** – *Environmental Impact Statement for the Proposed American Centrifuge Plant in Piketon, Ohio, NUREG-1834*. (NRC, 2006b)

  Environmental Assessment Finding of No Significant Impact (FONSI) for the Lead Cascade Facility in Piketon, Ohio. (DOE, 2004a)

  Environmental Assessment for the Proposed Amendment of the US Nuclear Regulatory Commission License Number SNM-2011 for the American Centrifuge Plant in Piketon, Ohio. (NRC, 2021c)
- **GLE** – *Environmental Impact Statement for the Proposed GE-Hitachi Global Laser Enrichment, LLC Facility in Wilmington, North Carolina, NUREG-1938*. (NRC, 2012b)

  Note: The 2008 Environmental Report (ML090890503) (GEH GLE, 2008) submitted to the NRC in support of the license application may also contain relevant information.

Additional NEPA documents related to depleted uranium (DU) management that may be useful are:

- *Final Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride, DOE/EIS-0269*. (DOE, 1999)
- *Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky Site, (DOE/EIS-0359)*. (DOE, 2004c)
- *Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, Ohio Site, (DOE/EIS-0360)*. (DOE, 2004b)
- *Final Supplemental Environmental Impact Statement for Disposition of Depleted Uranium Oxide Conversion Product Generated from DOE's Inventory of Depleted Uranium Hexafluoride (DOE/EIS-0359-S1 and DOE/EIS-0360-S1)*. (DOE, 2020)
- *Final Environmental Impact Statement for the Proposed Fluorine Extraction Process and Depleted Uranium Deconversion Plant in Lea County, New Mexico* (hereinafter referred to as the "Fluorine/DU EIS"). (NRC, 2012a)

3.2 Approach to NEPA Analyses

In this section, the Leidos Team has analyzed the potential impacts of constructing and operating a HALEU enrichment facility using gaseous centrifuge enrichment at the UUSA site in Eunice, New Mexico; gaseous centrifuge enrichment at the Centrus site in Piketon, Ohio; and SILEX (laser) enrichment at the GLE site in Wilmington, North Carolina. In addition, the Technical Report considers construction and operation of HALEU enrichment facilities at other industrial or previously undeveloped sites.

While enrichment facilities at one or more of these locations could supply enriched uranium to support the Proposed Action, the Leidos Team has considered the construction and operation of a facility that could produce up to 38 MT of HALEU in the form of UF_6 enriched to 19.75% U-235 per year at each location. This approach provides the upper bound of impacts that could occur at each site. Based on the requirement for the production of 50 MT/yr of HALEU metal, two enrichment facilities would be needed that each produce 38 MT/yr of HALEU as UF_6.

The Technical Report incorporates by reference, prior NEPA documentation and analysis conducted at each site for proposed commercial-scale uranium enrichment facilities. The facilities reviewed in these NEPA documents proposed to produce LEU enriched from less than 5% to less than 10% U-235. The Technical Report considers new facilities that would be required at each site to support approximately 1.1 million SWUs per year to produce 38 MT of HALEU in the form of UF_6. For the Centrus Energy and the GLE sites, the Technical Report considers that the construction of a new HALEU facility at one of these locations would be primarily in areas previously proposed for the respective commercial enrichment facilities that were licensed but never constructed. However, resources outside of these areas, but within each site boundary, have also been considered. It is assumed that if new construction would occur outside of previously planned areas, that siting of new facilities would remain within existing site boundaries and constructing on previously disturbed lands, or through the avoidance of sensitive resources.

A commercial enrichment facility for LEU has been constructed and is currently operating at the UUSA site. The Technical Report assumes that a HALEU facility at this location would be in addition to the facilities that are currently enriching uranium at the site, versus replacing LEU capacity with HALEU capacity. Since the UUSA facility is currently operating at 3.7 million SWUs and has not been built-out to its full capacity of 10 million SWUs per year, the Leidos Team has considered two scenarios. The first scenario considers a HALEU facility being constructed and operated adjacent to existing facilities and in expansion areas identified in Figure 3-7 that have not yet been developed for LEU enrichment. The second scenario considers an independent HALEU facility being constructed and operated within the site boundary, but outside of those areas planned as part of the LEU facility expansion. The latter would represent the upper bound of impacts for this site.

Given the degree of previous evaluations for impacts under NEPA for each site, the Leidos Team has presented impacts as part of this analysis in a comparative form to the prior analysis. When referencing prior analysis, the Leidos Team has reviewed potential changes in baseline data or circumstances, as well as any unique differences related to HALEU enrichment compared to LEU enrichment. The Technical Report focuses on these changes and differences when presenting affected environment information and analyzing potential impacts. It is important to note that a HALEU facility at one of these locations will require either a license amendment or new license for SNM. The respective applications would include facility details that are not known at this time that would be reviewed by the NRC under NEPA.

3.3 Affected Environment and Environmental Consequences

3.3.1 Land Use

This section discusses land uses on and near the three uranium enrichment facilities covered by existing NEPA documents, and the potential impacts on land use under the Proposed Action. Land use comprises existing or planned land uses, including zoning requirements (e.g., industrial, commercial, residential), local, county, and state plans and policies, and other land use restrictions.

3.3.1.1 UUSA Site – Eunice, New Mexico

Land use for the UUSA site is presented in Section 3.2 of the 2005 *Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico* (NRC, 2005a) (referred to as the "NEF EIS") and Section 3.1 of the 2015 *Environmental Assessment for the Proposed Louisiana Energy Services, URENCO USA Uranium Enrichment Facility Capacity Expansion in Lea County, New Mexico* (NRC, 2015) (referred to as the "2015 UUSA EA"). The UUSA site is 220 hectares (ha) (543 acres). The UUSA site is leased from the State of New Mexico until 2034 and houses the currently licensed and operating UUSA uranium enrichment facility. UUSA would be responsible for long-term stewardship. Construction for facility capacity at 3.7 million SWUs impacted approximately 159 ha (394 acres) of the property (see Section 2.1.2 of the 2015 UUSA EA) (NRC, 2015, p. 35). The UUSA site is currently used as a LEU enrichment facility, with expectations to increase capacity from 3.7 million to 10 million SWUs. The UUSA site has no special land use designations, zoning restrictions, or applicable land use plans. Based on satellite imagery, construction associated with capacity expansion from 3.7 million to 10 million SWUs has occurred to the west of the facility, as well as road access development to the north. Satellite imagery shows that the existing concrete storage pad area has canisters being stored on the northern portion of the site. Construction of additional uranium enrichment buildings (SBM 1007 and SBM-1009) were expected to take place in phases and be completed by 2020. These facilities do not appear to be constructed. UUSA has indicated that only previously disturbed areas on the site will be used during construction of the expanded facility. New structures would be constructed on previously disturbed land and would be contained to the 220-ha (543-acre) parcel leased by UUSA (NRC, 2015, p. 4).

As indicated in the 2005 NEF EIS (NRC, 2005a), the surrounding area consists of vacant land and industrial developments. Lea County spans 1,142,236 ha (2,822,522 acres) in total, with 784,411 ha (1,938,321 acres) of this area allocated for farming (USDA, 2017a, p. 3). In Andrews County, the closest Texas county to the site, farmland covers 358,861 ha (886,765 acres), with grazing being the predominant land use within 8 kilometers (km) (5 miles) of the UUSA property (NRC, 2015, p. 35; USDA, 2017b, p. 1). Oil and gas is the primary industry in Lea and Andrews Counties (NRC, 2015, p. 35). Land to the north, south, and west of the site contains operating oil pump jacks and associated equipment (NRC, 2005a, pp. 3-4). To the southeast of the Iite is the Lea County Landfill (NRC, 2005a, pp. 3-4). West of the site consists of privately owned land, a soil treatment facility, a historical marker, and picnic area. See Section 3.2 of the 2005 NEF EIS (NRC, 2005a) for a more detailed description of surrounding facilities and associated permits with industrial development. While the city of Eunice zones the area east of the city for commercial and heavy industrial use, the fenced UUSA property lies outside the city's jurisdiction. The facility does not conflict with Federal, state, or local land use plans.

Construction

Impacts on land use were considered for the initial construction of the UUSA uranium enrichment facility and have already occurred as the facility was constructed and is in operation (NRC, 2005a). These impacts include land use impacts for the proposed facility expansion to 10 million SWUs as those facilities would be in areas previously disturbed as part of the initial facility construction (NRC, 2015, p. 81). General conclusions from the prior NEPA analyses were that impacts on land use were SMALL. Construction activities impacted 160 ha (394 acres) of the previously undisturbed 220-ha (543-acre) site by 2015, including relocation of cattle grazing and a carbon dioxide pipeline; and installation of municipal water-supply piping, natural gas supply piping, and electrical transmission lines (NRC, 2005a, pp. 2-47). The 2015 UUSA EA does not indicate how many acres were needed for expansion, but construction occurred on previously disturbed land that would not exceed the boundaries of the UUSA site (NRC, 2015, p. 3). General conclusions from both NEPA analyses were that impacts on land use were SMALL.

Construction of a new HALEU enrichment facility would likely occur in the previously designated areas of the site. In this case, impacts on land use would be changing a portion of the site's use from a LEU enrichment facility to HALEU enrichment. If a new HALEU facility were located elsewhere on undeveloped portions of the site, impacts on land use would be less than those described in the 2005 NEF EIS (NRC, 2005a) for the initial facility, which included relocation of cattle grazing and a pipeline. Cattle grazing would not be impacted, as grazing ceased on the property when construction began (NRC, 2015, p. 3). The 2015 UUSA EA indicated that further development of the site did not interfere with surrounding land uses and zoning ordinances. Therefore, impacts on land use from construction of a HALEU enrichment facility would be SMALL.

Operation

The UUSA uranium enrichment facility is currently operating and producing LEU at an estimated capacity of 3.7 million SWUs, with the ability to expand to 10 million SWUs. Potential impacts related to operations of UUSA were evaluated in the 2005 NEF EIS (NRC, 2005a), and 2015 UUSA EA (NRC, 2015) for the proposed expansion to 10 million SWUs. These impacts included limiting the land use of the site to uranium enrichment, which is similar to industrial land use in the area and resulted in a SMALL impact (2005 NEF EIS, p. 4-3). Operation of a new co-located HALEU enrichment facility with an estimated capacity of 1.1 million SWUs at this location would be consistent with current land uses, zoning, and land use plans analyzed for the expanded capacity and overall impacts would be SMALL.

3.3.1.2 Centrus Site – Piketon, Ohio

Land use for the Centrus site is presented in Section 3.2 of the 2006 ACP EIS (NRC, 2006b). The 2021 ACP Amendment EA (NRC, 2021c) did not evaluate land use. As indicated in the 2006 ACP EIS, the Centrus site is situated in Scioto Township in Pike County in south-central Ohio. The facility is on the DOE Portsmouth site and leased by Centrus (formerly USEC). The facility is largely housed in buildings constructed by DOE in the 1980s for its gas centrifuge project. The proposed (but never constructed) ACP evaluated in the 2006 ACP EIS would have consisted of using refurbished existing buildings, newly constructed facilities, and adjacent grounds owned by DOE and leased by Centrus. The DOE reservation covers approximately 1,497 ha (3,700 acres) of DOE-owned land. Perimeter Road surrounds a 526-ha (1,300-acre) central area, which includes a 304-ha (750-acre) controlled access area. At the time of the 2006 ACP EIS, there were approximately 150 buildings, trailers, and sheds within the central area, with the gaseous uranium enrichment facilities in the controlled access area. Since then, extensive decontamination and decommissioning activities have occurred on the Portsmouth site, including the demolition of the X-236 uranium-enrichment process building, ongoing deactivation of the X-333 process building, and construction of the On-Site Waste Disposal Facility for managing waste and debris generated from demolition, making the primary land use of this 405-ha (1,000-acre) site focused on remediation, waste disposal, and preparing the land for future redevelopment (DOE, 2023b; PORTS Demolition, 2023). The central area of the DOE reservation is mostly treeless, with managed lawns, parking lots, and paved roadways dominating the open space. The 1,017-ha (2,514-acre) portion of the reservation land outside

Perimeter Road is used for various purposes, such as a water treatment plant, holding ponds, sanitary and inert landfills, cylinder storage yards, parking areas, and open fields and forested buffer areas (NRC, 2006b, pp. 3-3).

Limited activities on the DOE reservation include management of remediation and waste management activities, management of a DU conversion facility, and general upkeep and security activities. DOE leases parts of the reservation to Centrus and the Ohio National Guard. The United States Enrichment Corporation maintains office space at the facility, while the Ohio National Guard uses the facility for classroom training/meeting activities without storing weapons on-site (NRC, 2006b, pp. 3-5).

Adjacent land use to the Portsmouth site consists of residential homes, private and commercial farms, light industry, and transportation corridors including rail and highway. Within 8 km (5 miles) of the Portsmouth site, the land is mainly used for farms, pastures, forests, and rural residences. Dominant land use within the radius includes approximately 10,291 ha (25,430 acres) of farmland (cropland, wooded lot, and pasture) and 9,874 ha (24,400 acres) of forest (commercial woodlands and recreational forest). No state or national parks, conservation areas, or designated wild and scenic rivers are in the immediate vicinity.

Public recreational areas nearby are Rock Water Campground (0.9 miles west), Big Beaver Creek Golf Park (3.8 miles northeast), Brush Creek State Forest (5 miles southwest), and Lake White State Park (6 miles north).

Pike County contains farmland qualifying for protection under the Farmland Protection and Policy Act of 1981 (prime farmland), mainly along the Scioto River floodplain. However, marginal quality farmland within and adjacent to the Portsmouth site does not qualify as prime farmland (NRC, 2006b, pp. 3-3). Pike County spans 115,000 ha (284,171 acres) in total, with 39,581 ha (97,809 acres) of this area allocated for farming (USDA, 2017c).

Construction

Impacts on land use for the construction and operation of the ACP with a production capacity of 3.5 million SWUs potentially expandable to 7 million SWUs, were evaluated as a part of the 2006 ACP EIS (NRC, 2006b). General conclusions from the NEPA analysis were that impacts on land use would be SMALL. Potential impacts identified in the prior NEPA analysis included development on previously disturbed land, conversion of 10 ha (24 acres) of managed grassland and old fields to developed land to accommodate a new cylinder storage area, construction of 1 ha (2.5 acres) of new roads and parking areas, 10 ha (24 acres) of new or refurbished facilities, and no impacts on land use outside of the DOE reservation. These impacts were considered SMALL (NRC, 2006b, pp. 4-3). The NRC determined that the 2021 license amendment would have no impact on land use (NRC, 2021c, p. 15).

Construction of a new HALEU enrichment facility at the Centrus site would likely occur in areas previously identified for proposed ACP facilities that were analyzed in the 2006 ACP EIS (NRC, 2006b). According to the 2006 ACP EIS, these areas are largely industrial in nature and previously disturbed, so impacts on land use on the site would be limited to use of the site for HALEU enrichment and no impacts to level of development on the site or land use in surrounding areas. As with the construction of the ACP, a new HALEU enrichment facility would utilize existing buildings and possibly newly constructed facilities on adjacent areas within the DOE reservation. It is anticipated that impacts on land use from construction and operation of a new HALEU enrichment facility with an estimated capacity of 1.1 million SWUs at this location would be within the range of impacts analyzed for the ACP and the impacts would be SMALL.

Operation

There would be no additional changes in land use on the existing DOE reservation. Furthermore, no impacts on foreseeable land use or existing land use on the property surrounding the reservation are anticipated. Additionally, there would be no conflicts with proposed future land use planning, both on-site and in the surrounding area, including any economic development spurring from the Portsmouth site decommissioning and decontamination.

3.3.1.3 GLE Site – Wilmington, North Carolina

Section 3.2.1 of the GLE EIS (NRC, 2012b) covers the region within 5 miles of the site and includes New Hanover, Brunswick, and Pender Counties. The proposed GLE facility is part of the 656 ha (1,621-acre) Wilmington site in New Hanover County, North Carolina, owned by GE. The site, currently covered by mixed pine forest, is undeveloped and situated 10.4 km (6.5 miles) north of Wilmington, North Carolina. It is bordered by the Northeast Cape Fear River, Interstate (I-)140, residential developments, and the North Carolina State University Horticultural Crops Research Station. No prime farmland is present in the area.

The site is zoned I-2 (heavy industrial zone) under the jurisdiction of the New Hanover County Planning Board. Surrounding areas have varying zoning designations, including planned development district, rural agriculture, and R-20 (low-density residential). Noted are several residential developments and schools that are proposed or under construction nearby.

The Wilmington-New Hanover County Joint 2006 Coastal Area Management Act Plan Updated Land Classification Map (CW & NHC, 2006) and the New Hanover County 2016 Comprehensive Plan (NHC, 2016) designates the GLE facility site as a Wetland Resource Protection Area and Aquifer Resource Protection Area. The conservation area north and northwest of the site aims to protect natural resources while considering property owners' rights.

New Hanover County's land cover is primarily developed land (35%), wetlands (26%), forest (16%), and grassland/cultivated fields (15%) (NHC, 2016). State-designated use areas within 8 km (5 miles) of the GLE facility site include Cape Fear River Wetlands Game Land, Sutton Lake Game Land, North Chase Bottomlands Preserve, and Cape Fear Royal Tracts, managed for hunting and natural resource preservation.

Construction and Operation

The impacts on land use for the construction and operation of the 6 million SWU GLE facility was evaluated in the GLE EIS (NRC, 2012b). Impacts on land use would involve activities such as clearing and grading of land, vegetation removal, improvement of existing roads, and construction of support structures, which would remove mixed pine forest. Potential impacts include disturbance of 91 ha (226 acres) and a change in land cover, which is undeveloped forest. Construction impacts would be temporary. Operations have the potential for long-term impacts on plans for nearby low-density residential development to the north, east, and south. However, residential plans already exist close to other industrial facilities in the vicinity. Overall, impacts from construction and operations to land use would be SMALL. These impacts are described in Section 4.2.1 of the GLE EIS.

Construction of a new HALEU enrichment facility at the GLE site would likely occur in those areas designated for development of the uranium enrichment facility evaluated in the GLE EIS (NRC, 2012b). According to the GLE EIS, impacts would be consistent with zoning and land use plans. Given the size of the HALEU enrichment facility would be substantially smaller than the proposed GLE facility (1.1

million SWUs versus 6 million SWUs), it is anticipated that impacts on land use would be similar to those described in the GLE EIS and are thus, considered SMALL.

3.3.1.4 New HALEU Enrichment Facility (Generic Site)

Construction and Operation

Site selection for a HALEU enrichment facility would be expected to include criteria for land use compatibility with local, state, and Tribal plans and/or location within an industrial land use area. Impacts on land use for siting on existing industrial sites or areas would be SMALL. Impacts related to siting the facility on undeveloped lands would likely be greater as land use and land cover changes would occur as a result of land clearing, grading, excavation, and the construction of buildings and infrastructure. Compatibility with surrounding land use and land use plans would depend on site-specific conditions. The operation of a HALEU enrichment facility may require additional infrastructure such as roads and power lines, which would further alter the land use of the area. The construction and operation of a HALEU enrichment facility has the potential to deter certain types of land use such in the surrounding area, such as residential development; however, site selection in an industrial area would reduce impacts.

3.3.2 Visual and Scenic Resources

This section discusses visual and scenic resources present at each of the three uranium enrichment facilities covered by existing NEPA documents, and the potential impacts on those resources under the Proposed Action. Visual and scenic resources comprise the visual character and quality of the landscape, considering elements such as landforms, vegetation, water features, and human-made structures.

3.3.2.1 UUSA Site – Eunice, New Mexico

The visual appearance of the UUSA site is industrial. The height of the buildings is no greater than 131 feet and are located close together. From nearby viewpoints, the facility appears similar to other industrial facilities in the area. Perimeter fencing is visible from New Mexico Highway (NM)-176 (Andrews Highway) to the north. The buildings have security lighting that are down-shielded to keep the light contained within the boundaries of the site.

The site received the lowest scenic-quality rating based on the U.S. Bureau of Land Management visual resource inventory process, indicating that the area in question has limited visual appeal or scenic value (NRC, 2005a, pp. 3-10). This rating is associated with few interesting features, limited vegetation types, and no significant water features. The color tones are muted with subtle variations, and the visual features are common within the region. Additionally, any cultural modifications in the area are discordant and create a strong sense of disharmony. A low scenic-quality rating allows for a higher level of landscape modification, as the area's visual characteristics are not considered to be particularly valuable or unique. The site retains a relatively flat topography with low shrubs, grasses, and scattered mesquite. The area has a high density of oil and gas wells and industrial features, including the nearby developments of Waste Control Specialists, Wallach Concrete, and Sundance Services, from which the site is visible. The site is slightly visible from the Lea County Landfill to the southeast and from DD Landfarm to the west (NRC, 2005a, pp. 3-10). The UUSA site, compatible with surrounding land uses, is visible from NM-18, approximately 2 miles to the west, and from NM-176, which borders the site to the south. The site is not visible from the city of Eunice, which is located 5 miles to the west. The area surrounding the site has no significant recreational resources apart from a roadside picnic area and historical marker.

Construction

Fugitive dust from construction activities related to the facility expansion has the potential to affect visibility (NRC, 2015, p. 23). However, these emissions would not violate air quality standards (see Section 4.1.1.4 of the 2006 ACP EIS). Additionally, any impacts from fugitive dust emissions would be temporary, and measures to minimize these emissions would be implemented. As a result, the impacts on visual and scenic resources due to fugitive dust emissions would be SMALL. The construction activities and equipment used during the facility expansion, as well as the new buildings to be constructed, would be similar in appearance to those for construction of the existing facility. The level of construction activity during the facility expansion would be comparable to that which occurred during the construction of the present facility. For these reasons, the overall impacts from construction would be SMALL.

Impacts on visual and scenic resources were considered for the initial construction of the UUSA uranium enrichment facility and have already occurred as the facility has been constructed and is in operation (NRC, 2005a, p. 1). These impacts include visual and scenic resources impacts for the proposed facility expansion to 10 million SWUs as those facilities would be in areas previously disturbed as part of the initial facility construction (NRC, 2015, p. 23). General conclusions from these NEPA analyses were that impacts on visual and scenic resources were fugitive dust emissions from construction activities, which would not violate air quality standards. The construction activities and equipment used during the facility expansion were the same as during initial construction, which would be similar to other excavation activities in the area. Overall, impacts were deemed SMALL and temporary.

Construction of a new HALEU enrichment facility would likely occur in the previously designated expansion areas of the site. In this case, impacts on visual and scenic resources could include fugitive dust emissions and the use of similar construction activities and equipment, which would produce SMALL and temporary impacts. If a new HALEU facility were located elsewhere on undeveloped portions of the site, impacts on visual and scenic resources would be similar to those described in the 2005 NEF EIS (NRC, 2005a) for the initial facility. These impacts would be SMALL and temporary.

Operation

The UUSA uranium enrichment facility is currently operating and producing LEU with an estimated capacity of 3.7 million SWUs, with the ability to expand to 10 million SWUs. Impacts on visual and scenic resources related to operations of UUSA were evaluated in the 2005 NEF EIS (NRC, 2005a) and 2015 UUSA EA (NRC, 2015) for the proposed expansion to 10 million SWUs. These impacts included modifying the visual and scenic quality of the area, which is consistent with surrounding land uses. Expansion of the facility added perimeter fencing and new buildings close together and no higher than the existing buildings at 131 feet. These impacts were deemed SMALL, and any fog or mist from cooling towers could be mitigated. Operation of a new co-located HALEU enrichment facility with an estimated capacity of 1.1 million SWUs at this location would be within the range of impacts analyzed for the expanded capacity and would be SMALL.

3.3.2.2 Centrus Site – Piketon, Ohio

Visual and scenic resources for the Centrus site are presented in Section 3.4 of the 2006 ACP EIS (NRC, 2006b). The 2021 ACP Amendment EA (NRC, 2021c) did not assess visual and scenic resources. As indicated in the 2006 ACP EIS, the site it situated within the DOE Portsmouth site near production and support facilities, transmission lines, and vacant lots. These facilities are generally not visible from off the DOE reservation property. Ongoing decommissioning and decontamination activities on the greater Portsmouth site, including controlled demolition of the 22-ha (55-acre) X-326 uranium-enrichment Process Building in 2021, have resulted in the greatest changes to the industrialized area's skyline to date (DOE, 2023b). The surrounding landscape consists of open and forested buffer areas, agricultural lands, limited residential areas, and densely forested hills. Rolling hills and small open farmlands characterize the nearby landscape. The U.S. Bureau of Land Management uses four Visual Resource Classes for visual resource value, with Class I and II being the most valued, Class III having moderate value, and Class IV being the least valued. The proposed ACP site would be consistent with surrounding land within the DOE property, maintaining a Visual Resources Management Class III or IV designation inside and outside the fenced area (NRC, 2006b, pp. 3-12).

Construction and Operation

Impacts on visual and scenic resources for the construction and operation of the ACP with a production capacity of 3.5 million SWUs, potentially expandable to 7 million SWUs, were evaluated as a part of the 2006 ACP EIS (NRC, 2006b). General conclusions from the NEPA analyses were that impacts on visual and scenic resources would be SMALL. Potential impacts identified in the prior NEPA analysis included no alteration of the existing scenic value, which was classified as Class III or IV, addition of buildings less than 100 feet tall, and the loss of fields and lawns. All operations would be conducted within the proposed buildings, at the cylinder storage yards, and along the existing roadway network. There would be no new visual impacts, such as visible air plumes, and no new-looking activities as a result of construction.

Construction of a new HALEU enrichment facility at the Centrus site would likely occur in areas previously identified for proposed ACP facilities that were analyzed in the 2006 ACP EIS (NRC, 2006b). According to the 2006 ACP EIS, these areas are largely industrial in nature and previously disturbed lawns and fields. All operations would be conducted within the proposed buildings, at the cylinder storage yards, and along the existing roadway network. There would be no new visual impacts, such as visible air plumes, and no new-looking activities. It is anticipated that impacts on visual and scenic resources from construction and operation of new HALEU enrichment facility with an estimated capacity of 1.1 million SWUs at this location would be within the range of impacts analyzed for the ACP and SMALL.

3.3.2.3 GLE Site – Wilmington, North Carolina

Visual and scenic resources for the GLE site are presented in Section 3.4 of the GLE EIS (NRC, 2012b). The GLE site is situated within GE's existing Wilmington site, with existing facilities primarily visible from the east. The GE site is primarily visible from the east and southeast near the I-140/Castle Hayne Road interchange, with the tallest feature being a 130-foot water tower. The closest residences are northeast of the site, with vegetation largely blocking their views.

The GLE site would be located to the west-northwest of the existing GE facilities, with visibility from residences along Dekker Road's south side and I-140 to the south. However, most of the facility would be obscured by existing site structures. The topography is relatively flat, with a pine plantation screening the site from the north and west. The surrounding area is industrialized, with a power plant, manufacturing facilities, and quarries nearby, contributing to a low expectation for a pristine natural viewshed.

The Bureau of Land Management's Visual Resource Management system, although not officially applicable, provides a framework for evaluating visual resources. The GLE site has low sensitivity, as it is situated in an industrialized area with mostly commuters and workers expected to view the location. Using the Bureau of Land Management framework, the scenic quality is rated as low due to factors such as landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modification.

Construction and Operation

The impacts on visual and scenic resources for the construction and operation of the 6 million SWU GLE facility was evaluated in the GLE EIS (NRC, 2012b). Impacts on visual and scenic resources included increased traffic and visibility of construction cranes from roadways, which would be SMALL and temporary. Impacts from operation included the visibility of the facilities from nearby properties, which would be SMALL. Potential impacts include disturbance of approximately 91 ha (226 acres) and the removal of vegetation, which would be mitigated with a vegetation screen. These impacts are described in Section 4.2.3 of the GLE EIS.

Construction of a new HALEU enrichment facility at the GLE site would likely occur in those areas designated for development of the uranium enrichment facility evaluated in the GLE EIS (NRC, 2012b). According to the GLE EIS, there would be increased traffic and construction cranes visible from nearby roadways during construction, and new buildings no taller than 160 feet. Given the size of the HALEU enrichment facility would be substantially smaller than the proposed GLE facility (1.1 million SWUs versus 6 million SWUs), it is anticipated that impacts on visual and scenic resources would be similar to those described in the GLE EIS and are thus considered SMALL.

3.3.2.4 New HALEU Enrichment Facility (Generic Site)

Construction and Operation

Site selection for a HALEU enrichment facility would be expected to include criteria for changes to visual and scenic quality. Siting is expected to occur on an existing developed site or in an area with poor scenic quality such as where other industrial facilities are visible. Siting of the facility on an industrial site would not be likely to substantially affect scenic resources and therefore would have SMALL impacts. Impacts related to siting the facility on undeveloped lands could be greater and would depend on site-specific conditions due to contrast with the surrounding landscape and introduction of new structures. Construction could generate fugitive dust emissions, which could be mitigated through methods such as a dust mitigation plan. The operation of a HALEU enrichment facility could produce light pollution, which could affect views of the night sky; however, light pollution can be reduced through down-shielding of light sources. Structures such as fencing and buildings up to 160 feet tall have the potential to be seen from nearby roads or residential areas depending on the site selection. Impacts on visual and scenic resources can be reduced through the use of soil berms and planting of vegetation buffers.

3.3.3 Geology and Soils

The following sections discuss the impacts on geology and soils from the construction and operation of a HALEU enrichment facility at three potential sites: the UUSA site in Eunice, New Mexico; the Centrus site in Piketon, Ohio; and the GLE site in Wilmington, North Carolina. The analysis of impacts relies on analyses from previous NEPA documents that assessed the impacts from construction and operation of licensed uranium enrichment facilities at these sites.

3.3.3.1 UUSA Site – Eunice, New Mexico

Construction and Operation

Impacts on geology and soils considered for the construction and operation of the UUSA uranium enrichment facility have already occurred as the facility has been constructed and is in operation (NRC, 2005a). These impacts include geology and soils impacts for the proposed facility expansion to 10 million SWUs as those facilities would be located in areas previously disturbed as part of the initial construction (NRC, 2015). General conclusions from these NEPA analyses were that impacts on geology and soils were SMALL. Potential soil contamination from spills and short-term erosion impacts from operations activities could occur but would be local and limited, and the facility would follow approved best management practices (BMPs) and spill prevention plans to mitigate these impacts, which can be found in Table 5-1 of the 2005 NEF EIS and Table 4-10 of the 2015 UUSA EA.

Construction of a HALEU enrichment facility would occur in previously disturbed proposed expansion areas or could be placed on undeveloped portions within UUSA site. According to the 2015 UUSA EA (NRC, 2015), there are no prime farmlands or sensitive geological resources within the site boundary. Given the size of the HALEU enrichment facility would be substantially smaller than the existing UUSA facility (1.1 million SWUs versus 3.7 million SWUs), it is anticipated that impacts on geology and soils would be similar those described in the previous NEPA documents and are thus considered SMALL. Siting a HALEU enrichment facility at UUSA would also be subject to NRC NEPA reviews related to licensing and/or license amendments.

3.3.3.2 Centrus Site – Piketon, Ohio

Construction and Operation

Impacts on geology and soil were evaluated for the construction and operation of the Lead Cascade Facility as a part of the 2006 ACP EIS (NRC, 2006b) and the 2004 *Environmental Assessment Finding of No Significant Impact (FONSI) for the Lead Cascade Facility in Piketon, Ohio* (DOE, 2004a) (referred to as the "2004 LCF EA"). A LEU production capacity at the ACP of 3.5 million SWUs potentially expandable to 7 million SWUs, were evaluated as a part of the 2006 ACP EIS. General conclusions from these NEPA analyses were that impacts on site geology and soil would be SMALL. Potential impacts identified in the prior NEPA analysis included the potential for soil contamination from spills and short-term erosion impacts from initial construction and ongoing activities as a part of operations. These impacts were considered local and limited, and mitigated by the facility by following approved BMPs and spill prevention plans that can be found in Table 5-2 of the 2006 ACP EIS (NRC, 2006b).

The impacts on geology and soil for the construction and operation of a small-scale (16 centrifuge) HALEU demonstration facility was also reviewed in the 2021 ACP Amendment EA (NRC, 2021c). All HALEU demonstration equipment was installed in existing buildings, and it was concluded that this action had no additional impacts on geology and soil. ACO has indicated that if a HALEU market develops, it would consider the modular addition of one or more 120 centrifuge HALEU cascades, which would be built within existing buildings (NRC, 2021c). Construction of additional HALEU enrichment or support equipment would occur in previously disturbed proposed expansion areas within the Centrus site. According to the 2006 ACP EIS (NRC, 2006b), there are no prime farmlands or sensitive geological resources within the project boundary. It is anticipated that impacts on geology and soils from construction of additional HALEU capacity would be similar in nature to those characterized in the previous NEPA documents and are thus considered SMALL. Installing additional HALEU enrichment capacity would also be subject to NRC NEPA reviews related to licensing and/or license amendments.

3.3.3.3 GLE Site – Wilmington, North Carolina

Construction and Operation

The impacts on geology and soil for the construction, operation, and decommissioning of the 6 million SWU GLE facility were evaluated in the GLE EIS (NRC, 2012b). Impacts on geology and soils were considered SMALL. Potential impacts include disturbance of approximately 226 acres, soil erosion due to ground disturbance, and potential spills during construction activities. Implementation of BMPs for erosion control and spill prevention would limit these impacts and are described in Section 4.2.5.3 of the GLE EIS.

Construction of a HALEU enrichment facility could occur on the land evaluated for development of the GLE facility evaluated in the GLE EIS (NRC, 2012b) or could occur on undeveloped portions within the GE property. According to the GLE EIS, there are no prime farmlands or sensitive geological resources within the site boundary. Given the size of the HALEU enrichment facility would be substantially smaller than the proposed GLE facility (1.1 million SWUs versus 6 million SWUs), it is anticipated that impacts on geology and soils would be similar to those described in the GLE EIS and are thus, SMALL. Siting a HALEU enrichment facility at the GE site would also be subject to NRC NEPA reviews related to licensing and/or license amendments.

3.3.3.4 New HALEU Enrichment Facility (Generic Site)

Construction and Operation

Site selection for a HALEU enrichment facility would be expected to include criteria to avoid prime farmlands, highly erodible soils, and sensitive geological resources. Potential impacts on geology and soils from construction and operation of a new HALEU enrichment facility would be similar and likely smaller in magnitude to the previously discussed sites due to the smaller capacity requirements of the HALEU facility. These impacts would include ground disturbance, soil erosion, and potential for soil contamination from spills, which can be mitigated if proper BMPs described in the previous NEPA documents are followed. Impacts on geology and soils from constructing and operating a HALEU enrichment facility at an existing industrial site would likely be similar to those described above for a HALEU enrichment facility located at a uranium fuel cycle facility and therefore would be SMALL.

3.3.4 Water Resources

This section presents a discussion of the water resources present at each of the three uranium enrichment facilities covered by existing NEPA documents, and the potential impacts on those resources under the Proposed Action. Water resources comprise floodplains, surface water bodies such as rivers, streams, lakes, ponds, estuaries, oceans, and manufactured reservoirs and groundwater aquifers such as unconfined water table aquifers, deeper confined aquifers, and perched saturated zones. Exchange between surface water bodies and groundwater systems is common.

3.3.4.1 UUSA Site – Eunice, New Mexico

There are no surface water bodies or surface drainage features located on the 543-acre parcel on which the existing UUSA facility operates. The site is contained within the Monument Draw watershed; however, no freshwater resources are located in the vicinity. Additionally, the site is not located within any floodplains (NRC, 2005a, pp. 3-33).

The UUSA site is located 1 to 2 miles south and west of the High Plains aquifer (formerly known as the Ogallala aquifer), which is the largest groundwater system in North America, and supplies water to a region that includes portions of eight states (Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming) (NRC, 2005a, pp. 3-38). Irrigation and domestic drinking are the two largest uses of groundwater withdrawn from the aquifer (OSE ISC, 2016). The 2005 NEF EIS discusses the High Plains aquifer (referred to as the Ogallala aquifer) in more detail in Section 3.8.2.1 and presents site-specific and regional hydrogeology in Section 3.8.1 (NRC, 2005a, pp. 3-35 to 3-39).

The water source for the existing UUSA site is the Eunice, New Mexico, municipal water-supply system (NRC, 2015, p. 50). Local municipalities, including the city of Eunice, obtain water from the highly productive groundwater sources in the High Plains aquifer near the city of Hobbs (NRC, 2005a, pp. 3-38). The Eunice municipal water-supply system has a capacity of 11,125 cubic meters (m^3) per day (2.94 million gallons [gal] per day) (NRC, 2015, p. 86). Usage data from 2010 indicated that in Eunice, New Mexico, an estimated 4,680 m^3(1.23 million gal) was withdrawn from the municipal water-supply system per day, which accounts for approximately 42% of total capacity (OSE ISC, 2013).

When the environmental analysis was conducted in support of the existing UUSA facility, it was stated that no previous activities occurring within the 543-acre parcel could have contributed to degradation of groundwater, as the area was historically used for cattle grazing (NRC, 2005a, pp. 3-41). Since that time, the UUSA enrichment plant and associated support facilities have been constructed and have been operational since approximately June 2010 (NRC, 2015). Water obtained from the New Mexico portion of the High Plains aquifer is still considered to be high quality.

Construction

Impacts on water resources were considered for the initial construction of the UUSA uranium enrichment facility and have already occurred as a result of that facility's construction and continued operation. That analysis concluded that impacts on water resources associated with facility construction and operation would be SMALL, due to a lack of surface water features on-site, the use of BMPs to trap and treat wastewater and stormwater, and the ability of the municipal water-supply system to provide the additional 7,570 m^3 (2 million gal) per year of water estimated to be required during the construction phase, as well as the average and peak usage estimates for facility operation, without taxing its overall capacity (NRC, 2005a, pp. 4-12, 4-15 to 4-16).

New construction at this site would be anticipated to require the use of water for a variety of reasons, including concrete formation, dust control, compaction of fill, and revegetation, and would therefore create short-term impacts on the municipal water-supply system, which relies on the High Plains aquifer, as described above. Water usage associated with new construction at this site would not be expected to exceed the 2 million gal per year analyzed for the initial construction of the UUSA uranium enrichment facility. Based on 2010 usage data discussed above, it is estimated that the Eunice municipal water-supply system has approximately 58% of its capacity remaining, which could accommodate increased withdrawals during the construction phase.

Ground disturbance associated with construction would result in temporarily increased stormwater runoff and wastewater discharges. Additionally, temporary increases in the use of equipment and construction vehicles would create the potential for spills of oil, gas, or grease. Design of the construction sequence would include measures to retain and treat runoff on-site, by utilizing BMPs such as detention/retention basins. A spill prevention plan would be implemented to minimize the potential for spills and detail a plan of action in the event that a spill should occur. If construction activities would disturb over 0.40 ha (1 acre), a National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permit from the U.S. Environmental Protection Agency (EPA) (Region 6) and an oversight review by the New Mexico Environment Department Water Quality Bureau would be required. Compliance with the NPDES permit would minimize impacts on water resources resulting from ground-disturbing activities.

Because there are no existing easily accessible water resources on-site and BMPs would be used to minimize the impacts of construction stormwater and wastewater within the site boundaries, impacts on water resources during construction would be expected to be SMALL. Likewise, short-term impacts on the municipal water-supply system would be expected to be SMALL.

Operation

Should a new HALEU enrichment facility be constructed at this location, a consistent supply of water will be required to satisfy operational needs including potable, sanitary, and process consumption uses. New potable water supply lines were installed during construction of the existing UUSA facility. Small modifications may be needed to connect a new facility to the existing supply lines, but it is not anticipated that new supply lines would need to be installed.

Impacts on water resources associated with the operation of a new HALEU enrichment facility would likely be similar to, or possibly less than, those of the existing UUSA facility. Current average and peak UUSA operational water requirements are approximately 168 m^3 (44,500 gal) per day and 4,149 m^3 (1.10 million gal) per day, respectively (NRC, 2015). If operational water needs of a new enrichment facility were the same, the hypothetical combined total of 88,762 gal per day (average use) and 2.19 million gal per day (peak use) would tax the remaining potable water capacity for the city of Eunice during peak operations, based on water usage data from 2010. However, because a new HALEU enrichment facility would likely use existing on-site features, such as parking, storage space, administration and security buildings constructed for the existing enrichment facility, and because the new HALEU enrichment facility would have a throughput of 1.1 million SWUs compared to the 3.7 million SWUs of the current UUSA enrichment facility, it can be assumed that additional water requirements for a new HALEU enrichment facility would be significantly less than current requirements for the site as a whole.

Water levels in the High Plains aquifer have been in decline, and future demand for water in the region is anticipated to exceed the recharge rate. The Lea County Regional Water Plan (RWP), which addresses conservation of regional water supplies for future use, was most recently updated in 2016. The RWP reported that groundwater levels in Lea County are declining at a rate of up to 4 feet per year, with wells in Lea County declining approximately 0.59 feet per year (OSE ISC, 2016). Compliance with the RWP would mitigate the strain that a new facility at this site may place on the groundwater supply and would assist with water conservation in the future decades in which this facility would be operational. As a result of these mitigations, impacts on the municipal water-supply system resulting from the addition of a HALEU enrichment facility at this location would be expected to be SMALL to MODERATE.

The operation of a proposed HALEU enrichment facility at this location would result in liquid effluent discharges. During the design phase, anticipated discharge rates would be calculated, and BMPs for capturing and treating effluent on-site would be included to prevent process waters from leaving the site. There is the potential for stormwater to discharge off-site intermittently. BMPs would be incorporated into the design of the facility to minimize this to the extent practicable. UUSA would continue to comply with the requirements of its NPDES General Permit and its groundwater discharge permit/plan, as required by New Mexico Water Quality Control Commission regulations (NRC, 2015, p. 94). Due to the lack of existing easily accessible water resources on-site and the use of BMPs to minimize discharges of effluent, impacts on water resources resulting from operation would be expected to be SMALL to MODERATE.

3.3.4.2 Centrus Site – Piketon, Ohio

The 1,497-ha (3,700-acre) DOE Portsmouth site analyzed previously as the proposed location for the ACP, and analyzed in the Technical Report as a potential location for HALEU enrichment activities, consists primarily of uplands, although there are a number of streams, ditches, holding ponds, and lagoons on the property, as presented in Section 3.7.1 of the 2006 ACP EIS (NRC, 2006b, pp. 3-26 to 3-29). A small portion of the 100-year floodplain for Little Beaver Creek extends into the northwestern portion of the site, and the 100-year floodplain for Big Beaver Creek is adjacent to the western boundary, although no portion of the floodplain enters the site. When the environmental analysis was conducted in support of the proposed construction and operation of the ACP, no part of the DOE reservation had been reported to be affected by flooding of the Scioto River (NRC, 2006b, pp. 3-33 to 3-34; ACO, 2020), which drains the site and is located approximately 3 km (2 miles) west (NRC, 2006b, pp. 3-26).

In 2021, ACO, Mid-America Conversion Services (MCS), and Fluor-BWXT Portsmouth (FBP) held Ohio EPA NPDES permits that authorized discharges to surface waters, in support of ongoing operations at the proposed ACP site, as well as operation of the DUF_6 Conversion Facility operated by MCS and the decommissioning of the former Portsmouth Gaseous Diffusion Plant, undertaken by FBP. In 2021, ACO was responsible for three outfalls, two of which discharge directly to surface water, and one that discharges to an FBP NPDES outfall prior to leaving the site. MCS was responsible for 2, and FBP was responsible for 18 outfalls or sampling points. The Ohio EPA selects the chemical parameters to be monitored at each permitted outfall based on the chemical characteristics of the waters entering that outfall. For many of these parameters, the NPDES permit identifies discharge limitations (FBP, 2022).

Aside from the outfalls just described, surface water quality is currently subject to potential contamination via nearby DU cylinder storage yards. Sample waters collected quarterly in 2021 from four locations downstream of the DU cylinder storage yards were analyzed for polychlorinated biphenyls and found to contain none (FBP, 2022).

In addition to the chemical parameters monitored in accordance with the requirements described above, water discharged through NPDES outfalls, with the exception of MCS NPDES outfalls, as well as runoff from the On-Site Waste Disposal Facility and the cylinder storage yards is regularly monitored for radionuclides. Collected water samples from FBP NPDES outfalls are analyzed for uranium, uranium isotopes, technetium-99, and transuranic radionuclides. In 2021, discharges of radionuclides at all monitored FBP outfalls were within ALARA goals (ALARA is defined as “as low as reasonably achievable”) and were compliant with DOE Order 458.1. Collected water samples from ACO NPDES outfalls are analyzed for transuranic radionuclides, technetium-99, and uranium. In 2021, uranium was detected at low levels, which is typical for these outfalls. Likewise, low levels of technetium and uranium were detected in water samples collected from locations downstream of the On-Site Waste Disposal Facility (FBP, 2022).

The Centrus site satisfies its current water needs through well fields located along the Scioto River, which draw groundwater from the Scioto River Valley buried aquifer. The maximum potential water production for the entire site is approximately 20 million gal per day. Water usage in 2020 was reported to be approximately 2.5 million gal per day (ACO, 2020).

The 2006 ACP EIS’s Section 3.7.3 presents the hydrogeology of the site (NRC, 2006b, pp. 3-35 to 3-36). For the purposes of monitoring and environmental restoration, the DOE reservation is divided into four quadrants that roughly correspond to groundwater flow patterns. There are 11 groundwater monitoring locations on-site, 3 of which are located in close proximity to the area anticipated to house the ACP facilities:

- X-749/X-120/Peter Kiewit Landfill Monitoring Area
- Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility
- Former X-616 Chromium Sludge Surface Impoundments Area

Groundwater contamination plumes from the presence of trichloroethene, xylene, vinyl chloride, cobalt, and radionuclides are associated with the X-749/X-120/Peter Kiewit Landfill Monitoring Area and the Quadrant I Groundwater Investigation Area/X-749A Classified Materials Disposal Facility. Remediation activities are being performed in these areas. At the former X-616 Chromium Sludge Surface Impoundment, remediation for chromium contaminant was previously completed, but chromium levels have since exceeded the preliminary remediation goal in one well. Likewise, nickel concentrations have exceeded the goal limits in two wells in this area. Low levels of volatile organic compounds have also been detected. Remediation activities are ongoing (ACO, 2020).

Construction

Impacts on water resources resulting from the construction and operation of the ACP (with a production capacity of 3.5 million SWUs potentially expandable to 7 million SWUs) were evaluated as a part of the

2006 ACP EIS (NRC, 2006b). That analysis concluded that impacts on water resources would generally be SMALL. Impacts on water resources resulting from construction of a HALEU enrichment facility at this location would not be expected to extend beyond those analyzed for the construction of the ACP and presented in Section 4.2.6.1 of the 2006 ACP EIS (NRC, 2006b).

Briefly, ground-disturbing activities associated with land clearing, excavation, and grading would result in temporary increases in soil erosion and sedimentation, which could increase turbidity and affect the quality of downstream waters. If ground disturbance greater than 2 ha (5 acres) is anticipated, an NPDES permit would be required from the Ohio EPA. Adherence to the conditions of this permit would limit impacts on nearby surface waters, which ultimately drain the site to the Scioto River. Additionally, BMPs described in the 2006 ACP EIS, such as holding ponds designed to detain surface runoff and allow sediments to filter out of the water column, would further minimize impacts on adjacent surface waters (NRC, 2006b, pp. 4-18).

Water resources may also be impacted by sanitary wastewater generated as a result of construction activities, as well as spills of oil, gas, or grease that may occur as a result of increased use of equipment and construction vehicles on-site. The potential for spills would be minimized with the use of secondary containment features around storage tanks or sheds, and a spill response plan would be in place to quickly contain any spills that may occur. Sanitary wastewater associated with construction would be treated prior to re-entering the environment, as described in the 2006 ACP EIS (NRC, 2006b, pp. 4-19).

Overall, impacts on water resources resulting from construction of a HALEU enrichment facility would be expected to be SMALL based on the implementation of BMPs and compliance with all required permits.

Operation

Impacts on water resources resulting from the operation of a HALEU enrichment facility at this location would not be expected to extend beyond those discussed in Section 4.2.6.2 of the 2006 ACP EIS. Liquid discharges associated with facility operations would likely include sanitary wastewater, stormwater runoff, and incidental leaks and spills (NRC, 2006b, pp. 4-20 to 4-21).

On-site sanitary wastewater is currently treated by the DOE contamination and decommissioning contractor at existing on-site facilities. Additional sanitary wastewater generated by the operation of a HALEU enrichment facility at this location would continue to be treated by existing DOE site-wide services (NRC, 2021c, p. 12). During the design phase, anticipated stormwater discharge rates would be calculated, which would inform decisions pertaining to the inclusion of BMPs designed to capture and treat stormwater on-site and prevent contamination of groundwater and nearby surface waters, although there is the potential for stormwater to discharge off-site intermittently. Stormwater currently flows to on-site holding ponds, and it is anticipated that additional stormwater discharges associated with the enrichment of HALEU at this location would do the same (NRC, 2021c). The 2006 ACP EIS's Section 4.2.6.2 presents measures proposed to minimize effluent discharges resulting from operation of the ACP, and it can be assumed that similar methods would be included in the design of the HALEU enrichment facility, should this location be chosen.

As stated above, the maximum potential water production for the entire site is approximately 20 million gal per day. The proposed ACP would require approximately 0.65 million gal per day (NRC, 2006b, pp. 4-24). Should a HALEU enrichment facility be constructed in this location, it is estimated that water usage for operation of the HALEU enrichment facility would not be greater than the projected water usage at the ACP. This estimated water usage is in part because the new HALEU enrichment facility would have a throughput of 1.1 million SWUs compared to the 7 million SWUs of the proposed ACP enrichment facility.

Therefore, if it is conservatively assumed that the ACP and a HALEU enrichment facility are operated on-site as fully separate facilities as originally proposed, the addition of 0.65 million gal per day per facility to the current estimated on-site water usage of 2.5 million gal per day would result in a new total on-site water usage estimate of 3.8 million gal per day. This on-site estimate represents a 20% increase from the water usage estimates analyzed in the 2006 ACP EIS. It also represents 19% of the available water production potential on-site, estimated at 20 million gal per day.

The above estimate is a conservative one that assumes construction and operation of facilities would occur without consideration for the other. It is likely that the previous design of the ACP would be adapted to accommodate HALEU enrichment, or that features such as administrative and security buildings would be shared, should there be a need for two separate enrichment facilities on-site. It is unlikely that the inclusion of a HALEU enrichment facility would result in a doubling of the water usage estimates provided in the 2006 ACP EIS. As a result, increase in water usage from the inclusion of a HALEU enrichment facility would be expected to result in a SMALL impact on availability of groundwater in the Scioto River aquifer. Likewise, due to the inclusion of BMPs to reduce the possibility of liquid effluent leaving the site untreated, impacts on water resources resulting from operation of a HALEU enrichment facility would also be expected to be SMALL.

3.3.4.3 GLE Site – Wilmington, North Carolina

The 656-ha (1,621-acre) Wilmington site is drained by several small streams, contains 3 ephemeral woodland ponds and several man-made features such as process lagoons and stormwater detention basins and has 1 effluent channel that receives treated process wastewater effluent and stormwater runoff from the developed portions of the site. The Wilmington site is located within the Northeast Cape Fear River subbasin of the Cape Fear River basin, with the nearest named surface water body being the Northeast Cape Fear River, which forms the southwestern border of the property. No 100- or 500-year floodplains extend into the Wilmington site (NRC, 2012b, pp. 3-34 to 3-36 and 3-39 to 3-40).

In the area of the Wilmington site, the Northeast Cape Fear River and its tributaries are designated as Class C swamp waters by the North Carolina Department of Environmental Quality Division of Water Resources, meaning they are protected for secondary recreation (boating, but not swimming), fishing, and wildlife. Surface waters on-site are presented in more detail in Section 3.7.1 of the GLE EIS (NRC, 2012b, pp. 3-36).

Section 3.7.1 of the GLE EIS (NRC, 2012b, pp. 3-36 to 3-37) summarizes radiological and nonradiological data from 1997 to 2006 from multiple freshwater sources monitored by the North Carolina Department of Environmental Quality Division of Water Resources, the North Carolina Radiation Protection Section, GE, and the Lower Cape Fear River Program, which is a collaboration of academia, government, industry, and the public. During this time period, values for copper, fecal coliform, and dissolved oxygen exceeded the limit at one or more monitoring locations.

The Wilmington site has one NPDES permit for sanitary and process wastewaters and another for stormwater. The stormwater permit requires a stormwater pollution prevention plan and semiannual sampling during a storm event at each of the three stormwater outfalls that drain the site (NRC, 2012b, pp. 3-38). The wastewater permit expired on February 28, 2009, but the site operates under a renewal draft permit, which allows for continued operation under the conditions of the previous permit. The wastewater permit addresses Outfall 001, which discharges process wastewater, and Outfall 002, which discharged treated sanitary wastewater until April 2008. Process wastewater from Outfall 001 is monitored prior to discharge for various parameters and has limitations on total suspended solids, total nitrogen, fluoride, cyanide, pH, various metals, oil and grease, and total toxic organics. The sanitary wastewater system was new at the time of the environmental analysis conducted in support of the GLE facility and does not release any effluent. Instead, a reverse osmosis water treatment facility treats sanitary wastewater prior to its reuse for industrial processes at the FMO facility and the Wilmington site cooling towers. Treated sanitary effluent has limitations for turbidity, nitrogen, biochemical oxygen demand, total suspended solids, and fecal coliform.

Site-specific and regional hydrogeology are discussed in Section 3.7.4 of the GLE EIS. Water for the site is sourced from the Peedee aquifer. Three production wells withdraw water from the Peedee aquifer for potable use, and several extraction wells and sumps are used to extract groundwater that is used as process water at existing on-site facilities (NRC, 2012b, pp. 3-39 to 3-41).

Previous incidents have resulted in impacts on groundwater at several distinct locations on-site, which are presented in Section 3.7.4.3 of the GLE EIS (NRC, 2012b). Monitoring data from 2002 to 2006, collected for the environmental analysis conducted in support of the proposed GLE facility, identified levels of chromium, fluoride, nitrate, nitrite, various organic compounds, and gross alpha radiation exceeded North Carolina standards. Levels of pH during this time period were also observed to be higher than the state standard (NRC, 2012b, pp. 3-41; GEH GLE, 2008, pp. Table 3.4-3).

Construction

Impacts on water resources resulting from the construction and operation of the proposed GLE facility (with a production capacity of 6 million SWUs) were evaluated in the GLE EIS (NRC, 2012b). That analysis concluded that impacts on water resources would generally be SMALL. Potential impacts identified in the GLE EIS are presented in Section 4.2.6 and Section 4.2.7 of the GLE EIS. In addition, other impacts include the potential for contamination of surface and groundwater resulting from chemical leaks or spills and an increase in liquid discharges associated with facility operations.

Construction of a new HALEU enrichment facility at this site would likely occur in areas previously designated for development and evaluated in the GLE EIS (NRC, 2012b). It is anticipated that a new HALEU enrichment facility, with a production capacity of 1.1 million SWUs, would be substantially smaller than the previously proposed GLE facility. Therefore, it is anticipated that impacts on water resources would be similar to, or less than, those previously analyzed.

During construction, ground-disturbing activities associated with land clearing, excavation, and grading would result in temporary increases in soil erosion and sedimentation, which increase turbidity and affect the quality of downstream waters. While design of the construction sequence would include measures to retain and treat runoff on-site, a temporary decrease in overall water quality is possible. Additionally, the temporary increase of construction vehicles on-site and the use of equipment creates the potential for leaks or spills of fuels, oil, or grease, which could impact downstream waters and contaminate groundwater. The use of BMPs for storing and handling such contaminants would greatly limit the potential for such impacts. Site-specific practices to manage effluent discharges are discussed in Section 4.2.6.1 of the GLE EIS (NRC, 2012b, pp. 4-42 to 4-43).

During the construction phase, potable and nonpotable water would be supplied from off-site sources via tanker trucks, which would minimize potential impacts on the groundwater supply in this area (NRC, 2012b, pp. 4-27).

Overall, impacts on water resources resulting from construction of a HALEU enrichment facility would be expected to be SMALL based on the implementation of BMPs and compliance with all required construction permits.

Operation

Likewise, impacts on water resources resulting from the operation of a HALEU enrichment facility at this location would not be expected to extend beyond those analyzed in the GLE EIS (NRC, 2012b). Liquid discharges associated with facility operations would likely include sanitary and process wastewater and stormwater runoff. During the design phase, anticipated wastewater discharge rates would be calculated, which would inform decisions pertaining to the inclusion of BMPs designed to retain effluent on-site and prevent contamination of groundwater and nearby surface waters. The previously proposed GLE facility was estimated to produce 35,000 gal of process wastewater per day, to be discharged at Outfall 001. This total included approximately 5,000 gal per day in liquid radwaste, which would be treated prior to discharge. Sanitary wastewater would be received by the existing wastewater treatment and industrial reuse system. It can be assumed that additional discharges occurring as a result of HALEU enrichment operations at this location would be incorporated into these existing systems. Additionally, the NPDES permit discussed above remains valid, should discharge to Outfall 002 become necessary in the future (NRC, 2012b, pp. 4-24).

Design of a HALEU enrichment facility at this location would also include BMPs to capture and treat stormwater to the extent practicable, although there is the potential for stormwater to discharge off-site intermittently. Watershed modeling conducted in support of the previously proposed GLE facility suggested that runoff would increase by 36% as a result of construction and operation of the new facility (NRC, 2012b, pp. 4-25). Construction of a HALEU enrichment facility would likely be incorporated into the evolving design of the proposed GLE facility, which has yet to be completed. Inclusion of a HALEU enrichment facility at this location would therefore be unlikely to result in runoff increases above what was previously predicted.

Stormwater resulting from HALEU enrichment activities at the Wilmington site would be managed by detention basins or similar measures, which would be designed in compliance with state water quality treatment regulations as well as any county-specific regulations. Additionally, stormwater resulting from facility operations would be regulated by an NPDES permit, which would include a stormwater pollution prevention plan (NRC, 2012b, pp. 4-25).

Additional withdrawals of groundwater for potable and process uses would be required to support facility operations, should enrichment activities occur at the Wilmington site. The estimated increase in potable and process water needs would not be expected to be greater than the 11,000 gal per day and 75,000 gal per day, respectively, analyzed in the GLE EIS. It is noted in the GLE EIS that these estimates are less than the Wilmington site's water usage in the 1990s, and no water supply issues were reported at that time (NRC, 2012b, pp. 4-27).

Mitigation measures to limit impacts on surface and groundwater impacts are presented in Sections 4.2.6.3 and 4.2.7.3 of the GLE EIS (NRC, 2012b). Overall, impacts on water resources at the Wilmington site under the Proposed Action are anticipated to be SMALL due to planned systems for runoff, treatment and monitoring, and compliance with required permits.

3.3.4.4 New HALEU Enrichment Facility (Generic Site)

Construction and Operation

Site selection for a HALEU enrichment facility would be expected to include criteria to avoid floodplains and areas with sensitive surface water and groundwater features. It would also be expected that the site selection process would prioritize regions with adequate water supplies capable of accommodating the construction and operational needs of a new facility. Impacts on water resources likely would be SMALL if the facility is sited on an existing industrial site, as these sites would be expected to have limited surface water features and existing systems for retaining and treating wastewater and stormwater discharges. Discharges resulting from the construction and operation of a new enrichment facility would comply with all relevant permits, including applicable NPDES requirements and discharge limits. Protocols would be in place to minimize the potential for an inadvertent release of contaminants, such as in the event of a leak or spill, and to mitigate impacts should such an event occur.

Impacts on water resources related to siting the facility on undeveloped lands could be greater and would depend on site-specific conditions. If floodplains or areas with sensitive water resources could not be fully avoided, consultation and permitting under the Federal Clean Water Act (CWA), as well as state and local water regulations, may be required.

3.3.5 Air Quality

The following section discusses potential air quality impacts that would occur from construction and operation of the HALEU enrichment facility at the three uranium enrichment facilities covered by existing NEPA documents described in Section 3.1.4, *Existing NEPA Documentation*. The analysis of impacts relies on analyses from previous NEPA documents that evaluated the siting of a uranium enrichment facility at each location.

Construction and operation of a HALEU enrichment facility would result in air emissions of criteria pollutants, hazardous air pollutants (HAPs), radiological compounds, and greenhouse gases (GHGs). The following evaluates projected emissions relative to air quality conditions within the project region and applicable air pollution standards and regulations. Section 3.3.11, *Public and Occupational Health – Normal Operations*, presents estimates of health effects due to radiological air emissions that would occur from the Proposed Action.

Under the Clean Air Act (CAA), EPA established National Ambient Air Quality Standards (NAAQS) for common air pollutants known as criteria pollutants. The NAAQS represent the maximum allowable atmospheric concentrations that may occur and still protect public health and welfare. The CAA established air quality planning processes and requires states to develop a State Implementation Plan that details how they will maintain the NAAQS or attain a standard in nonattainment within mandated time frames. Under the CAA, states are allowed to develop their own ambient air quality standards so long as they are at least as stringent as the NAAQS.

EPA designates all areas of the United States as having air quality better than (attainment) or worse than (nonattainment) the NAAQS. Former nonattainment areas that have attained the NAAQS are designated as maintenance areas.

In addition to criteria pollutants, EPA also regulates HAPs that are known or are suspected to cause serious health effects or adverse environmental effects. EPA sets Federal regulations to reduce HAP emissions from stationary sources in the National Emission Standards for Hazardous Air Pollutants (NESHAP) (EPA, 2023a).

Air quality impacts from construction of the HALEU enrichment facility would occur from (1) combustive emissions due to the use of fossil-fuel-powered equipment, trucks, and worker commuter vehicles and (2) fugitive dust emissions due to the operation of equipment on exposed soil.

Air quality impacts from operations of the HALEU enrichment facility would occur from (1) the transport by truck of natural uranium feed material, enriched UF_6 product, and DUF_6 material (except by rail from the Centrus site); (2) uranium compounds and hydrogen fluoride (HF) released from rooftop vents; (3) a natural gas-fired boiler for the facility heating system; (4) a diesel-powered electric generator for use in the event of power outages (otherwise, operated 1 hour per month for routine maintenance testing); and (5) worker commuter vehicles. The region of influence (ROI) for the air quality analysis includes the areas surrounding each potential enrichment facility location and generally within a few miles of a proposed emission source.

3.3.5.1 UUSA Site – Eunice New Mexico

Presently, EPA categorizes Lea County that surrounds the UUSA site as in attainment of all NAAQS (EPA, 2023b). The New Mexico Environment Department Air Quality Bureau regulates sources of air pollution in New Mexico. Additional descriptions of the air quality resource within the UUSA site ROI are presented in the 2005 NEF EIS Section 3.5 and 2015 UUSA EA Section 3.4 (NRC, 2005a; NRC, 2015).

Construction

The analysis of emissions associated with constructing additional enrichment capabilities at the UUSA site determined that all criteria air pollutant concentrations at the property boundary would be below the NAAQS and New Mexico state ambient air quality standards. Therefore, the potential air quality impacts from construction of this facility expansion would be SMALL (NRC, 2015, p. § 4.1.1.4). Since the effort needed to construct the HALEU enrichment facility would be substantially smaller than the construction activities evaluated in the 2015 UUSA EA, air quality impacts from construction of the HALEU enrichment facility would also be SMALL. Implementation of BMPs identified under Air Quality and Transportation in the 2015 UUSA EA Table 2-1 would minimize potential impacts on ambient air quality and GHG emissions.

Operation

The analysis of emissions from operation of the additional enrichment capabilities at the UUSA site determined that the ambient impact of uranium compounds and HF would be substantially lower than their respective regulatory levels. In addition, emissions from three diesel generators associated with these facilities would be minor, as they only would operate during emergency power needs. Otherwise, the diesel generators would operate for one hour per month and therefore would not be subject to Air Quality Bureau air permitting requirements. Therefore, the potential air quality impacts from operation of this facility expansion would be SMALL (NRC, 2015, p. § 4.1.2.4). Since the size of the HALEU enrichment facility and resulting SWU demand and material throughput would be substantially smaller than those evaluated in the 2015 UUSA EA, air quality impacts from operation of the HALEU enrichment facility also would be SMALL. The UUSA facility would implement a monitoring program to protect human health and the environment from radiological emissions (NRC, 2015, p. § 2.1.5.2).

3.3.5.2 Centrus Site – Piketon, Ohio

Presently, EPA categorizes Pike County that surrounds the Centrus site as in attainment of all NAAQS (EPA, 2023b). The Ohio EPA regulates sources of air pollution in Ohio. Additional descriptions of the air quality resource within the site ROI are presented in the 2006 ACP EIS Section 3.5.3 (NRC, 2006b).

Construction

The analysis of emissions associated with construction of the enrichment capabilities at the Centrus site determined that criteria air pollutant concentrations at the property boundary would be below the NAAQS except for annual levels of fine particulates (particulate matter less than or equal to 2.5 microns, or $PM_{2.5}$). With the implementation of mitigation measures for equipment to operate with newer nonroad emission standards (Tier 2) and to use ultra-lower sulfur diesel (see the 2006 ACP EIS Table 5-3), the resulting annual $PM_{2.5}$ concentrations would not exceed the NAAQS standard. Therefore, the potential air quality impacts from construction of this facility would be reduced to SMALL (NRC, 2006b, p. § 4.2.4.1). Since the effort needed to construct the HALEU enrichment facility would be much smaller than the construction activities evaluated in the 2006 ACP EIS, air quality impacts from construction of the HALEU enrichment facility also would be SMALL. Implementation of BMPs identified in 2006 ACP EIS Table 5-1 would minimize potential fugitive dust impacts.

Operation

The analysis of emissions from operation of the enrichment capabilities at the Centrus site determined that the ambient impact of uranium compounds and HF would be substantially lower than their respective regulatory levels. In addition, the ambient impact of emissions from 26 diesel generators associated with these facilities would be below the NAAQS at the property boundary (NRC, 2006b, pp. 4-12). Since the diesel generators would operate for less than 500 hours per year, they would not be subject to Ohio EPA air permitting requirements. Therefore, the potential air quality impacts from the operation of the facility would be SMALL (NRC, 2006b, p. § 4.2.4.2) Since the size of the project enrichment facility and resulting SWU demand and material throughput would be substantially smaller than those evaluated in the 2006 2006 ACP EIS, air quality impacts from operation of the project facility also would be SMALL. The Centrus facility would implement a radiological measurement and monitoring program to protect human health and the environment from the impact of radiological emissions (NRC, 2006b, p. § 6.1).

3.3.5.3 GLE Site – Wilmington, North Carolina

Presently, EPA categorizes New Hanover County that surrounds the GLE site as in attainment of all NAAQS (EPA, 2023b). The North Carolina Department of Environment and Natural Resources Division of Air Quality regulates sources of air pollution in North Carolina. Additional descriptions of the air quality resource within the site ROI are presented in the GLE EIS Section 3.5 (NRC, 2012b).

Construction

The analysis of emissions associated with construction of the uranium enrichment capabilities at the GLE site determined that criteria air pollutant concentrations at the property boundary would be below the NAAQS and state ambient air quality standards except for 24-hour levels of coarse particulates (particulate matter less than or equal to 10 microns, or PM_{10}) and fine particulates ($PM_{2.5}$). Therefore, the potential air quality impacts from construction of this facility would be MODERATE (NRC, 2012b, p. § 4.2.4.1). Since the effort needed to construct the enrichment facility would be much smaller than the construction activities evaluated in the GLE EIS, it is expected impacts from construction of the HALEU enrichment facility would not exceed any ambient standard and therefore would be SMALL. Implementation of mitigation measures in the GLE EIS (NRC, 2012b, p. § 4.2.4.3) would minimize impacts from construction emissions.

Operation

The following presents the analysis of the operation of the GLE facility, assuming the HALEU enrichment facility would use the same laser-based technology in its enrichment process. The proposed laser-based enrichment process would not require any continuous combustion activities and therefore would produce minimal criteria pollutant emissions. The process would generate minor amounts of uranium compounds and HF emissions. Some short-term UF_6 gaseous releases would occur inside the operations building during the connection/disconnection of UF_6 cylinders to process equipment and process equipment maintenance. All air pollutant releases would be collected within buildings, then routed through ventilation systems that include high-efficiency particulate air filters and high-efficiency gas absorption filters. The exhaust air stream from these emission controls would be vented to the atmosphere and would meet the discharge requirements in 10 Code of Federal Regulations (CFR) Part 20, Appendix B.

The GLE facility would include two 382-horsepower emergency diesel generators that would operate intermittently during periods of power outages and during routine maintenance testing. Based on air permit conditions for the existing emergency diesel generators at the GLE site, the permitted number of operating hours per year is 240. However, actual operating hours would vary depending on the number and duration of power disruptions. Two mechanical draft cooling towers would also emit minor accounts of particulate emissions. Section 4.2.4.2 of the GLE EIS (NRC, 2012b) concluded that potential air quality impacts of criteria pollutants and HAPs resulting from operation of the proposed GLE facility would be SMALL.

Since the size of the HALEU enrichment facility and resulting SWU demand and material throughput would be substantially smaller than those evaluated in the GLE EIS (NRC, 2012b), air quality impacts from operation of the HALEU enrichment facility also would be SMALL. Implementation of mitigation measures identified in GLE EIS Section 4.2.4.3 would minimize impacts from operations emissions.

3.3.5.4 New HALEU Enrichment Facility (Generic Site)

Construction and Operation

The air quality analyses for development of an enrichment facility at the three uranium enrichment facilities covered by existing NEPA documents determined that construction of a facility would result in SMALL air quality impacts, with potentially MODERATE impacts due to exceedances of the NAAQS for coarse (PM_{10}) and fine particulates ($PM_{2.5}$). Effective implementation of BMPs for fugitive dust control would reduce particulate impacts to SMALL. Operation of these facilities would result in SMALL air quality impacts, due to relatively low emissions and compliance with applicable regulatory requirements that would control emissions to acceptable levels. Since a HALEU enrichment facility would be much smaller than the three facilities evaluated above, it is expected that impacts from construction and operation of the HALEU enrichment facility at these locations would be SMALL.

Siting a HALEU enrichment facility at a greenfield site could require more construction effort to clear and grade the site and therefore could result in higher air quality impacts compared to siting the facility in a previously disturbed area. It is expected that the construction contractor would effectively implement fugitive dust controls, which would ensure that construction air quality impacts would be SMALL. Similar to the results of the above analyses for operation of uranium enrichment facilities, operation of the HALEU enrichment facility would result in SMALL air quality impacts. Siting a HALEU enrichment facility at any location would take into consideration current air quality conditions and would comply with the applicable regulatory requirements at that location.

3.3.6 Ecological Resources

The following section evaluates the potential impacts on ecological resources if implementation of the Proposed Action were to occur at the three uranium enrichment facilities covered by existing NEPA documents. Impacts on ecological resources could occur from removal or degradation of vegetation, wildlife habitats, wetlands, and Federal and state-listed species, and contamination by radioactive or hazardous materials via airborne or waterborne pathway.

3.3.6.1 UUSA Site – Eunice, New Mexico (Gaseous Centrifuge)

Detailed descriptions of terrestrial and aquatic ecology and threatened and endangered species at the UUSA site are presented in Sections 3.7.1 and 3.7.2 of the 2015 UUSA EA (NRC, 2015). As indicated in that EA, Federal and state rare, threatened, and endangered species are not known to occur at or near the UUSA site. While targeted species surveys have not been conducted since 2005, special status species would not be expected to occur due to the disturbance by construction and operation activity and the associated reduction of habitat. Much of the UUSA site was cleared and graded as part of the initial construction of the presently licensed facility.

Construction and Operation

Under the Proposed Action at the UUSA site, construction and operations activities would occur within the industrialized areas of the current facility (Figure 3-5 and Figure 3-6), and there would be no routine releases of hazardous materials. As such, the construction and operations activities would not disturb ecological resources (including sensitive habitats or special status species). Therefore, potential adverse impacts on ecological resources would not be anticipated under implementation of the Proposed Action at the UUSA site.

3.3.6.2 Centrus Site – Piketon, Ohio (Gaseous Centrifuge)

Detailed descriptions of ecological resources at the Piketon site are presented in Sections 3.8.1 through 3.8.5 of the 2006 ACP EIS (NRC, 2006b). As indicated in that EIS, wetlands, Federal and state rare, threatened, and endangered species are known to occur at or near the Piketon site. Results of the 2006 analysis determined that impacts on ecological resources from the action would be SMALL through implementation of several BMPs on-site.

Construction and Operation

For the Proposed Action, a new analysis—complete with interagency consultations—would be required to update the inventory of ecological resources on-site and provide a determination of effects.

Activities associated with construction and operations activities at the Piketon site would occur primarily within the industrialized areas of the current facility (Figure 3-8 and Figure 3-9). Except for the new cylinder storage area, new construction would occur entirely within previously developed and disturbed lands as part of the current licensed facility. The continuous disturbance from human activity, grounds maintenance, and disruptions from ongoing facility operations, have likely degraded the once native habitats that were present within the area prior to facility development. The areas proposed for new construction likely support very little habitat for wildlife—other than for those species adapted to human disturbance (such as transient small mammals, insects, and birds).

Based on a review of aerial imagery from 2021 of the site, the land proposed for the new cylinder storage area for the ACP is primarily forested. Construction of a cylinder storage area for the HALEU enrichment facility within this area would likely result in increased erosion, stormwater runoff, and loss of vegetation. A relatively high diversity of fauna (terrestrial and aquatic species) use the various terrestrial and aquatic habitats at the Piketon site. The Piketon site is within the home range of approximately 49 mammals, 114 bird species (year-round residents, winter residents, and migratory species), 11 reptile species, and 6 amphibian species (NRC, 2006b). Potential impacts on vegetation include decline or mortality of trees near the construction boundary, effects related to hydrologic changes, deposition of dust and other particulate matter, introduction of invasive plant species, and accidental releases of hazardous materials (e.g., fuel spills). Impacts on wildlife from construction within the forested areas on-site would include habitat disturbance, wildlife disturbance, and injury or mortality of wildlife. Habitats within the footprint disturbed by construction would be reduced or altered, and construction activities would result in habitat fragmentation.

Construction within the forested areas on-site would cause a loss of habitat, which could result in a long-term reduction in wildlife abundance and richness. Although habitats adjacent to the proposed facility site would mostly remain unaffected, wildlife might make less use of these areas due to disturbance (indirect habitat loss). Habitat disturbance could facilitate the spread and introduction of invasive plant species. Wildlife habitat could be adversely affected if invasive vegetation became established in the disturbed areas and adjacent off-site habitats. Construction activities could cause wildlife disturbance, including interference with behavioral activities. Wildlife could respond in various ways, including attraction, habituation, and avoidance. Principal sources of noise would include vehicle traffic and operation of machinery. Regular or periodic noise could cause adjacent areas to be less attractive to wildlife and result in a reduction in use. Construction activities could result in the direct injury or death of certain wildlife species. Wildlife could also be exposed to accidental fuel spills or releases of other hazardous materials.

To reduce or eliminate these impacts on wildlife, the cylinder storage area for a new HALEU facility should be placed in other previously developed areas of the site, if possible.

According to an unofficial U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) data request, there are a total of five federally listed species protected under the Endangered Species Act (ESA) (16 United States Code [U.S.C.] 1531 et seq.) with potential to occur in the area (USFWS, 2023). These species are presented in Table 3-2.

If the Piketon site were chosen, an official USFWS IPaC data request would need to be submitted for the project under Section 7 of the ESA to generate an *Official Species List,* and identify if federally designated critical habitats are present. Additional analysis would be required to determine the severity and nature of impacts on the federally protected species as part of the final design and description of the Proposed Action. Removal of forested habitats would impact vegetation, wildlife, and possibly special status species. Special status species are defined as those protected under the ESA, Migratory Bird Treaty Act (16 U.S.C. 703-712), Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d), and state-listed species. As such, targeted species surveys may be required and interagency coordination would be warranted, including but not limited to: Section 7 consultation with the USFWS's Ohio Ecological Services Field Office and coordination with the Ohio Department of Natural Resources for state-listed species protected under Ohio law (Ohio Revised Code 1531.25).

Table 3-2. Federally Listed Species With Potential to Occur Within the Piketon Site

Common Name	***Scientific Name***	***Status***
Mammals		
Indiana bat	*Myotis sodalis*	FE
Northern long-eared bat	*Myotis septentrionalis*	FE
Tricolored bat	*Perimyotis subflavus*	FPE
Clams		
Rayed bean	*Villosa fabalis*	FE
Insects		
Monarch butterfly	*Danaus plexippus*	FC

Source: (USFWS, 2023)
Key: FC = federally listed as candidate; FE = federally listed as endangered under the ESA;
FPE = federally proposed endangered (species proposed for official listing as endangered)

Migratory birds are protected under the Migratory Bird Treaty Act. Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act. Numerous migratory birds, including some birds of conservation concern and eagles, occur and/or have the potential to occur as transients within the forested areas of the Piketon site. The USFWS recommends conducting tree-clearing activities outside of the bird nesting season to avoid the need for active nest relocation or destruction, when appropriate. To avoid impacts on migratory birds, tree clearing within the land proposed for the new cylinder storage area would need to occur outside of the nesting season (late February through early August). Tree-clearing work during the nesting season would require a migratory bird nest survey 72 hours prior to the start of clearing activities. A permit would be required for the purposeful take of an active migratory bird nest. A permit is not required to destroy migratory bird inactive nests.

Furthermore, a large number of wetlands are present at the Piketon site. Wetlands and/or water features are subject to protection under Section 404 of the CWA (33 U.S.C. 1251 et seq.) (refer to Section 3.3.4, *Water Resources*, for an additional discussion of these resources). Most of the wetlands at the site are associated with wet fields, areas of previous disturbance, drainage ditches, or wet areas along roads and railway tracks. Wetlands could be impacted by alteration of surface water runoff patterns, soil compaction, or groundwater flow. Upon site selection, formal wetland delineation surveys would be required to determine presence or absence of jurisdictional wetlands. Impacts on federally protected wetlands could require consultation with the U.S. Army Corps of Engineers to obtain a permit. Additionally, subsequent NEPA analysis under these actions may also be required.

3.3.6.3 GLE Site – Wilmington, North Carolina

Detailed descriptions of ecological resources at the Wilmington site are presented in Sections 3.8.1 through 3.8.6 of the GLE EIS (NRC, 2012b). As indicated in that EIS, environmentally sensitive areas, wetlands, Federal and state rare, threatened, and endangered species are known to occur at or near the Wilmington site. Results of the 2012 analysis determined that impacts on ecological resources from the action would be SMALL to MODERATE. For the Proposed Action, a new analysis—complete with interagency consultations—would be required to update the inventory of ecological resources on-site and provide a determination of effects.

Construction and Operation

Activities associated with the Proposed Action at the Wilmington site are assumed to occur within previously undeveloped areas. Based on a review of aerial imagery from 2021 of the Wilmington site, the land proposed for the revised entrance road, new GLE facility, and GLE Study Area is primarily forested. Construction within this area would likely result in increased erosion, stormwater runoff, and loss of vegetation. Although the Wilmington site was subjected to varying degrees of environmental disturbances from silviculture, agriculture, industrial operations, residential developments, and roads, the habitats within the Wilmington site and surrounding areas support a relatively high diversity of wildlife species. Nearly 370 species of mammals, birds, reptiles, and amphibians potentially occur. Wildlife species that could occur within the Proposed Action area are primarily those that inhabit forested habitats although some aquatic biota may also be present. Aquatic habitat at the Wilmington site includes on-site streams, several impoundments, and ponds that provide habitat for aquatic invertebrates, waterfowl and shorebirds, and amphibians (NRC, 2012b, pp. 3-57).

For the primarily forested land associated with the proposed entrance road, new GLE facility, and GLE Study Area, potential impacts on vegetation include decline or mortality of trees near the construction boundary, effects related to hydrologic changes, deposition of dust and other particulate matter, introduction of invasive plant species, and accidental releases of hazardous materials (e.g., fuel spills). Impacts on wildlife from construction would include habitat disturbance, wildlife disturbance, and injury or mortality of wildlife. Habitats within the footprint disturbed by construction would be reduced or altered, and construction activities would result in habitat fragmentation.

Construction would cause a loss of habitat, which could result in a long-term reduction in wildlife abundance and richness. Although habitats adjacent to the proposed facility site would mostly remain unaffected, wildlife might make less use of these areas due to disturbance (indirect habitat loss). Habitat disturbance could facilitate the spread and introduction of invasive plant species. Wildlife habitat could be adversely affected if invasive vegetation became established in the disturbed areas and adjacent off-site habitats. Construction activities could cause wildlife disturbance, including interference with behavioral activities. Wildlife could respond in various ways, including attraction, habituation, and avoidance. Principal sources of noise would include vehicle traffic and operation of machinery. Regular or periodic noise could cause adjacent areas to be less attractive to wildlife and result in a reduction in use. Construction activities could result in the direct injury or death of certain wildlife species. Wildlife could also be exposed to accidental fuel spills or releases of other hazardous materials.

According to an unofficial USFWS IPaC data request, there are 17 federally listed species protected under the ESA with potential to occur in the area (USFWS, 2023). These species are presented in Table 3-3.

Table 3-3. Federally Listed Species With Potential to Occur at the Wilmington Site

Common Name	***Scientific Name***	***Status***
Mammals		
Tricolored bat	*Perimyotis subflavus*	FPE
Northern long-eared bat	*Myotis septentrionalis*	FE
West Indian manatee	*Trichechus manatus*	FT
Birds		
Eastern black rail	*Laterallus jamaicensis* ssp. *jamaicensis*	FT
Piping plover	*Charadrius melodus*	FT
Red knot	*Calidris canutus rufa*	FT
Red-cockaded woodpecker	*Picoides borealis*	FE
Reptiles		
American alligator	*Alligator mississippiensis*	SAT
Green sea turtle	*Chelonia mydas*	FT
Kemp's ridley sea turtle	*Lepidochelys kempii*	FE
Leatherback sea turtle	*Dermochelys coriacea*	FE
Loggerhead sea turtle	*Caretta caretta*	FT
Snails		
Magnificent ramshorn	*Planorbella magnifica*	FPE
Flowering Plants		
Cooley's meadowrue	*Thalictrum cooleyi*	FE
Golden sedge	*Carex lutea*	FE
Rough-leaved loosestrife	*Lysimachia asperulaefolia*	FE
Insects		
Monarch butterfly	*Danaus plexippus*	FC

Source: **(USFWS, 2023)**

Key: FC = federally listed as candidate; FE = federally listed as endangered under the ESA; FPE = federally proposed endangered (species proposed for official listing as endangered); FT = federally listed as threatened under the ESA; SAT = Similarity of Appearance (Threatened)

Note: SAT – A species that is threatened due to similarity of appearance with another listed species and is listed for its protection.

Additionally, nine migratory birds (including the bald eagle) were identified with potential to occur. Migratory birds are protected under the Migratory Bird Treaty Act. Bald eagles are protected under the Bald and Golden Eagle Protection Act. As previously described for the Piketon site, tree-clearing work during the nesting season within the forested areas of the Wilmington site would require a migratory bird nest survey 72 hours prior to the start of clearing activities. A permit would be required for the purposeful take of an active migratory bird nest. A permit is not required to destroy migratory bird inactive nests.

If the Wilmington site were chosen, an official USFWS IPaC data request would need to be submitted for the project under Section 7 of the ESA to generate an *Official Species List,* and identify if federally designated critical habitats are present. Additional analysis would be required to determine the severity and nature of impacts on the federally protected species as part of the final design and description of the Proposed Action. Removal of forested habitats would impact terrestrial and aquatic vegetation, wildlife, and possibly special status species (defined as those protected under the ESA, Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, and state-listed species). As such, targeted species surveys may be required and interagency coordination would be warranted, including but not limited to: Section 7 consultation with the USFWS's Raleigh Ecological Services Field Office and coordination with the North Carolina Wildlife Resources Commission for state-listed species protected under the North Carolina Endangered Species Act (G.S. Chapter 113, Article 25).

Additionally, a large number of wetlands are present at the Wilmington site. Wetlands and/or water features are subject to protection under Section 404 of the CWA (33 U.S.C. 1251 et seq.) (refer to Section 3.3.4, *Water Resources*, for an additional discussion of these resources). Wetlands could be impacted by alteration of surface water runoff patterns, soil compaction, or groundwater flow. Upon site selection, formal wetland delineation surveys would be required to determine presence or absence of jurisdictional wetlands. Impacts on federally protected wetlands could require consultation with the U.S. Army Corps of Engineers to obtain a permit. Additionally, subsequent NEPA analysis under these actions may also be required.

3.3.6.4 New HALEU Enrichment Facility (Generic Site)

Construction and Operation

Impacts on ecological resources are analyzed on a project-specific basis. The severity of impacts would be dependent on the current ecological conditions of the selected site, in comparison to the disturbance footprint associated with the facility designs. The NRC will perform the requisite NEPA analysis for impacts on special status species and wetlands, in accordance with the ESA, Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, CWA, and applicable state threatened and endangered species laws in its site selection process, and prior to construction of a new HALEU enrichment facility. The ESA Section 7 consultation, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act analysis includes formal and/or informal consultations with the USFWS, while wetland impacts shall be coordinated with the U.S. Army Corps of Engineers. Local state action agencies shall be contacted for adverse impacts on state threatened and endangered species.

A summary of this site-specific NEPA analysis process is provided below.

Site-Specific NEPA Analysis Considerations Summary

Once the final enrichment facility site has been selected, a subsequent analysis would be required to complete the following**:**

- Define and assess the affected area/area of impact for ecological resources under implementation of the Proposed Action.
- Identify and describe the ecological resources (including terrestrial and aquatic vegetation, wildlife, special status species, and wetlands) within the affected area/area of impact that would be affected or have potential to be affected (directly or indirectly) under implementation of the Proposed Action. Special status species reviews can be completed through the USFWS's IPaC and

state game and fish department databases. Wetlands, streams, lakes, ponds and other waters that may be impacted (regulated by state and Federal law) may be identified through the USFWS's National Wetlands Inventory dataset; however, formal wetland delineation surveys would be required to determine presence or absence of jurisdictional wetlands.

- Conduct targeted species surveys to identify the presence/absence of special status species within the affected area/area of impact and conduct interagency coordination with the USFWS and applicable state agency/agencies, if warranted.
- Assess the effects of the Proposed Action on significant ecological resources and include a determination of effects for special status species—in accordance with the ESA, Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, and applicable state threatened and endangered species laws.
- Identify any necessary mitigations required to avoid or minimize adverse effects to special status species or wetlands.

Impacts on ecological resources would be analyzed on a project-specific basis. The severity of impacts on ecological resources will be dependent on the current ecological conditions of the selected site, in comparison to the disturbance footprint associated with the facility designs. Site selection for a HALEU enrichment facility would be expected to include criteria to avoid areas with sensitive habitats or special status species. Impacts on ecological resources could be expected to be lower if construction of a new facility were to occur in an already developed or disturbed site versus an undeveloped or undisturbed site. Impacts from siting the facility on an industrial site would likely be SMALL, as construction and operation activity would not be expected to disturb special status species or reduce sensitive habitat. Siting the facility on undeveloped lands would likely have higher degree of impacts depending on site-specific conditions. Locating a HALEU enrichment facility within undeveloped lands could have SMALL to MODERATE impacts on ecological resources, depending on the resources disturbed and the effort to mitigate and minimize potential impacts. An inventory of threatened or endangered species would be developed during site-specific reviews to identify unique or special habitats, and ESA consultations conducted with the U.S. Fish and Wildlife Service would assist in reducing/avoiding adverse impacts.

3.3.7 Historic and Cultural Resources

As previously described, the NRC has analyzed the potential historic and cultural resources impacts of constructing and operating a uranium enrichment facility at the UUSA site in Eunice, New Mexico; at the Centrus site in Piketon, Ohio; and at the GLE site in Wilmington, North Carolina. The analysis of potential impacts of constructing and operating a HALEU enrichment facility at any of the three locations relies upon the previously prepared NEPA documents described in Section 3.1.4, *Existing NEPA Documentation*.

3.3.7.1 UUSA Site – Eunice, New Mexico

The NRC has analyzed the potential impacts of constructing and operating a uranium enrichment facility at the UUSA site in Eunice, New Mexico (NRC, 2005a; NRC, 2015). The NRC previously identified seven historic properties within the area of proposed facility construction, prehistoric archaeological sites (campsites) of indeterminate age (2005 NEF EIS Section 3.3). The NRC determined potential impacts on historical and cultural resources at the proposed NEF site were expected to be SMALL, with execution of a Memorandum of Agreement among several parties. These parties included the NRC, the New Mexico State Historic Preservation Officer (SHPO), the New Mexico State Land Office, Lea County, and LES (now UUSA) who stipulate all seven of the sites would be excavated and data recovery would be conducted before construction began to mitigate the adverse effects (NRC, 2005a, p. § 4.2.2). The Memorandum of Agreement stipulations were satisfied in 2007 when the New Mexico SHPO concurred with the findings of the data-recovery activities. In 2014, the NRC determined that no historic properties would be affected by the proposed facility expansion because no historic properties remain on the UUSA property, and the New Mexico SHPO concurred (NRC, 2015, p. § 1.5.4.2).

Construction and Operation

UUSA has indicated that only previously disturbed areas on the site of its existing facility would be used during construction and operation of an expanded uranium enrichment facility. As previously determined by the NRC (NRC, 2015), no historic properties would be affected by the proposed facility expansion because no historic properties remain on the UUSA property. Any changes to facility construction location (e.g., in an undeveloped area) or demolition of buildings or structures proposed to be conducted during implementation of the proposed action would be evaluated for historic and cultural resources impacts and subject to the National Historic Preservation Act (NHPA) Section 106 consultation process with the New Mexico SHPO, federally recognized Tribes, and other interested parties prior to implementation.

As described above, no historic properties remain on the UUSA property. Therefore, construction and operation of the HALEU enrichment facility at UUSA is expected to have SMALL impacts on historic and cultural resources.

3.3.7.2 Centrus Site – Piketon, Ohio

The NRC has analyzed the potential impacts of constructing and operating a uranium enrichment facility at the Centrus site in Piketon, Ohio (NRC, 2006b; NRC, 2021c). The NRC identified 15 historic properties within the area of proposed facility construction, which included the Gaseous Diffusion Plant enrichment facility. In addition, the NRC included three properties located around the perimeter in its consideration of potential effects. As previously determined by the NRC, there would be no adverse indirect or direct effect on these historic properties from the construction or operations of the proposed uranium enrichment facility. In addition, construction of new buildings and refurbishment of existing buildings would result in buildings of design, size, and function similar to the existing buildings, and therefore would not alter the historic setting of the existing Historic District.

Construction and Operation

Any additional disturbance of the site for construction and operation of the HALEU enrichment facility is not anticipated to have impacts on historic and cultural resources that exceed those associated with construction of the proposed ACP. Any changes to or demolition of buildings or structures proposed to be conducted during implementation of the Proposed Action would be evaluated for historic and cultural resources impacts and subject to the NHPA Section 106 consultation process prior to implementation. Therefore, construction and operation of the HALEU enrichment facility at the Centrus site is expected to have SMALL impacts on historic and cultural resources.

3.3.7.3 GLE Site – Wilmington, North Carolina

The NRC has previously analyzed the potential impacts of constructing and operating a uranium enrichment facility at the GLE site in Wilmington, North Carolina (NRC, 2012b). The NRC previously identified one historic property within the area of proposed facility construction, which would be avoided during preconstruction and construction activities (see GLE EIS Section 4.2.2.1). Although no construction activities were proposed in the portion of the Wilmington site where historic and cultural resources are known to exist, the Wilmington site is located within a region containing high concentrations of historic and cultural resources. Due to potential impacts on undiscovered historic and cultural resources, the NRC determined potential impacts at the proposed GLE site were expected to be SMALL to MODERATE, with license conditions that would require GLE to consider the potential effects on historic and cultural resources from any ground-disturbing activities in unsurveyed areas of the GLE facility site and development of Common Procedure CP-24-201 to address the unanticipated discovery of human remains or artifacts.

Construction and Operation

As previously determined by the NRC (2012b), there would be no adverse indirect or direct effect on known historic properties from the construction or operations of the uranium enrichment facilities that were proposed under the GLE EIS (see Section 2.1 of the GLE EIS). Any changes to or demolition of buildings or structures to be conducted during implementation of the Proposed Action would be evaluated for historic and cultural resources impacts and subject to the NHPA Section 106 consultation process prior to implementation. Therefore, construction and operation of the HALEU enrichment facility at the GLE site is expected to have SMALL to MODERATE impacts on historic and cultural resources.

3.3.7.4 New HALEU Enrichment Facility (Generic Site)

Construction and Operation

Site selection for a HALEU enrichment facility would be expected to include criteria to avoid areas with known cultural resources, and measures to identify resources and mitigate potential impacts through NHPA Section 106 and NEPA processes. Impacts from siting the facility at an existing uranium fuel cycle facility or industrial site would likely be SMALL, as construction and operation activity would likely occur in developed or previously disturbed areas. Siting the facility on undeveloped lands would have a higher potential for impact depending on site-specific conditions. Potential effects would be evaluated and subject to the NHPA Section 106 process. Potential effects would likely be mitigated and range from SMALL to MODERATE.

3.3.8 Infrastructure

The following section evaluates the potential impacts on infrastructure if implementation of the Proposed Action were to occur at one of the three uranium enrichment facilities covered by existing NEPA documents. For the purposes of the Technical Report, infrastructure refers to utilities, such as electricity and natural gas. Please note that water and wastewater are discussed in Section 3.3.4, *Water Resources*, waste management (including solid waste, hazardous waste, and radioactive waste) is discussed in Section 3.3.10, *Waste Management*, and transportation infrastructure is discussed in Section 3.3.13, *Traffic*.

Impacts on infrastructure could occur if an action disrupted utility operations during construction activities or caused an increase in demand for utility services during construction or operations. A significant adverse effect to infrastructure would occur if construction and/or operation of the proposed HALEU enrichment activities caused long-term disruption of utility operations, negatively affected the ability of local and regional utility suppliers to meet customer demands, or required substantial public utility system upgrades.

3.3.8.1 UUSA Site – Eunice, New Mexico

Electricity

The NRC has previously analyzed the potential impacts of constructing and operating a uranium enrichment facility at the UUSA site in Eunice, New Mexico (NRC, 2005a; NRC, 2015). Per the 2005 NEF EIS, the proposed NEF required the installation of electrical utility lines. Approximately 30 megawatts of electricity was to be provided by Xcel Energy, the local electrical service company. Infrastructure installed to support this need included two new synchronized 115-kilovolt (kV) overhead transmission lines on a large loop system; these lines tie into a trunk line located approximately 13 km (8 miles) west of the site.

Associated power-support structures were installed within an existing right-of-way along NM-234 in accordance with a highway easement modification approved by the state. Impacts on electricity were considered for the initial construction of the uranium enrichment facility (see 2005 NEF EIS) and have already occurred as the facility has been constructed and is in operation. Xcel Energy also installed two on-site transformers.

The NRC's authorization of a license amendment to increase enrichment capacity to 10 million SWUs, included the increased capacity of UUSA's substation. The substation is able to support the addition of 115-kV to 13-kV transformers to meet the energy needs of the facility expansion (NRC, 2015). The UUSA uranium enrichment facility is currently operating and producing LEU with an estimated capacity of 3.7 million SWUs, with the ability to expand to 10 million SWUs.

Construction and Operation

The 2005 NEF EIS (NRC, 2005a) discussed the existing electrical utility service and proposed demand of the UUSA facility and noted that impacts on energy resources, including electricity, would be SMALL. Construction of a HALEU enrichment facility would largely be accomplished with portable generators and in any event would not result in more electricity use than during operations.

Operation of a new co-located HALEU enrichment facility with an estimated capacity of 1.1 million SWUs at this location would be within the range of impacts analyzed for the expanded capacity. 'The proposed HALEU enrichment activity would have similar or reduced adverse effect in comparison to conditions assessed under prior UUSA NEPA documents (NRC, 2005a; NRC, 2015).

The proposed HALEU enrichment activity at the UUSA facility would represent an increase in enrichment activity of approximately 43% beyond the current production assessed in the 2005 NEF EIS (NRC, 2005a). Associated demand for electricity is expected to increase in proportion to production. It is anticipated that Xcel Energy has sufficient capacity to accommodate this increased demand and the proposed HALEU enrichment activities would result in a SMALL impact on the existing electricity infrastructure.

Natural Gas

Per the 2005 NEF EIS (NRC, 2005a), the Public Service Company of New Mexico (PNM) provides natural gas services to the Eunice area. PNM announced in October 2020 that PNM's parent company, PNM Resources, was being acquired by AVANGRID with the transaction expected to close between October and December 2021 (PNM, 2020). However, due to ongoing legal proceedings, the merger has not yet occurred (PR Newswire, 2023). In the meantime, PNM remains the natural gas utility provider to the UUSA site.

The annual natural gas consumption for the enrichment facility, as anticipated in the 2005 NEF EIS (NRC, 2005a, pp. 4-75), is approximately 3.1 million m^3 (110 million cubic feet) based on plant requirements of approximately 354 m^3 (12,500 cubic feet) per hour. This demand and the construction of a natural gas pipeline to connect UUSA to existing service lines were both assessed under prior NEPA. The UUSA uranium enrichment facility is currently operating and producing LEU with an estimated capacity of 3.7 million SWUs, with the ability to expand to 10 million SWUs.

Construction and Operation

The 2005 NEF EIS (NRC, 2005a) discussed the existing natural gas utility and proposed demand of the UUSA facility and noted that impacts on energy resources, including natural gas, would be SMALL. Construction of a HALEU enrichment facility would largely be accomplished with portable generators and would use little or no natural gas. In any event, construction would not result in more natural gas use than during operations.

Operation of the proposed HALEU enrichment facility would represent an increase in enrichment activity of approximately 43% beyond the current production assessed in the 2005 NEF EIS (NRC, 2005a). Associated natural gas demand is expected to increase in proportion to production. It is anticipated that PNM has sufficient capacity to accommodate this increased demand and the proposed enrichment activities would result in a SMALL impact on the existing natural gas infrastructure.

3.3.8.2 Centrus Site – Piketon, Ohio

Electricity

The NRC has previously analyzed the potential impacts of constructing and operating a uranium enrichment facility at the Portsmouth site in Piketon, Ohio (NRC, 2006b). Per the 2006 ACP EIS (NRC, 2006b, pp. 2-16), electrical power is supplied from the external 345-kV power grid to an on-site substation where it is stepped down in voltage to 13.8 kV, then supplied to the various centrifuge process and support buildings. The distribution voltages are further stepped down as necessary, depending on the facility requirements.

The gaseous diffusion process utilized in the past for uranium enrichment at the Portsmouth Gaseous Diffusion Plant, required large amounts of electricity. Dedicated utilities were installed to support the gaseous diffusion process. These existing utilities have more than sufficient capacity to serve the ACP, and the 2006 ACP EIS considered it unlikely for the proposed action to affect the cost or availability of local public utility supplies (NRC, 2006b, pp. 4-33).

Construction and Operation

Construction of a HALEU enrichment facility would largely be accomplished with portable generators and, in any event, would not result in more electricity use than during operations. Operation of the proposed HALEU enrichment facility would use approximately 16% of the electrical capacity previously analyzed and found to have a SMALL impact on public utilities in 2006. Therefore, a SMALL impact on electrical utilities would be anticipated.

Natural Gas

As stated in the 2006 ACP EIS (NRC, 2006b), there is a 5-centimeter (2-inch) diameter natural gas supply line to the Portsmouth Gaseous Diffusion Plant that was planned to be used by the ACP. This supply is adequate to serve the enrichment activities planned to occur at the ACP and is provided by a dedicated utility provider. Therefore, service to the ACP does not affect other local consumers. These existing dedicated utilities have more than sufficient capacity to serve the ACP, and the 2006 ACP EIS considered it unlikely for the proposed action to affect the cost or availability of local public utility supplies (NRC, 2006b, pp. 4-33).

Construction and Operation

Construction of a HALEU enrichment facility would largely be accomplished with portable generators and would use little or no natural gas. In any event, construction would not result in more natural gas use than during operations. Operation of the proposed HALEU enrichment facility would use approximately 16% of the natural gas capacity previously analyzed and found to have a SMALL impact on public utilities in 2006. Therefore, a SMALL impact on natural gas service would be anticipated.

3.3.8.3 GLE – Wilmington, North Carolina

Electricity

The NRC has previously analyzed the potential impacts of constructing and operating a GLE facility in Wilmington, North Carolina (NRC, 2012b). Per the GLE EIS (p. 8-5), electricity would be supplied through existing systems in the Wilmington area. The specific quantities of electricity required were not known in 2012 due to lack of facility design, and the GLE facility has not been constructed. However, it was not anticipated that the quantities required would put any strain on the availability of electricity for local consumers. If additional electrical infrastructure is needed, installation would take place in accordance with all applicable Federal, state, and local regulations and permitting requirements.

Construction and Operation

Although the 2012 GLE EIS did not state the level of impacts on utilities, it was determined that the GLE facility would not put any strain on the availability of any energy resources, including electricity. Construction of a HALEU enrichment facility would largely be accomplished with portable generators and, in any event, would not result in more electricity use than during operations. Operation of the proposed HALEU enrichment facility would use approximately 18% of the electrical capacity previously analyzed. Therefore, a SMALL impact on electrical service would be anticipated.

Natural Gas

Per the GLE EIS (NRC, 2012b, pp. 8-5), the natural gas would be supplied through existing systems in the Wilmington area. The specific quantities of natural gas used were not known in 2012 due to lack of facility design, and the GLE facility has not been constructed. However, it was not anticipated that the quantities required would put any strain on the availability of natural gas for local consumers. If additional infrastructure is needed to support local natural gas service, installation would take place in accordance with all applicable Federal, state, and local regulations and permitting requirements.

Construction and Operation

Although the 2012 GLE EIS did not state the level of impact on utilities, it was determined that the GLE facility would not put any strain on the availability of any energy resources, including natural gas. Construction of a HALEU enrichment facility would largely be accomplished with portable generators and would use little or no natural gas. In any event, construction would not result in more natural gas use than during operations. Operation of the proposed HALEU enrichment facility would use approximately 18% of the natural gas capacity previously analyzed. Therefore, a SMALL impact on natural gas service from HALEU enrichment activities would be anticipated.

3.3.8.4 New HALEU Enrichment Facility (Generic Site)

Construction and Operation

Site selection for a HALEU enrichment facility is expected to include criteria for adequate utility capacity and infrastructure. These criteria are expected to include the requirement for sufficient capacity to meet the anticipated initial and projected future utility needs of the HALEU enrichment facility without disrupting service to other customers during construction or operation. Impacts for siting the facility in industrial areas would be SMALL as these areas are expected to have existing utility infrastructure and capacity. Impacts could be greater for undeveloped sites, as additional utility infrastructure would likely be required. Installation of such infrastructure would result in a greater area of ground disturbance and may adversely affect utility service to existing customers. Allocating available utility capacity for the

HALEU enrichment facility could limit utility capacity available for future needs. With the use of siting criteria, these impacts would likely to range from SMALL to MODERATE.

3.3.9 Noise

Any pressure variation that the human ear can detect is considered "sound," and "noise" is defined as unwanted sound. Sound is described in terms of amplitude (perceived as loudness) and frequency (perceived as pitch). Sound pressure levels are typically measured with a logarithmic decibels (dB) scale. To account for human sensitivity to frequencies of sound (i.e., less sensitive to lower and higher frequencies, and most sensitive to sounds between 1,000 and 5,000 hertz), A-weighted sound levels (dBA) is widely used (Acoustical Society of America, 1985, pp. 19-20). This scale has a good correlation to a human's subjective reaction to sound. Most noise standards, guidelines, and ordinances use the A-weighted scale.

The day-night average sound level (L_{dn}) is the average over a 24-hour period, with the addition of 10 dB to sound levels from 10:00 p.m. to 7:00 a.m. to account for the greater sensitivity of most people to nighttime noise. The L_{dn} scale is widely used for community noise assessment and has been adopted by several government agencies (e.g., Federal Aviation Administration, Department of Housing and Urban Development, and the NRC). In general, a 3-dB change over an existing noise level is considered a barely discernible difference, and a 10-dB increase is subjectively perceived as a doubling in loudness and almost always causes an adverse community response (NWCC, 2002, p. 48).

Background noise is defined as the noise from all sources other than the source of interest. The background noise level can vary considerably, depending on the location, season, and time of day. Background noise levels in a busy urban setting can be as high as 80 dBA during the day. In isolated outdoor locations with no wind, vegetation, animals, or running water, background noise may be under 10 dBA. Typical noise levels in rural settings are about 40 dBA during the day and 30 dBA during the night, which correspond to an L_{dn} of 40 dBA; in wilderness areas, typical noise levels can be below 35 dBA (Harris, 1991, pp. 5.16-5.17).

At the Federal level, the Noise Control Act of 1972 and subsequent amendments (Quiet 4 Communities Act of 1978, 42 U.S.C. 4901–4918) delegate the authority to regulate noise to the states and direct government agencies to comply with local noise regulations. EPA guidelines recommend L_{dn} of 55 dBA as sufficient to protect the public from the effect of broadband environmental noise in typically quiet outdoor and residential areas and farms (EPA, 1974a, p. 4). For protection against hearing loss in the general population from non-impulsive noise, EPA recommends L_{eq} of 70 dBA or less over a 40-year period.

HALEU activities would have to follow applicable Federal, state, or local guidelines and regulations on noise.

Existing uranium enrichment facilities that could potentially be used for HALEU enrichment and existing NEPA documentation for those sites are discussed and summarized below.

3.3.9.1 UUSA Site – Eunice, New Mexico

Construction

Noise levels would be predominately due to traffic noise. Construction and decommissioning activities could be limited to normal daytime working hours. The nearest residence is 4.3 km (2.6 miles) from UUSA, and noise impacts at this distance from construction activities would be SMALL (NRC, 2005a, pp. 2-56).

Operation

As evaluated in the 2005 NEF EIS and 2015 UUSA EA, noise levels during operations would primarily be confined to inside buildings and would be within the U.S. Department of Housing and Urban Development guidelines, and therefore noise impacts would be SMALL (NRC, 2005a, pp. 3-67).

3.3.9.2 Centrus Site – Piketon, Ohio

Construction

Construction activities are expected to generate a 53 L_{dn} at the nearest residence, which is below applicable land use compatibility guidelines, and therefore noise impacts would be SMALL (NRC, 2006b, pp. 4-39). Noise levels during decommissioning are also anticipated to be small and similar to those generated during construction of the proposed ACP, and therefore noise impacts would be SMALL (NRC, 2006b, pp. 2-58).

Operation

No adverse noise impacts from routine ACP operations are expected at the closest residence due to low operational noise, the attenuation provided by the building facade, and distance attenuation of over 900 meters (3,000 feet). Catastrophic failure of a centrifuge could cause a sudden but brief loud noise, due to the high rotational speed of the centrifuge. However, the likelihood of a single centrifuge catastrophically failing is very low and therefore noise impacts would be SMALL (NRC, 2006b, pp. 2-58).

3.3.9.3 GLE Site – Wilmington, North Carolina

Construction

Under the proposed action, noise impacts associated with construction activities would be short term and limited to the immediate vicinity of the proposed GLE facility. During construction, vehicular traffic to and from the proposed GLE facility would generate intermittent noise along local roadways. However, the noise contribution from these sources would be limited to the immediate vicinity of the Wilmington site. Major activities would include building construction and equipment installation. Potential noise impacts on the nearest subdivision would be moderate but temporary in nature when road construction occurs, and therefore noise impacts would be SMALL to MODERATE (NRC, 2012b, pp. 2-31).

If decommissioning includes demolition, heavy construction equipment may be required. Salvaged materials and waste/debris would be hauled off-site by truck. Noise from truck traffic on access roads would be comparable to that experienced during construction. Noise levels at the fenceline from truck traffic on the north access road nearest the Wooden Shoe subdivision are expected to be below the New Hanover County Noise Ordinance, and therefore noise impacts would be SMALL (NRC, 2012b, pp. 2-31).

Operation

During GLE facility operations, exterior equipment, such as pumps, heat pumps, transformers, and cooling towers, would generate noise. Other sources of noise would include commuter vehicular and delivery truck traffic. Noise levels at the fenceline nearest to the Wooden Shoe residential subdivision would be below day and night ambient sound levels that correspond to the New Hanover County Noise Ordinance and therefore noise impacts would be SMALL (NRC, 2012b, pp. 2-31).

BMPs to reduce noise-related impacts include the following:

- Maintain equipment in good working order in accordance with manufacturer’s specifications.
- Limit noisy activities to the least noise-sensitive times of the day (daytime between 7 a.m. and 7 p.m.) and weekdays and limit idle time for vehicles and motorized equipment.

- Employ noise-reduction devices (e.g., mufflers) as appropriate.
- Provide a noise complaint process for surrounding communities.

3.3.9.4 New HALEU Enrichment Facility (Generic Site)

Construction and Operation

Site selection for a HALEU enrichment facility is expected to include criteria for land use compatibility, which would reduce the potential for noise impacts on sensitive receptors. Noise Impacts for a HALEU facility constructed in an industrial area would be SMALL, as these areas would likely have existing noise sources and compatible surrounding land uses. Noise impacts could be SMALL to MODERATE for construction on undeveloped sites, depending on adjacent land use and receptors. Operational noise would primarily be confined to the interior of buildings. Some exterior equipment/process and vehicular traffic would contribute to the noise environment. However, due to the anticipated noise generated and attenuation over distance, noise impacts from operations are expected to be SMALL.

3.3.10 Waste Management

The following section discusses potential impacts on waste management from uranium enrichment activities that would support the Proposed Action described in Section 3.1, *Description of the Activity*.

Construction and Operation

The construction, operation, and decommissioning of a gas centrifuge or laser enrichment facility results in the generation of potential waste materials during (1) construction, which generates typical construction wastes associated with an industrial facility; (2) operations, which generate gaseous, liquid, and solid waste streams; (3) decommissioning (including decontamination and demolition), and (4) generation and temporary storage of DUF_6, a material that is not a waste until it is determined to no longer be needed. The Proposed Action would result in the generation of approximately 1,500 MT of DUF_6, which represents 0.2% of the 810,000 MT of DUF_6 that was stored at the DOE Paducah and Portsmouth sites (DOE, 2020). Therefore, impacts on the management of the total DOE DUF_6 inventory would be SMALL.

Waste materials include radioactive, designated hazardous waste (as defined in 40 CFR 261), and nonhazardous waste (any other wastes not identified as radioactive or hazardous). Hazardous wastes include any contaminated fluids, equipment, and piping as defined in 40 CFR 261 generated during construction, operation, and decommissioning of an enrichment facility.

The handling and disposing of waste materials is governed by various Federal and state regulations. To satisfy the Federal and state regulations, facilities must have waste management programs for the collection, removal, and proper disposal of waste materials. The facilities' waste management programs are required to include mechanisms to minimize the generation of waste through reduction, reuse, or recycling. These programs are designed to assist in identifying process changes that can be made to reduce or eliminate mixed wastes, methods to minimize the volume of regulated wastes through better segregation of materials, and the substitution of nonhazardous materials as required under RCRA regulations. Based on the available environmental impacts' evaluation information for gas centrifuge and laser enrichment facilities (NRC, 2005a, pp. 4-55 to 4-65 and 4-82; NRC, 2006b, pp. 4-72 to 4-82; NRC, 2012b, pp. 4-91 to 4-101, 4-125, 4-144 to 4-146, and 4-151), the waste-management impacts are assessed for facility construction, operations, and decommissioning.

The same waste management processes and programs and treatment, storage, and disposal facilities are used throughout the facilities' lifecycle from construction through demolition. Nonhazardous waste generated are disposed of in appropriate licensed/permitted facilities. Low-level radioactive wastes (LLW) and mixed low-level radioactive wastes (MLLW) and hazardous wastes generated are processed, packaged, and transported consistent with Federal, state, license, permit, and other agreement requirements and are treated, stored, and/or disposed in an appropriate licensed low-level radioactive or permitted mixed low-level or hazardous waste disposal facility. Materials and equipment that are eligible for recycling or nonhazardous disposal are sampled or surveyed to ensure contaminant levels are below release limits. Buildings and other structures are decontaminated, and the debris shipped off-site for disposal. Decontamination radioactive or hazardous waste is packaged and shipped off-site to an appropriately licensed or permitted facility. Staging and laydown areas are segregated and managed to prevent contamination of the environment and creation of additional wastes. As a result, the potential impacts associated with the management of these waste streams would be SMALL.

Based on the capacities of the available nonhazardous, LLW, MLLW, and hazardous waste treatment, storage, and disposal facilities and the relatively small quantities (ranging from less than 10 to a few thousand cubic meters depending on the waste stream) generated throughout the facilities' lifecycles, the potential impact on waste treatment, storage, and disposal capacities (which are on the order of millions of cubic meters) would be SMALL.

The potential impacts associated with the management of wastes and on available waste management facilities' capacities are similar regardless of the enrichment facility location because the waste management requirements and available treatment, storage, and disposal facilities are the same. Therefore, overall waste management impacts during construction through and including demolition of a HALEU enrichment facility would be SMALL.

3.3.11 Public and Occupational Health – Normal Operations

This section presents a discussion of the public and occupational health impacts associated with construction and operation of enrichment facilities at three locations. These facilities are considered because they have existing NEPA coverage. If needed, site-specific NEPA evaluation would be performed by the NRC for a selected facility. While the potential location of the HALEU enrichment facility was not identified, the techniques (computer codes, modeling assumptions) and the operational parameters used to evaluate impacts for each of these three facilities are useful in estimating the impacts of the proposed HALEU facility.

3.3.11.1 UUSA Site – Eunice, New Mexico

This section discusses the existing environment and environmental impacts associated with the UUSA facility in Lea County, New Mexico. An EIS was prepared (NRC, 2005a) to support the original license application for uranium enrichment at 3 million SWUs per year. An amended license request and EA (NRC, 2015) increased the license to 10 million SWUs per year.

Existing Environment

Airborne releases of uranium and hazardous chemicals from the facility are through the gaseous effluent releases from the separation operations and cylinder receipt and dispatch operations. The gaseous effluent discharges come from the facility ventilation systems. The systems are designed to route gaseous streams from the facilities through filters for treatment before discharge to the atmosphere. The radioactivity levels within the facility stacks are continuously monitored and the filters in the facility vent systems are changed weekly. The total amount of uranium released to the environment through air effluent discharge is less than 10 grams per year, although the analysis presented in the 2015 UUSA EA conservatively assumes that 240 microcuries (µCi) of uranium (approximately 350 grams [0.77 pounds (lbs)]) per year are released from operations at 3 million SWUs per year through air effluent discharge (NRC, 2015, p. 67).

Radiological doses were estimated at the site boundary locations, at the nearest businesses for the adult member of the public, and at nearest residence locations for the member of the public. Calculated doses from airborne releases (NRC, 2015, p. 68) were:

- 1.7×10^{-2} millirem (mrem) per year at the site boundary with the maximum dose
- 2.3×10^{-3} mrem per year at the nearest business
- 1.7×10^{-3} mrem per year at the nearest residence

Some members of the public are also exposed to direct radiation, primarily from cylinders at the facility storage pad and from operations at the Cylinder Receipt and Dispatch Building. The doses to the previously identified receptors from direct radiation (NRC, 2015, p. 68) were calculated to be:

- 18.8 mrem per year at the site boundary with the maximum dose
- 6×10^{-3} mrem per year at the nearest business
- 8×10^{-10} mrem per year at the nearest residence

The total dose from airborne and direct radiation (NRC, 2015, p. 68) were calculated to be:

- 18.9 mrem per year at the site boundary with the maximum dose
- 8.3×10^{-3} mrem per year at the nearest business
- 1.7×10^{-3} mrem per year at the nearest residence

Doses from the existing liquid effluent releases at the site were calculated from samples collected quarterly at sanitary wastewater Lift Station 1. Assuming the concentrations of uranium measured at this point were the concentrations of water consumed by an individual (no dilution effects), the potential maximum total effective dose equivalent directly at the point of liquid effluent discharges was less than 1 mrem. This total effective dose equivalent was calculated using the maximum uranium isotope concentration measured and it was determined assuming the wastewater is the only source of water ingested by a reference man during a year. Groundwater is the main source of drinking water in the area, and the site features negate any significant potential that the drinking water pathway could be impacted by routine liquid effluent releases. Therefore, the actual dose at the receptor location would be much less than 1 mrem per year (NRC, 2015, p. 69).

UUSA workers received an average dose of 32 mrem in 2012. The collective worker exposure, but not necessarily the average dose, was expected to increase as additional capacity was being brought online. For workers that received an occupational dose, estimated individual occupational radiation doses for different classes of workers ranged from less than 5 mrem per year for the general office staff to 300 mrem per year for cylinder handlers. These doses are all well below the regulatory limit of 5 rem per year (10 CFR 20.1201(a)) and the site administrative limit of 1 rem per year (NRC, 2015, p. 70).

Exposure to uranium is known to result in kidney damage in humans mostly due to high acute exposures, whether inhaled or ingested. There is evidence that kidney damage due to high occupational exposures can eventually heal after the exposure ends. Non-malignant respiratory diseases (e.g., fibrosis, emphysema) have been observed in human and animal studies. Extremely high exposure may be lethal (may cause renal or respiratory failure). Uranium exposure to children is expected to have the same impacts as on adults, but there is no evidence that children are more susceptible than adults. Neurobehavioral changes have been observed in animal studies of high exposures and conflicting evidence suggests a potential decrease in fertility among the subject animal. However, human studies have not confirmed these same effects. (ATSDR, 2012)

The primary chemical hazards associated with operation of the UUSA facility are uranium and fluorine compounds, UF_6 and the products of its reaction to the humidity in the air once released. The various forms of fluorine (e.g., fluorine gas, HF, and hydrofluoric acid) are all potentially harmful either through exposure in the air or inhalation. (Ingestion is not a typical form of exposure.) Exposure to high concentrations of fluorine gas can make it hard to breathe, cause lung damage, and be fatal. At lower levels, it is still very irritating and very dangerous to the eyes, skin, nose, and lungs. HF is also a very irritating gas. While not as dangerous as fluorine, HF can have impacts similar to those of fluorine. Exposure to large amounts of it can cause death. At lower concentrations, effects include eye, nose, and skin irritation. Large amounts, when inhaled, can also harm the lungs and heart. Exposure to hydrofluoric acid is typically through skin contact and it can burn the eyes and skin; deep, painful wounds may develop over several days. When not treated properly, serious skin damage and tissue loss can occur. A large amount of hydrofluoric acid on the skin can affect the heart and lungs or can lead to death (ATSDR, 2003).

The most significant potential source of uranium and fluorine releases are during brief opening of lines or connections. These releases occur primarily during connection/disconnection of cylinders during feed and withdrawal operations. Exposure to uranium and fluorine compounds would be primarily through inhalation. Current estimated total site annual emissions are no more than 0.022 lbs of uranium and no more than 2.2 lbs of HF. Fluorine releases of this magnitude result in an average air concentration of 3.9 micrograms per cubic meter ($\mu g/m^3$) at the rooftop stack, and significantly lower concentrations off-site. This is below the most stringent standard for public exposure to fluorides, California's 14 $\mu g/m^3$ (NRC, 2015, pp. 71-73).

Engineering controls and personal protective equipment are employed to limit worker chemical exposures during operations. The measures are a part of the site's Environment, Health and Safety Program. These measures are expected to maintain worker exposures to uranium below the occupational limit for chemical toxicity of 10 milligrams per week (10 CFR 20.1201(e)) and HF exposures below the Occupational Safety and Health Administration's (OSHA's) 8-hour permissible exposure limit (PEL) of 3 parts per million (2.5 milligrams per cubic meter [mg/m^3]) (29 CFR 1910.1000) and below New Mexico's occupational exposure limit for fluoride of 2.5 mg/m^3 (20.2.72.502 NMAC) (NRC, 2015, pp. 71-72).

Occupational injuries were assessed based on a comparable enrichment facility operated by Urenco Capenhurst Limited. With an injury rate of between 0 and 0.65 injuries per 100,000 work hours (or roughly 0 to 0.65 accident injuries per 50 full-time employees), this facility experienced between 0 and 4 major injuries per year between 2003 and 2007. The injury rate of 0.65 injuries per 50 full-time employees is similar to that for other fuel enrichment facilities (e.g., see discussion of the GLE facility below) (NRC, 2015, p. 64).

Construction

The environmental documentation addresses two phases of construction; the initial construction of the UUSA facility and a capacity expansion from 3 million SWUs to 10 million SWUs. The impact assessment in the original analysis of 3 million SWUs operation (NRC, 2005a) addressed construction of a new facility in Lea County, New Mexico, all structures were new and there was no existing source of radioactive material that would have impacted site workers. The construction of the facility was to be performed in stages, as part of the facility would come online while construction activities continued. At that point, workers would be susceptible to radiation exposure from facility operations. The analysis of construction for the augmented capacity (NRC, 2015, p. 70) started with a facility operating at a capacity of 3 million SWUs. Therefore, the entire construction effort was ongoing while the facility was operating, and workers could potentially be exposed to radiation during the entire construction period.

No construction impacts on the public were identified in either of the NEPA documents.

Construction worker impacts result from normal workplace-related events resulting in injury or fatality. The impact analysis in the 2005 NEF EIS addressing the original construction at the site used U.S. Department of Labor, Bureau of Labor Statistics' information on workplace accidents to assess the nonradiological risk to workers. Based on the total number of full-time construction workers, estimates for workplace injury of 24 worker injuries per year (total of 200 for the full duration of construction) and possibly 2 fatalities during the initial 8-year construction period were estimated (NRC, 2005a, pp. 4-45, 4-46). No such analysis was performed in the 2015 UUSA EA for the capacity upgrade.

Construction worker dose estimates considered worker doses from exposure to direct radiation from the cylinder storage yard and cascade hall areas. Because operations during the expansion of the facility capacity occur with a larger amount of enrichment operations, estimated worker doses were higher than for the initial construction effort. Without proper dose management procedures some workers could receive doses greater than 500 mrem per year. However, facility management committed to limiting doses to individual workers to less than 500 mrem per year (NRC, 2015, p. 112). Estimates of construction worker doses during the initial construction of the facility are significantly smaller, due to smaller enrichment efforts and fewer stored cylinders. Estimates were 5 mrem per year or less for workers working near completed operational cascades (NRC, 2005a, pp. 4-46).

Operation

Occupational injuries and exposures estimated in the analysis of the initial operation of the enrichment facility were based on occupational injury information for the state of New Mexico based on similar manufacturing industries and for another Urenco facility. Projected injuries and fatality risk for a workforce of 210 were 8 non-fatal injuries and a fatality risk of 4×10^{-4}. At the comparable Urenco facility for the years 1999 to 2003, there were an average of five reported injuries and no fatalities (NRC, 2005a, pp. 4-47). The 2015 UUSA EA for expanded operations (NRC, 2015, p. 103) compared the UUSA facility to other operating fuel cycle facilities, stating that the occupational injury rates would be similar. Yearly reportable lost-time accidents (OSHA lost workday case) for 2003–2007 for the similar enrichment facility operated by Urenco Capenhurst Limited in Great Britain averaged 0.55 per 100 full-time workers. The assessment also provided the annual injury and illness incidence rates by industry compiled by the U.S. Department of Labor, Bureau of Labor Statistics. Using the chemical manufacturing industry numbers, the injury rate for 2011 was 1.4 per 100 full-time equivalents (FTEs) per year, which is greater than the average of 0.55 per 100 FTEs reported for the Capenhurst enrichment facility.

Workers at the facility would be subject to exposure to chemical hazards, including UF_6, HF, and compounds of uranium. Few exposure events have been reported at the UUSA facility. Uranium compounds and HF are actively trapped by the ventilation systems (NRC, 2015, p. 104). HF concentrations at the point of discharge are expected to have concentrations of 3.9 $\mu g/m^3$ significantly below the OSHA and National Institute for Occupational Safety and Health limits for an 8-hour work shift of 2.5 mg/m^3 (NRC, 2005a, pp. 4-46).

The 2005 NEF EIS provided estimates for various classes of workers; general office staff, operations and maintenance technician, and cylinder handler. Considering exposure rates for multiple locations on the facility site, on average the cylinder handler was expected to receive the highest annual dose of 300 mrem. In contrast office staff were expected to receive less than 5 mrem per year (NRC, 2005a, pp. 4-50).

The more recent analysis of occupational exposure used average exposures from U.S. fuel cycle facilities to estimate worker doses. From 2008 to 2012, average worker doses ranged from 90 to 120 mrem per year. With the implementation of a comprehensive exposure control program and adherence to ALARA principles. The expected worker doses are well below the 5 rem per year requirement of 10 CFR 21.1201 and below the administrative limit of 1 rem per year for the site. (NRC, 2015, pp. pp 109, 110)

The public is not expected to be impacted by chemical emissions from the enrichment facility. Facility emissions would be through the various facility ventilation systems, all of which are monitored and contain filtration systems (for 10 million SWUs per year operations). Estimated releases consist of no more than 2.2 lbs of HF and 0.027 lbs of uranium per year. At these rates concentration of HF and uranium (average 8-hour concentrations of 9.3×10^{-3} µg/m^3 and 9.9×10^{-5} µg/m^3) are orders of magnitude lower than the most stringent reference level (California's 13 µg/m^3) while the uranium concentration is five orders of magnitude lower than OSHA occupational limits for an 8-hour exposure. HF and uranium levels to which the public would be exposed are well below any that would induce health effects (NRC, 2015, pp. 104-105).

Public radiation doses were estimated for airborne releases, liquid effluents, and direct radiation. A summary of public doses is presented in Table 3-4. Public exposure from airborne release result from the release through facility stacks. These releases are through filtration systems and monitored continuously. Both estimates are derived by scaling up the emissions from a 1.5 million SWU facility to 3 million SWUs and 10 million SWUs. The estimates are deemed conservative by Urenco. Estimated releases are 240 µCi and 800 µCi per year of uranium isotopes (uranium-234 [U-234], U-235, uranium-236, and U-238). Direct exposures to the public are from the cylinder yard storage areas and cylinder receipt and discharge operations. The reduction in dose between the original estimates and the estimates for the expanded operation are the result of refinements to the assumptions used in the dose assessment. There were no projected public doses from liquid effluents. The only source of wastewater from the facility is expected to be the sanitary wastewater, which is not expected to contain any radioactive material (NRC, 2005a, pp. 4-48 to 4-49; NRC, 2015, pp. 106-108).

Table 3-4. UUSA Public Dose Estimates

Public Dose Receptor	*3 MT SWU Facility* [(a)]	*10 MT SWU Facility* [(b)]
Airborne Releases		
Highest site boundary (mrem/yr)	0.0053	0.0177
Nearest resident(mrem/yr)	0.0013	0.0043
Highest nearby worker (mrem/yr)	0.0026	0.0087
Population (person-rem/yr)	0.014	0.047
Direct Radiation		
Highest site boundary (mrem/yr)	18.9	9.4
Highest nearby worker (mrem/yr)	2.6	9.3

Key: mrem/yr = millirem per year; MT = metric ton; SWU = separative work unit; UUSA = Urenco USA

Notes:

[a] From *Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico* (NRC, 2005a, pp. 4-49)

[b] From *Environmental Assessment for the Proposed Louisiana Energy Services, Urenco USA Uranium Enrichment Facility Capacity Expansion in Lea County, New Mexico*. Docket No. 70-3103 (NRC, 2015, pp. 107-108)

Public exposures from the airborne emissions would all be below the exposure limits of 10 CFR 20.1301 (a)(1) of 100 mrem per year and EPA's NESHAP airborne dose criteria of 10 mrem per year. All doses to members of the public are also expected to be significantly below the EPA limit of 25 mrem per year in 40 CFR 190 for dose to members of the public from uranium fuel cycle facilities.

3.3.11.2 Centrus Site – Piketon, Ohio

The ACP would be located on the site of the former DOE and USEC (now Centrus) gaseous diffusion enrichment plant. Gaseous diffusion operations ceased in 2001. Current activity includes the operation of a DUF_6 conversion facility.

Radionuclides and chemicals that are naturally occurring and human made from historical and current operations at the site can be found in several different media in and around the DOE reservation. These media include soil, surface water, sediment, groundwater, and air. The 2006 ACP EIS addressed the impact of this contamination as well as the impact of ongoing emissions from the site.

The proposed ACP facility was analyzed for a 7 million SWU/yr enrichment capability.

Air releases of radionuclides from current operations at the Portsmouth site result in low levels of radiation exposure to people in the vicinity of the site. Ambient air monitoring data were used to calculate a dose to a hypothetical person living at the monitoring station. The highest net dose calculation is 0.0019 mrem per year, which is well below the EPA's NESHAP limit of 10 mrem per year, and the NRC dose limit of 100 mrem per year. Based on data for releases to the air for the year 2002, the estimated radiation dose to the maximally exposed individual (MEI) (a hypothetical individual assumed to residing at the most exposed point on the plant boundary) from all site operations was 0.031 mrem per year. These estimated maximum exposed individual doses are well below EPA and NRC limits. (NRC, 2006b, pp. 3-64 to 3-65)

A more complete estimate of the maximum individual dose was provided in the DU conversion EIS. Considering dose impacts from other than airborne releases, that EIS estimated a 2 mrem per year dose. This dose, while still lower than EPA and NRC standards, includes several other exposure pathways, including from liquid effluents and direct gamma radiation (NRC, 2006b, pp. 3-64 to 3-65).

The on-reservation worker average whole-body dose is less than 10 mrem per year. However, in the DU conversion facility EIS, cylinder yard worker exposure is estimated to be 64 mrem per year). Both estimates are significantly less than the NRC and DOE worker dose standards of 5 rem per year (10 CFR 20) (NRC, 2006b, pp. 3-64 to 3-65).

OSHA has PELs for chemicals emitted into the air. Two of the chemicals of interest at this site are HF and uranium. Toxicological health effects from uranium and fluorine exposure are discussed previously in Section 3.3.11.1, *UUSA Site – Eunice, New Mexico*. Concentrations of both are below OSHA limits (NRC, 2006b, pp. 3-65 to 3-66).

For other nonradiological pollutants, EPA has established levels at which the hazard from these pollutants are deemed to be insignificant. A hazard quotient based on concentrations of these pollutants compared to these quantities of less than one indicates the pollutant is present in quantities not of significant risk. In an assessment of several media; air, soil, surface water, sediment, and groundwater; the hazard quotients were less than one (NRC, 2006b, pp. 3-65 to 3-66).

There have been no industrial fatalities at this site. Injuries from industrial accidents at the facilities (between two and three for 2002 and 2003) are lower than the U.S. Department of Labor, Bureau of Labor Statistics national average for similar facilities (3.4 in 2002) (NRC, 2006b, pp. 3-69).

Construction

Construction worker impacts result from normal workplace-related events resulting in injury or fatality. The impact analysis in the 2006 ACP EIS addressing construction of the ACP at the site used U.S. Department of Labor, Bureau of Labor Statistics' information on workplace accidents to assess the nonradiological risk to workers. Based on the total number of full-time construction workers, workplace injury estimates of 14 worker injuries per year (total of 218 for the full duration of construction) and no fatalities (0.59) during the construction period were developed (NRC, 2006b, pp. 4-58).

No other radiological or nonradiological impacts on workers were identified. Though occupational exposure to fugitive dust containing particulates and emissions from construction equipment are expected, concentrations are small enough to result in a SMALL impact. Off-site exposure through water and air pathways is possible, releases to waterways would be SMALL and the off-site concentrations of air pollutants would be less than on-site (NRC, 2006b, pp. 4-59).

Radiological impacts would be limited to doses to construction workers. The primary modes of exposure for construction personnel would be (1) inhalation of radiological dust; (2) external exposure to radionuclides deposited in the soil; (3) external exposure to radionuclides contained in soil suspended in the air; and (4) direct radiation exposure from existing sources nearby on the site such as the cylinder storage yards. The major contributor to construction worker maximum annual dose was identified as direct radiation; this source contributed 88 mrem per year to the total individual worker dose of 89 mrem per year. The total maximum possible dose to construction workers from all four pathways is less than 100 mrem per year limit in 10 CFR 20.1301(a)(1) (NRC, 2006b, pp. 4-59, 4-60).

Operation

Facility worker impacts result from normal workplace-related events resulting in injury or fatality. The impact analysis in the 2006 ACP EIS addressing the ACP facility used U.S. Department of Labor, Bureau of Labor Statistics' information on workplace accidents to assess the nonradiological risk to workers. Based on the total number of full-time facility workers, workplace injury estimates of 17 worker injuries per year (total of 454 for the full duration of construction) and no fatalities (0.41) during the operational period were developed (NRC, 2006b, pp. 4-61).

The impacts on the public from nonradiological exposures were identified as being much less than that to workers, primarily due to controls on emissions and the dispersion of pollutants. Worker exposure to hazardous chemicals, uranium and HF, would be expected during ACP operation. Uranium exposures should be from puff exposures (occurring during connection and disconnection of cylinders during feed and withdrawal operations). The estimated concentrations of uranium in the air are expected to be as high as 0.7 mg/m^3. This estimated concentration is over an order of magnitude less than the applicable OSHA Immediately Dangerous to Life or Health level of 10 mg/m^3 over a 1-hour period. Similarly, airborne HF and uranyl fluoride concentrations would be attributable to feed and withdrawal operations. Concentrations of HF near the release point could be briefly higher than the OSHA Immediately Dangerous to Life or Health level of 2.5 mg/m^3 over an 8-hour period, but are still expected to be an order of magnitude lower over the full 8-hour period (NRC, 2006b, pp. 4-61).

Historically, worker doses from operations at the Portsmouth Gaseous Diffusion Plant have been well below administrative and regulatory limits (an annual administrative limit of 1 rem and the 10 CFR 20.1201 limit of 5 rem). The highest dose to site workers at the gaseous diffusion plant in 2003 was to cylinder workers and was 29 mrem (NRC, 2006b, pp. 4-70).

Impacts on the public from radiological exposures were evaluated for airborne releases, direct radiation, and liquid releases. While evaluated, impacts from liquid releases were expected to be negligible. Releases of liquids containing radioactive material is not expected. Direct radiation impacts were estimated for an individual located near the site boundary. Should that person live at the site boundary, the annual dose from direct radiation would be 87 mrem (NRC, 2006b, pp. pg 4-69). Airborne releases of uranium from the facility are primarily through the gaseous effluent releases from the separation operations and cylinder receipt and dispatch operations. The gaseous effluent discharges would come from the facility ventilation systems. These systems are designed to route gaseous streams from the facilities through filters for treatment before discharge to the atmosphere. The radioactivity levels within the facility stacks would be continuously monitored and the filters in the facility vent systems changed weekly.

Radiological doses were estimated at the site boundary locations, at the nearest businesses for the adult member of the public, and at nearest residence locations for the member of the public. Calculated doses from airborne releases (NRC, 2006b, pp. 4-63 to 4-70) were as follows:

- 0.21 mrem per year at the site boundary with the maximum dose
- 0.16 mrem per year at the nearest business
- 0.3 mrem per year for an on-site person

All individual doses from airborne exposures would be less than the 10 mrem per year airborne dose limits in 40 CFR 61, Subpart H, the EPA's NESHAP. The total annual dose from all exposure pathways would be less than the limit of 100 mrem per year) in 10 CFR 20.1301. All exposures are also expected to be significantly below the EPA limit of 25 mrem per year, as set in 40 CFR 190 for uranium fuel cycle facilities (NRC, 2006b, pp. 4-63 to 4-70).

Collective population dose for the population within 50 miles of the facility was calculated to be 3.14 person-rem (USEC, 2004, pp. 4-110).

The assessment of impacts for the HALEU demonstration cascade operations identified a slight increase in HF concentrations. However, the annual average HF concentration for the HALEU demonstration cascade was calculated to be 0.00227 $\mu g/m^3$ at the location of the maximum exposed individual, less than the 0.00235 $\mu g/m^3$ than what was evaluated for the full ACP at the same location. This is less than the OSHA PEL for HF of 2,500 $\mu g/m^3$. No other significant differences between the assessments were identified (NRC, 2021c).

3.3.11.3 GLE Site – Wilmington, North Carolina

This section discusses the existing environment and environmental impacts associated with the Proposed GLE facility in Wilmington, North Carolina. While the license application for this facility was withdrawn, the information in the environmental documentation provides insight into the potential impacts of the construction and operation of a possible HALEU enrichment facility.

Radiological exposures (from man-made sources) result from operations at the Wilmington nuclear fuel complex and the Wilmington Field Services Center. The most likely exposure pathway for the public is from airborne releases. Public exposure from direct gamma radiation is not a significant exposure pathway; radiation levels at the site boundary are at background levels (NRC, 2012b, pp. 3-96 to 3-99).

Releases from the nuclear fuel complex are sampled continuously and those from the Wilmington Field Services Center are monitored for beta activity, the largest component of the release is beta emitting Cobalt-60. In addition, continuous air monitoring is performed at six air sampling stations on the Wilmington site. Data collected from the sample points indicate that the uranium concentration in air are an order of magnitude lower than the most restrictive maximum allowable uranium air concentration limit contained in 10 CFR 20, App B (5×10^{-14} µCi per cubic centimeter) (NRC, 2012b, pp. 3-96 to 3-99).

Calculations of the dose to an individual living at the site boundary from the airborne releases result in estimates that range between 0.027 to 0.4 mrem per year between 1995 and 2008, the higher value occurring in 1997. These estimated doses to the nearest resident are well below the NRC limit of

100 mrem per year in 10 CFR 20.1301(a) and the NESHAP limit of 10 mrem per year from airborne releases (NRC, 2012b, pp. 3-96 to 3-99).

A smaller number of people could be impacted by the liquid effluent flow from the Final Process Lagoon. Calculations based on the concentrations of this effluent, conservatively estimate doses of between 9 and 21 mrem per year for an individual that continuously ingests water for a year (NRC, 2012b, pp. 3-96).

Occupational radiation exposure data for the 5 years (FY 2003 to FY 2007) show that the average worker during this period received a dose that ranged from 77 to 106 mrem. No worker received a dose greater than 750 mrem. These doses are well below the NRC limit of 5 rem per year in 10 CFR 20.1201 and the Wilmington site's administrative limit 4 rem per year (NRC, 2012b, pp. 3-99).

Fuel manufacturing operations are the primary contributor to chemical exposures to both workers and public, the primary chemicals of concern being uranium and HF. In 2004, the Wilmington site emitted about 27 kilograms (kg) (60 lbs) of total fluorides and 15 kg (32 lbs) of HF, while in 2007, facility-wide fluoride emissions from the fuel manufacturing and fuel component complexes were 145 kg (320 lbs). Air permits limit facility-wide fluoride emissions to 20,000 lbs per year (NRC, 2012b, pp. 3-100).

Construction

During construction, impacts would be limited to construction workers. There would be no potential for measurable exposure to the public from existing site contamination (NRC, 2012b, pp. 4-76).

During any construction activity, there is the potential for accidental injuries and fatalities. The U.S. Department of Labor, Bureau of Labor Statistics provides information on injury and fatality rates for construction activities in several industries. The GLE EIS used this data to estimate worker injury and fatality information. Estimates for construction workforce were an average of 235 workers per year for a total of 2,346 workers for the 10-year construction period. Based on these numbers of workers (such as FTEs), a projected 89 reportable cases of injury or illness and 52 lost workdays were estimated for the duration of the construction effort. No fatalities (0.22) were predicted (NRC, 2012b, pp. 4-74).

Construction workers could be exposed to radiological materials via five pathways: (1) inhalation of contaminated dust attributable to construction, (2) inhalation of emissions from current fuel manufacturing operations, (3) inhalation from emissions of laser separation operations[17], (4) exposure to contaminated soils, and (5) exposure from on-site sources (storage yards). Worker doses were dominated by doses from exposure from the cylinder storage yards. The estimated annual doses from each of these pathways were:

- 10.5 mrem per year from existing site sources
- 3.2×10^{-2} mrem per year from contaminated soil
- 6×10^{-3} mrem per year from inhalation of re-suspended contaminated soil
- 2.8×10^{-3} mrem per year from facility operations
- 3.2×10^{-5} mrem per year from laser enrichment operations

Workers were not assumed to be part of the laser enrichment workforce and therefore their doses were compared to limits for the general public. The sum of these doses (10.5 mrem per year) is below the limit of 100 mrem per year contained in 10 CFR20.1301 (a)(1) for the general public. The sum of all of

[17] Construction and operation of the facility was planned to be in phases. Some operational facilities were expected to be operational and enriching uranium while additional construction continued.

these doses is well below the average individual dose of 311 mrem per year in the United States, from natural sources (NRC, 2012b, pp. 4-74 to 4-76).

Operation

Occupational injuries and fatalities were estimated using the same approach used for construction. A total of 14,100 (371 per year) FTE workers were assumed to work at the laser enrichment facility during its 38 years of operation. Using incident and fatality rates for the chemical manufacturing industry and the expected workforce numbers, 324 injuries or illnesses were estimated and no fatalities (0.2) from workplace incidents were anticipated (NRC, 2012b, pp. 4-76 to 4-77).

Worker injuries resulting from exposure to toxic chemicals (primarily fluoride as either HF or uranyl fluoride and uranium) would be limited by an Industrial Health and Safety program. Efforts would be made to minimize airborne releases of contaminants and to limit the impacts of such releases. As a reference to the possible air concentrations of HF, the Technical Report referenced an analysis for the ACP in Piketon, Ohio, that estimated that HF and uranium concentrations would be less than 1% of OSHA's PELs (NRC, 2012b, pp. 4-77).

The analysis of the occupational (worker) exposure addressed the most significant contributor to occupational radiation exposure direct radiation from the UF_6. Since no data would be available for the new GLE facility, average occupational doses at the proposed GLE were assumed to be similar to those at existing fuel cycle facilities in the United States. At these fuel cycle facilities, worker exposure is primarily from exposures associated with handling feed, product, depleted material, and empty cylinders. Average worker doses ranged from 100 to 130 mrem per year between 2003 and 2007 (NRC, 2012b, pp. 4-88, 4-89).

A comprehensive exposure control program would be implemented to manage occupational radiation exposure and dose. The program would maintain exposures ALARA through the use of radiation monitoring systems, personnel dosimetry, and mitigation systems to reduce environmental concentrations of uranium. A similar program at existing GNF-A operations at the Wilmington site for 2003 to 2007 limited the worker dose to between 50 and 75 mrem and the maximum dose during the same time period ranged from 470 to 560 mrem. These doses are below the below the regulatory limits of 5 rem per year of 10 CFR 20.1201 and the site administrative limits (4 rem per year) (NRC, 2012b, pp. 4-88).

Potential long-term, low-level HF and uranium exposure to members of the public would be the primary off-site chemical exposures of concern. Engineered features, operation buildings at negative pressures and effluent filtrations systems, would limit releases so that only minor quantities of HF and uranium could be released. Estimates of HF emissions were based on estimates associated with the National Enrichment Facility (the UUSA facility discussed) and scaled for differences in throughput. Although the UUSA facility is a gas centrifuge enrichment facility, the major points of HF release are associated with feed and withdrawal operations, operations that would be similar for both types of enrichment facilities. Estimates of concentrations of HF at an on-site location were well below any levels of concern, e.g., OSHA chronic (8-hour exposure levels). Off-site concentrations at site boundaries were all less than the on-site concentrations and lower than Federal and state standards (NRC, 2012b, pp. 4-78 to 4-80).

Estimated releases of uranium also result in off-site concentrations at an on-site location several orders of magnitude below any levels of concern, e.g., the OSHA 8-hour exposure limit. Concentrations at site boundaries would also be less than the on-site concentrations sufficiently low as to not be a concern (NRC, 2012b, pp. 4-78 to 4-80).

Toxicological health effects from uranium and fluorine exposure are discussed previously in Section 3.3.11.1, *UUSA Site – Eunice, New Mexico*.

Public radiation exposures from operation of the GLE facility could result from airborne emissions, liquid effluents, and direct radiation. Facility airborne releases would all be processed through a ventilation system with emission controls to remove uranium and minimize emissions. Before liquids would be released, they would be treated and sampled to limit releases. Direct radiation is most likely from the storage of materials (feed, product) outside of the buildings as any direct radiation emitted within the facilities would be significantly absorbed by the building structures (NRC, 2012b, pp. 4-81).

Airborne releases would be through the operation building stack. Emissions from the current operations at the fuel manufacturing operation at the Wilmington site were used as a surrogate for the emissions from the laser enrichment facility, since no such data was available for such a facility. Dose estimates were provided for an on-site member of the public and an MEI at the site boundary, and the nearest resident. Doses to these individuals were 3.2×10^{-5} mrem per year, 1.1×10^{-4} mrem per year, and 1.4×10^{-5} mrem per year, respectively. Assumptions about the parameters associated with the on-site individual resulted in this dose being lower than the dose to an individual at the site boundary, mainly a reduced exposure time (2,000 hours per year). Public exposures from the airborne emissions would all be below the exposure limits of 10 CFR 20.1301 (a)(1) of 100 mrem per year and EPA's NESHAP airborne dose criteria of 10 mrem per year (NRC, 2012b, pp. 4-78 to 4-83).

Direct radiation impacts were assessed by considering the measured radiation dose at various locations from existing radiation sources at the Wilmington site. Radiation monitors placed both on-site and off-site (intended to capture any exposure from existing radiation sources, including the cylinder yards) do not show radiation levels above background. Since the planned cylinder storage yards were to be located further from site boundaries than existing structures, no direct radiation impacts on the public were expected (NRC, 2012b, pp. 4-85).

Process and sanitary waste streams have the potential to contain radioactive effluents. Process wastewater is the result of decontamination, cleaning, and laboratory activities. All process wastewater is collected in a single tank and sampled on a regular basis before being sent to a processing system and then discharged to a process lagoon. Blowdown (which does not come in contact with uranium materials) from the cooling towers would be discharged directly to the process lagoon[18]. Doses were estimated for several off-site locations. The calculated maximum dose from liquid effluents would be 7.3×10^{-5} mrem per year. Public exposures from the liquid effluent streams would all be below the exposure limits of 10 CFR 20.1301 (a)(1) of 100 mrem per year.

All exposures are also expected to be significantly below the EPA limit of 25 mrem per year in 40 CFR 190 for dose to members of the public from uranium fuel cycle facilities (NRC, 2012b, pp. 4-88).

3.3.11.4 New HALEU Enrichment Facility (Generic Site)

The HALEU enrichment facility could be located at any of the three sites discussed above or could be located at a site that does not currently have an enrichment facility. If located with one of these uranium enrichment facilities, the enrichment of natural uranium to LEU or LEU+ could occur within the existing facilities, while new structures would be built to use that material as feed for enrichment to 19.75% U-235. Alternatively, a new enrichment facility could be constructed at these sites to provide

[18] Stormwater is also collected. No radioactivity is anticipated in the runoff, but the collection ponds are monitored to verify no unanticipated radioactive isotopes are present.

the capability to enrich natural uranium to 19.75% HALEU. A new site would imply a completely new enrichment facility.

Construction human health impacts would be higher for construction at an existing site. As shown in the discussions above, radiological exposure to workers is possible if the construction occurs at an existing site. Construction at a new site would not expose workers to radioactive material, unless the new site is the location of facilities performing fuel cycle activities not directly associated with enrichment. Other potential impacts on workers, exposure to hazardous chemicals and workplace accidents, would not be dependent upon the site selected.

Overall operational human health impacts would be similar no matter where the HALEU enrichment facility would be located. However, if the existing capacity is used to enrich natural uranium to LEU enrichments, only the impacts associated with boosting enrichment to 19.75% U-235 would be new impacts. The first part of the enrichment process would be part of ongoing activities.

The analysis performed in the Technical Report conservatively assumes that construction occurs at an existing site and operation is associated with a new facility (i.e., the analysis uses the larger set of impacts for each part of the enrichment activity).

The HALEU enrichment facility required to produce 25 MT of HALEU per year[19] would process less natural uranium and use fewer SWUs than any of the three facilities discussed above. The HALEU enrichment facility would require about 1,000 MT of uranium feed and 1.1 SWUs of separative work to yield 25 MT of HALEU. The analyses for the three enrichment plants addressed facilities capable of doing 3 to 10 million SWUs of work and would require between 3,700 and 12,500 MT of feed material. (If the product from these enrichment facilities is LEU enriched to about 4.4%, this LEU level results in approximately 430 to 1,400 MT of product.)

Construction

Based on the analyses for the three facilities discussed previously, workforce accident and exposure to hazardous chemicals during construction result in SMALL impacts. Using the information from the construction of the enrichment facilities above, workforce accidents during construction could reasonably be expected to be limited to fewer than 100 accidents and no fatalities. There would be differences in the HALEU enrichment facility from the three facilities discussed above. The reduced size of the facility would lead to shorter construction times. Criticality concerns could require the use of smaller capacity product cylinders and product withdrawal could require more withdrawal stations. This possibility could increase the size of the withdrawal facility, and other differences could also affect construction worker impacts. However, these differences would not significantly impact the size of the facility.

The analyses of worker exposure to hazardous chemicals concluded that with proper controls hazardous chemical exposures could be limited to levels below those that would have health impacts. Concentrations of HF and uranium particulates (if construction is at an operating facility) in air would be lower than any applicable OSHA standard. This conclusion applies to both construction and operation.

The health effects of worker exposure to radioactive material during construction should also be similar to, but smaller than, that assessed for the three facilities. Estimates for construction doses at the three facilities ranged from 5 mrem per year to 500 mrem per year and total workforce doses were small enough that no latent cancer fatalities (LCFs) among the workers would be expected. Individual annual doses

[19] Enrichment facility contracts would be for a maximum of 145 MT of HALEU. The facility operational period under the contract is expected to be 6 years, thus an annual production rate sufficient to support the production of 25 MT of HALEU. Multiple enrichment contracts may be awarded. This analysis addresses production at a single enrichment facility.

could be as high as the largest of the estimates, but total workforce dose estimates should be smaller due to a shorter construction period or smaller workforce.

No impacts on the public would be expected from construction of the HALEU enrichment facility.

Operation

All of the analyses above indicate that the risk to the operational staff and to the public from exposure to hazardous chemicals would be negligible. All concentrations, on-site and off-site, of HF and uranium particulates are well below applicable OSHA and EPA standards. Estimates of concentrations of HF at an on-site location were well below any levels of concern, e.g., OSHA chronic (8-hour exposure levels). Off-site concentrations at site boundaries were all less than the on-site concentrations and lower than Federal and state standards.

The risks to workers from accidents at the HALEU enrichment facility should be no higher than that for workers at the three enrichment facilities analyzed. While accidental injuries would be expected, there should be no accidental fatalities.

The latest worker dose data published by the NRC includes information on worker exposure at the UUSA facility. In 2020, a total of 51 workers received a measurable dose, totaling 4.9 person-rem. The average individual dose was 97 mrem. No individual worker received a dose of greater than 100 mrem (NRC, 2022a, pp. A-4). This dose is similar to the annual doses discussed in the UUSA analyses for U.S. fuel cycle workers of just over 100 mrem per year. There are isotopic differences between HALEU and natural and LEU. HALEU has a higher concentration of U-234, which has a higher specific activity, is more radioactive, than other uranium isotopes. However, this difference should not significantly impact worker dose. As discussed in the analysis of the three enrichment facilities, most of the worker dose is associated with feed and withdrawal releases of UF_6. Most of these activities involved either natural uranium (feed) or DU (tails). All but 25 MT of the approximately 1,500 MT of feed material are withdrawn as tails. Therefore, the HALEU enrichment facility average annual worker dose is estimated to be 100 mrem.

The Urenco analysis of public health impacts from airborne releases used a scaling factor based on SWU capacity to estimate public doses. Using this same approach, doses to the populations and MEIs around a HALEU facility that operates at about 1.1 million SWUs a year, if located at each of the analyzed sites, should be about 10% of doses associated with the augmented operations at UUSA, about a third of the doses associated with the GLE in Wilmington and about 15% of the doses associated with the 7 million SWU operations at the Centrus ACP facility in Piketon, Ohio. These estimates are provided in Table 3-5. Any new facility, similarly situated with respect to nearby population centers and with controlled access areas of similar size to these facilities, should have similar human health impacts. Public exposures from the airborne emissions would all be below the exposure limits of 10 CFR 20.1301 (a)(1) of 100 mrem per year and EPA's NESHAP airborne dose criteria of 10 mrem per year.

Table 3-5. HALEU Enrichment Facility Public Dose Estimates

Public Dose Receptor	*Urenco USA Facility*	*Centrus ACP*	*GLE*
Airborne Releases			
Highest site boundary (mrem/yr)	0.002	0.03	5×10^{-5}
Nearest resident (mrem/yr)	0.0004	Not calculated	5×10^{-6}
Highest nearby worker (mrem/yr)	0.0009	0.02	Not calculated
Population (person-rem/yr)	0.0047	3.14	0.1

Key: ACP = American Centrifuge Plant; GLE = Global Laser Enrichment; HALEU = high-assay low-enriched uranium; mrem/yr = millirem per year; rem = roentgen equivalent man

Estimates for direct radiation doses at the site boundary would depend upon where cylinder storage areas would be located on the site. However, the less than 10 mrem per year estimate for the Urenco augmented capacity operations should provide a reasonable estimate for the maximum direct dose.

Since none of the uranium enrichment facility analyses indicated significant doses from liquid effluents, any HALEU enrichment facility should have similar impacts.

3.3.12 Public and Occupational Health – Facility Accidents

Companies holding licenses under 10 CFR 70, Domestic Licensing of Special Nuclear Material, must perform an integrated safety analysis (ISA) and submit a summary to the NRC for approval. An ISA (1) identifies potential accident sequences during operations of an enrichment facility, (2) designates items relied on for safety (IROFS) to either prevent such accidents or mitigate their consequences to an acceptable level, and (3) describes management measures to provide reasonable assurance of the availability and reliability of IROFS.

The performance requirements in 10 CFR 70, Subpart H, define acceptable levels of risk for accidents at nuclear fuel cycle facilities such as the enrichment facility. The regulations in Subpart H require reduction of the risks of credible high-consequence and intermediate-consequence events and assure that under credible abnormal conditions all nuclear processes are subcritical. Threshold consequence values, based on the requirements of 10 CFR 70.61 and the EPA's Acute Exposure Guideline Levels for chemical exposure to HF, that define the high- and intermediate-consequence events, except for criticality events, are described in Table 3-6.

Table 3-6. Definition of High- and Intermediate-Consequence Events

Receptor	*Intermediate Consequence* [(a)]	*High Consequence*
Worker – radiological	> 25 rem	> 100 rem
Worker – chemical (10-minute exposure)	> AEGL-2 for UF_6 > AEGL-2 for HF (> 19 mg U/m^3)[b] (> 78 mg HF/m^3) = (95 ppm)	> AEGL-3 for UF_6 > AEGL-3 for HF (> 147 mg U/m^3) (> 139 mg HF/m^3) = (170 ppm)
Environment at the Restricted Area Boundary	5.4 mg U/m^3 or 24-hour average release greater than 5,000 times the values in Table 2 of Appendix B of 10 CFR 20	NA
Individual at the controlled area boundary – radiological	> 5 rem	>25 rem
Individual at the controlled area boundary – chemical (30-minute exposure)	> 4.06 mg soluble U intake > AEGL-1 for HF (> 2.4 mg U/m^3) (> 0.8 mg HF/m^3) = (0.98 ppm)	> 21 mg soluble U intake > AEGL-2 for HF (> 13 mg U/m^3) (> 28 mg HF/m^3) = (34.23 ppm)

Source: (NRC, 2012b, pp. 4-114, 4-115, Table 4-28)

Key: > = greater than; AEGL = acute exposure guideline levels; CFR = Code of Federal Regulations; HF = hydrogen fluoride; m^3 = cubic meter; mg = milligram; NA = not applicable; ppm = parts per million; U = uranium; UF_6 = uranium hexafluoride

Note:

[a] AEGL are public and private sector derived consensus values intended to describe the risk to humans resulting from once-in-a-lifetime, or rare, exposure to airborne chemicals (http://www.epa.gov/oppt/aegl/).

NRC regulations are designed to ensure that the high- and intermediate-accident scenarios would be highly unlikely (10 CFR 70, Subpart H). The combination of responses by IROFS that mitigate or prevent emergency conditions and the implementation of emergency procedures and protective actions in accordance with the facility emergency plan would limit the consequences and reduce the likelihood of accidents that could otherwise extend beyond the enrichment facility site and property boundaries. Receptors located at the restricted area boundary within the enrichment facility site and at the controlled area boundary (CAB) (property boundary) represent worst-case exposures to nonradiological workers at the facility and members of the public, respectively (NRC, 2012b, pp. 4-114).

The enrichment facility would be designed with a number of features that would protect workers and mitigate the effects of accidents. In addition to physical design features such as barriers, ventilation systems, and alarms, an emergency plan would be implemented to minimize the consequences of accidents to workers.

An inadvertent nuclear criticality is the only accident that does not involve a significant release of UF_6. Accidents involving release of UF_6 liquids or vapors are analyzed by identifying the quantity of a containerized material at risk inside the facility, the amount of material released into a room as vapor or particulates under the accident scenario, the fraction of released material that is of respirable size, and the fraction of material exhausted to the atmosphere through an available pathway, typically a building ventilation system. The dispersion of released material in the atmosphere and transport to on-site locations are calculated using guidance provided in Regulatory Guide 1.111 (NRC, 1977a). Dispersion and transport to off-site locations is analyzed with conservative inputs for exposure parameters and atmospheric transport factors. These methods estimated direct exposures to members of the public from an airborne plume, as well as exposures over a year's time from deposited uranium materials, to determine accident consequences to the public. Doses to members of the public are evaluated ranging from a person at the site boundary to the entire collective population within 80 km (50 miles) of the proposed facility. Impacts on the public from a criticality accident are analyzed similarly, but for radioactive gases, including fission products and radioiodine, that would be released from a criticality event in a vessel inside the facility (NRC, 2012b, pp. 4-114).

3.3.12.1 UUSA Site – Eunice, New Mexico

Construction

Accidents during construction are standard industrial hazards. Accidents from standard industrial hazards are described in Section 3.3.11, *Public and Occupational Health – Normal Operations*.

Operation

A range of possible accidents was selected for detailed evaluation to bound the potential human health impacts. The representative accident scenarios selected vary in severity from high- to intermediate-consequence events and include accidents initiated by natural phenomena, operator error, and equipment failure. The accident scenarios evaluated are as follows (NRC, 2005a, pp. 4-52):

- Generic inadvertent nuclear criticality
- Hydraulic rupture of a UF_6 cylinder in the blending and liquid sampling area
- Natural phenomena hazard—earthquake
- Fire in a UF_6 handling area
- Process line rupture in a product low-temperature takeoff station

The accident analyses described in this section assume that the probability of an accident is 100% to maximize the environmental consequences.

Table 3-7 presents the consequences from the accidents, assuming such accidents would occur. The accident consequences vary in magnitude and include accidents initiated by natural phenomena, operator error, and equipment failure. When necessary to reduce the consequence and likelihood of accidents, preventative and mitigative measures or IROFS (not credited in the consequence analysis) would be implemented to meet the performance requirements of 10 CFR 70, Subpart H. Accidents at the enrichment facility would pose acceptably low risks after incorporation of IROFS. IROFS would include such things as passive engineered controls, active controls, and administrative controls.

The most significant accident consequences are those associated with the release of UF_6 caused by rupturing an overfilled and/or overheated cylinder. The proposed design reduces the likelihood of this event by using redundant heater controller trips. Accidents at the facility would pose SMALL to MODERATE impacts on workers, the environment, and the public (NRC, 2005a, pp. 4-54).

Table 3-7. Summary of Health Effects Resulting from Accidents at the UUSA Enrichment Site

Accident	***Worker [a]***		***Environment at Restricted Area Boundary***	***Individual at Controlled Area Boundary, SW Direction***		***Collective Dose***		
	U mg/m³ (rem)	***HF mg/m³***	***U mg/m³***	***U mg/m³ (rem)***	***HF mg/m³***	***Direction***	***Person-rem***	***LCFs***
Inadvertent Nuclear Criticality	High [b]		0.66 [c]	(0.14) [d]	---	West	44	0.03
Hydraulic Rupture of a UF_6 Cylinder	Low		44	250 (0.97)	86	North	12,000	7 [e]
Earthquake	High [b]		0.11	0.64 (0.0017)	0.13	North	19	0.008
Fire in a UF_6 Handling Area	59 (0.020)	20	0.012	0.070 (0.000072)	0.024	North	0.92	0.0006
Process Line Rupture	17 (0.022)	5.8	00035	0.020 (0.000078)	0.0069	North	0.97	0.0006

Source: (NRC, 2005a, pp. 4-53, Table 4-14)

Key: CAB = controlled area boundary; CFR = Code of Federal Regulations; HF = hydrogen fluoride; LCFs = latent cancer fatalities; mg/m^3 = milligrams per cubic meter; SW = southwest; U = uranium; UF_6 = uranium hexafluoride; UUSA = Urenco USA

Notes: To convert rem to sievert, multiply by 0.01.

[a] Worker exits after 10 minutes.

[b] High consequence could lead to a fatality.

[c] Pursuant to 10 CFR 70.61(c)(3), this value is the sum of the fractions of individual fission product radionuclide concentrations over 5,000 times the concentration limits that appear in 10 CFR Part 20, Appendix B, Table 2.

[d] The dose to the individual at the CAB is the sum of internal and external doses from fission products released from the Technical Services Building gaseous effluent vent systems stack.

[e] Though the consequences of the rupture of a liquid-filled UF_6 cylinder would be high, redundant heater controller trips would make this event highly unlikely to occur.

3.3.12.2 Centrus Site – Piketon, Ohio

Construction

Accidents during construction are standard industrial hazards. Accidents from standard industrial hazards are described in Section 3.3.11, *Public and Occupational Health – Normal Operations*.

Operation

The accident analysis for the Centrus enrichment facility is not available to the public. However, the NEPA document indicates that analytical results indicate that plausible radiological accidents at the proposed ACP pose acceptably low risks and would result in SMALL to MODERATE impacts on workers, the environment, and the public (NRC, 2006b, pp. 4-71, 4-72).

3.3.12.3 GLE Site – Wilmington, North Carolina

Construction

Accidents during construction are standard industrial hazards. Accidents from standard industrial hazards are described in Section 3.3.11, *Public and Occupational Health – Normal Operations*.

Operation

With the exception of the criticality accident, the hazards evaluated involve the release of UF_6 from process systems that are designed to confine UF_6 during normal operations. As described below, UF_6 poses a chemical and radiological risk to workers, the public, and the environment. GLE has committed to various preventative and mitigative measures to significantly reduce these impacts. The representative accident scenarios selected vary in severity from intermediate- to high-consequence events and include accidents initiated by natural phenomena, operator error, and equipment failure. The accident scenarios evaluated are as follows (NRC, 2012b, pp. 4-113):

- Nuclear criticality
- Liquid fuel fire outside (cylinder storage and handling)
- System breach inside a solid feed station (feed and vaporization)
- System breach inside an autoclave (sampling system)
- Criticality due to uranium accumulated in decontamination and maintenance equipment (decontamination/maintenance)

Table 3-8 summarizes the consequences from the hypothetical accidents. Receptors located at the restricted area boundary within the site and at the CAB represent worst-case exposures to nonradiological workers at the facility and members of the public, respectively. The consequences of the accident scenarios involving a release of UF_6 vary widely. For the generic criticality accident, previous experience with this type of criticality accident indicates that a worker in close proximity (less than 4.5 meters [15 feet]) is unlikely to survive. With increasing distance from the accident, the radiation dose would be lower. Therefore, the accident is a high-consequence event for the worker. However, GLE has committed to various preventative and mitigative measures to significantly reduce these consequences. An MEI at the CAB would receive a radiation dose of 0.57 rem total effective dose equivalent, which represents a low consequence to an individual (less than [<] 5 rem). The collective dose to the off-site population in the east-southeast direction is estimated to be 3.87 person-sievert (387 person-rem). This population dose would cause an estimated 0.28 LCFs. The specific criticality accident for decontamination and maintenance would likewise have high consequences for a nearby worker and roughly one-half the estimated concentrations of uranium and HF at the site boundary of those for the generic criticality. It is estimated to similarly result in one-half the off-site dose and cancer risk (NRC, 2012b, pp. 4-114).

Table 3-8. Summary of Health Effects Resulting from Accidents at the GLE Site

Accident (Node)	*Worker [a]*		*Environment at RAB*	*Individual (MEI) at CAB*		*Collective Dose and LCFs*		
	U mg/m^3 (rem) [b]	*HF mg/m^3 (ppm)*	*µCi/mL*	*U mg/m^3 (rem)*	*HF mg/m^3 (ppm)*	*Direction*	*Person-rem*	*LCFs*
Generic Criticality	High [c]	NA	2.64 [d]	(0.57) [e]	NA	ESE	387	0.28
Liquid Fuel Fire Outside	5.6×10^3 (3.91)	1.8×10^3 (2.2×10^3)	3.2×10^{-9}	2.79 (0.02)	1.06 (1.3)	ESE	41.2	3.0×10^{-2}
Breach Inside a Solid Feed Station	66 (0.46)	22 (27)	2.64×10^{-11}	3.2×10^{-2} (< 0.001)	1.1×10^{-2} (1.3×10^{-2})	ESE	0.032	7.6×10^{-4}
System Breach Inside an Autoclave	1.8×10^4 (13.0)	6.25×10^3 (7.6×10^3)	2.7×10^{-9}	9.12 (3.8×10^{-2})	3.45 (4.2)	ESE	67.8	5.0×10^{-2}
Decontamination and Maintenance Criticality	High [c]	NA	1.32	(0.28)	NA	ESE	190	0.14

Source: (NRC, 2012b, pp. 4-116, Table 4-29)

Key: < = less than; CAB = controlled area boundary; CFR = Code of Federal Regulations; ESE = east-southeast; HF = hydrogen fluoride; LCF = latent cancer fatalities; µCi/mL = microcuries per milliliter; MEI = maximally exposed individual; mg/m^3 = milligrams per cubic meter; ppm = parts per million; RAB = restricted area boundary; U = uranium

Notes:

a Worker exits after 5 minutes in all cases.

b To convert rem to sievert, multiply by 0.01.

c High consequence could lead to a fatality.

d Pursuant to 10 CFR 70.61(c)(3), this value is the sum of the fractions of individual fission product radionuclide concentrations over 5,000 times the concentration limits that appear in 10 CFR 20, Appendix B, Table 2.

e The dose to the individual at the CAB is the sum of internal and external doses from fission products released from the criticality.

The accident consequences to a worker greater than low would be those from scenarios involving nuclear criticality, a liquid fuel fire outside resulting in a cylinder rupture and UF_6 release, a breach inside a solid feed station, and a system breach inside an autoclave. The accident scenarios with potential consequences to the public greater than low would be a system breach inside an autoclave and a liquid fuel fire outside resulting in a cylinder rupture and UF_6 release. The potential consequences to the public from both of these accidents would be potentially intermediate due to exposure to both uranium and HF.

The accident consequences vary in magnitude and demonstrate that both UF_6 and HF release can be of concern if these accidents were to occur. However, the design of the proposed facility minimizes the likelihood of accidents occurring, while the facility emergency plan addresses all identified potential low- to high-consequence events. Therefore, the NRC concludes in the GLE EIS that, through the combination of plant design, passive and active engineered controls (i.e., IROFS), and administrative controls, all processes would be maintained non-critical, and accidents at the proposed facility pose an acceptably low risk to workers, the environment, and the public. Thus, the probability weighted consequence (or risk) from accidents is expected to be SMALL.

3.3.12.4 New HALEU Enrichment Facility (Generic Site)

The HALEU enrichment facility could be located at any of the sites discussed above or could be located at a site that does not currently have an enrichment facility. If located with one of these facilities, enrichment could occur within the existing facilities or new structures could be built. Site selection for a

HALEU enrichment facility is expected to include criteria that would limit potential exposure to off-site populations from releases from high- to intermediate-consequence accidents. An enrichment facility at any site would be subject to NRC regulations (10 CFR 70, Subpart H), which are designed to ensure that high and intermediate-accident scenarios are highly unlikely. The annual production capacity of a HALEU enrichment facility would be less than the capacity of any of the three enrichment facilities addressed above. The use of safe-by-design components would prevent an inadvertent nuclear criticality. In addition, the proposed facility emergency plan would address all lower-risk, high- and intermediate-consequence events. Through the combination of facility design, passive and active engineered controls (i.e., IROFS), administrative controls, and management of these controls, accidents at an enrichment facility would pose an acceptably low risk to workers, the environment, and the public.

Construction

Accidents during construction of a new HALEU enrichment facility are standard industrial hazards. Accidents from standard industrial hazards are described in Section 3.3.11, *Public and Occupational Health – Normal Operations*.

Operation

The most significant accident consequences, of the accident scenarios analyzed, are those associated with an inadvertent nuclear criticality and to a lesser extent the release of UF_6. Preventative and mitigative measures related to a UF_6 release scenario could potentially include: (1) fire alarm and detection systems, (2) a fire suppression system; (3) fire barriers preventing propagation of fires into and out of areas holding quantities of uranium materials; (4) features to prevent overheating of UF_6 cylinders; and (5) facility design features to minimize the impacts of initiating events such as those for a seismic event. Mitigative measures relevant to radiological accidents would include: (1) radiation protection systems to alert workers and isolate systems when parameters exceed set limits; (2) physical separation of areas within the facility designed to prevent or reduce exposure; (3) controlled positive or negative air pressures within designated areas to control air flow; (4) carbon absorbers, high-efficiency particulate air filters, and automatic trips on ventilation systems to prevent releases outside of affected areas; and (5) limited building leakage paths to the outside environment through appropriate door and building design. Preventative controls for a nuclear criticality accident would include maintaining a safe geometry of all vessels, containers, and equipment that contain fissile material and ensuring the amount of such material in these vessels does not exceed set limits. Mitigative controls would include criticality monitoring and alarm systems and emergency response training.

The differences in accident consequences would primarily be due to differences in assumed worker exposure times and in site-specific parameters such as distances to receptors and population distribution. Because the identified enrichment facilities would be handling much larger quantities of material than a HALEU enrichment facility, the consequences of accidents in the HALEU enrichment facility would be expected to be similar to or less than the consequences reported above. An inadvertent nuclear criticality could be fatal to an involved worker. Accident doses could be greater than the 25-rem total effective dose equivalent established by DOE as a guideline for assessing the adequacy of protection of public health and safety from potential accidents. LCFs within the general public could occur. Impacts from release of hazardous chemicals could be high with persons experiencing both adverse effects and irreversible adverse effects. Facility design would reduce the likelihood of the rupture event by using redundant heater controller trips. The use of safe-by-design components would significantly reduce the likelihood of an inadvertent nuclear criticality. In addition, the proposed facility emergency plan would address all lower-risk, high- and intermediate-consequence events. Through the combination of facility design, passive and active engineered controls (IROFS), administrative controls, and management of these controls, accidents at an enrichment facility would pose an acceptably low risk to workers, the environment, and the public. Based on the analyses for the facilities discussed previously, accident risk at a HALEU enrichment facility would result in SMALL impacts.

3.3.13 Traffic

This section discusses potential traffic impacts on nearby roadways resulting from project-related vehicles during construction and operation. The project would generate new vehicle trips (for the Technical Report, a vehicle trip is defined as a one-way trip movement; a round trip is defined as two vehicle trips) during site preparation and construction from the transport of materials, supplies, equipment and wastes via trucks and from commuting construction workers from personal vehicles. During operation, new vehicle trips would be generated from nonradiological transportation (i.e., transport of nonradiological supplies, materials, and wastes via trucks and commuting personnel in personal vehicles) and from radiological transportation (i.e., transport of radioactive materials, products, and wastes via trucks).

Annual average daily traffic (AADT) is a measure of the daily average number of vehicles that pass through a given segment of roadway and is indicative of traffic conditions (i.e., higher AADT volumes lead to increases in traffic congestion and delays). To evaluate changes in baseline traffic conditions at the time traffic analyses were conducted for past NEPA documents, the Leidos Team compared AADT volumes presented in those documents to the most recent available AADT volumes.

3.3.13.1 UUSA Site – Eunice, New Mexico

The primary roadways that serve the UUSA site, as discussed in Section 3.13.1 of the 2005 NEF EIS (NRC, 2005a), are NM-176 (also referred to as NM-234 near the project area) and NM-18. NM-176 is a two-lane highway that traverses east-west and is adjacent to the southern border of the UUSA facility (formerly the National Enrichment Facility) property boundary. Two access roads were constructed for the UUSA facility, which provide direct access to the facility from NM-176. NM-18 is a four-lane divided highway that traverses in a north-south direction and intersects NM-176 approximately 3 km (2 miles) west of the UUSA site. Table 3-9 provides the 2013 AADT volumes that were presented in Table 3-9 of the 2015 UUSA EA (NRC, 2015) and the 2019 AADT volumes that were obtained from the New Mexico Department of Transportation.

Table 3-9. AADT Volumes (Years 2013 and 2019 AADT) Near the UUSA Site

Road	*Location*	*2013 AADT*	*2019 AADT*	*Percent Increase [a]*
NM-176	East of NM-207 in Eunice, NM	2,881	5,203	80%
	Near UUSA Facility (between NM-18 and Texas state line)	2,800	4,801	70%
NM-18	North of Jal, NM, and south of NM-207	2,449	3,865	60%
	Between NM-207 (south of Eunice, NM) and NM-176	1,930	2,892	50%
	Between NM-176 and NM-207 (north of Eunice, NM)	5,840	7,104	20%
	North of NM-207 (north of Eunice, NM) and south of Hobbs, NM	10,145	11,796	20%

Source: (NMDOT, 2023; NRC, 2015)

Key: % = percent; AADT = annual average daily traffic; NM = New Mexico; NM-18 = New Mexico Highway 18; NM-176 = New Mexico Highway 176; NM-207 = New Mexico Highway 207; UUSA = Urenco USA

Note:

[a] Values are rounded estimates.

Since publication of the 2015 UUSA EA (NRC, 2015), the AADT volumes on NM-176 and NM-18 near the project site have experienced moderate to high percentage increases in traffic volumes. However, the 2019 AADT (NMDOT, 2023) volumes represent relatively low to moderate AADT volumes overall and it is expected that excess daily design capacities still remain for these roadways (USDOT, 2017).

Construction

Impacts on traffic were considered for the initial construction of the UUSA facility and have already occurred as the facility has been constructed and is in operation (NRC, 2005a). As discussed in Section 4.2.11.1 of the 2005 NEF EIS (NRC, 2005a), it was estimated that during construction of the UUSA facility, approximately 3,400 truck round trips could occur for any single year, resulting in approximately 28 daily vehicle trips (assuming 250 working days in a year). However, the majority of new daily vehicle trips generated would result from commuting workers and would have the greatest traffic impacts. The traffic impacts would be most detected during peak commuting hours, especially on NM-176, as this road directly serves the UUSA site. The 2005 NEF EIS estimated that 800 workers during peak construction conditions could generate 1,600 daily vehicle trips (or 800 vehicle trips during the peak commuting hours). The 2005 NEF EIS generally concluded SMALL to MODERATE traffic impacts during construction. The UUSA facility has the ability for expansion to 10 million SWUs and traffic impacts from this expansion are discussed in Section 4.1.1.11 of the 2015 UUSA EA (NRC, 2015). The 2015 UUSA EA estimated the same numbers as the 2005 NEF EIS for truck and worker vehicle trips during construction and concluded that the traffic impacts would be SMALL.

Operation

As discussed in Section 4.1.2.11.1 of the 2015 UUSA EA (NRC, 2015), it was estimated that the current number of operational workers at the existing UUSA facility is approximately 250 and expansion of the UUSA facility would increase the number of workers to 258, which is an increase in 8 daily round trips (or 16 daily vehicle trips), representing a minimal incremental increase. The 2015 UUSA EA also noted that the annual number of truck round trips for the transport of nonradiological materials and wastes during operation would not change from volumes stated in the 2005 NEF EIS (NRC, 2005a) (Section 4.2.11.2 of the 2005 NEF EIS estimated 2,949 truck round trips or 24 daily vehicle trips for nonradiological truck transportation for the currently operating UUSA facility). Both the 2005 NEF EIS and 2015 UUSA EA concluded that traffic impacts from nonradiological transportation (trucks and personal vehicles) would be SMALL during operation. The change in truck traffic volumes for the operation of an expanded UUSA facility would be attributed only to additional trucks from radiological transportation. For radiological transportation at the UUSA facility, the 2015 UUSA EA estimated 1,787 truck round trips (or 15 daily vehicle trips) for the existing facility (from estimates presented in Table 4-1 and Table 4-2 of the 2015 UUSA EA) and 1,426 truck round trips (or 12 daily vehicle trips) for the proposed expansion (from estimates presented in Table 4-2 of the 2015 UUSA EA). However, the 2005 NEF EIS and 2015 UUSA EA did not analyze radiological transportation impacts from the standpoint of traffic congestion and delays on local roadways.

Construction and operation of a new HALEU enrichment facility would also occur at the same UUSA site and would, therefore, impact the same roadways analyzed in the past NEPA documents previously cited. Construction and operation of a new co-located HALEU enrichment facility with an estimated capacity of 1.1 million SWUs at this location would be within the level of impacts determined in the 2005 NEF EIS (NRC, 2005a) and 2015 UUSA EA (NRC, 2015). However, baseline AADT volumes on NM-176 near the UUSA site have increased 70% to 80% since the traffic analyses conducted in these NEPA documents. Construction of the Proposed Action would temporarily increase the daily traffic on this roadway and traffic congestion and delays could occur on NM-176, especially during construction peak commuting hours. During operation of a new HALEU facility, minimal increases in daily traffic are expected from workers and from trucks (for nonradiological and radiological transportation). It is expected that NM-176 and NM-18 would be able to handle the incremental increases in daily traffic volumes during construction and operation of the Proposed Action, even after considering recent increases in AADT volumes since the total traffic volumes would still be within daily design capacities for both roadways. Therefore, traffic impacts from a new HALEU facility would be considered MODERATE during construction and SMALL during operation.

3.3.13.2 Centrus Site – Piketon, Ohio

The primary roadways that serve the Centrus site, as discussed in Section 3.12.1 of the 2006 ACP EIS (NRC, 2006b) are U.S. Route 23 (US-23) and Ohio State Route 32 (OH-32). Both routes are four-lane highways with US-23 traversing north-south and OH-32 traversing east-west. Principal access to the Centrus project site is from an access road off of US-23. Table 3-10 provides the 2004 AADT volumes that were presented in Table 4-4 of Section 4.2.11.1 of the 2006 ACP EIS (NRC, 2006b) and the 2019 AADT volumes that were obtained from the Ohio Department of Transportation.

Table 3-10. AADT Volumes (Years 2004 and 2019 AADT) Near the Centrus Site

Road	*Location*	*2004 AADT*	*2019 AADT*	*Percent Increase*
US-23	Between OH-32 and Centrus site	15,110	15,425	2%
OH-32	Between OH-220/Schuster Road and CR-610/Tipton Lane	8,830	9,348	6%

Source: (ODOT, 2023; NRC, 2006b)
Key: % = percent; AADT = annual average daily traffic; CR-610 = County Road 610; OH-32 = Ohio Highway 32; US-23 = U.S. Highway 23

Since publication of the 2006 ACP EIS, AADT volumes on US-23 and OH-32 increased 2% and 6%, respectively, which represent SMALL increases. As such, baseline traffic conditions as evaluated in the 2006 ACP EIS has experienced minor changes and it is expected that excess daily design capacities still remain for these roadways (USDOT, 2017).

Construction

The impacts on traffic for the construction and operation of the ACP with a production capacity of 3.5 million SWUs potentially expandable to 7 million SWUs, were evaluated in the 2006 ACP EIS (NRC, 2006b). As discussed in Section 4.2.11.1 of the 2006 ACP EIS, it was estimated that during construction, up to 2,286 truck round trips (or 20 daily vehicle trips) could occur for any single year. The majority of new daily vehicle trips generated during construction would result from commuting workers and would have the greatest impact on delays and congestion on local roadways. The greatest impacts would occur during peak commuting hours, especially on US-23 as it directly serves the ACP site. The 2006 ACP EIS estimated that as many as 1,306 construction workers could generate 2,612 daily vehicle trips (or 1,306 vehicle trips during the peak commuting hours). The 2006 ACP EIS concluded that increased traffic volumes during construction would result in MODERATE impacts.

Operation

As discussed in Section 4.2.11.2 of the 2006 ACP EIS (NRC, 2006b), it was estimated that operation of the proposed facility would require 3,134 annual truck round trips (or 24 daily vehicle trips) for nonradiological and radiological transportation. Additionally, it was estimated that as many as 795 workers could generate 1,113 daily vehicle trips, but only 199 vehicle trips would be likely to occur during the peak commuting hours due to the shift schedule. As presented in Table 4-9 of the 2006 ACP EIS, the total number of daily vehicle trips was estimated to be 1,137, with the majority of that generated by the commuting workers. The 2006 ACP EIS concluded that during operation of the proposed facility, increased traffic volumes would result in SMALL traffic impacts.

Construction and operation of a new HALEU enrichment facility would also occur at the same site that was analyzed for the proposed ACP facilities and would, therefore, impact the same roadways analyzed in the 2006 ACP EIS (NRC, 2006b). It is expected that the number of vehicle trips generated from employees during construction and operation of the HALEU enrichment facility would be fewer than the numbers estimated in the 2006 ACP EIS and that potential traffic impacts from a new HALEU facility would be within the level of impacts determined in that EIS. Based on a review of recent AADT data, US-23 and OH-32 would have the daily design capacity to handle the incremental increase in traffic volumes as the AADT volumes have increased only slightly since the traffic analysis was conducted for the 2006 ACP EIS. Therefore, traffic impacts for a new HALEU facility would be considered MODERATE during construction and SMALL during operation.

3.3.13.3 GLE Site – Wilmington, North Carolina

Baseline Changes

The primary roadways that serve the GLE site are discussed in Section 3.10.1 of the GLE EIS and are presented in Table 3-11. This table also includes the AADT volumes that were presented in Table 3-17 of the GLE EIS and AADT data from the most recent available years obtained from the North Carolina Department of Transportation (NCDOT, 2023a).

Table 3-11. AADT Volumes (Years 2008 and 2019 AADT) Near the GLE Site

Road	*Location*	*2008 AADT*	*2019 AADT*	*Percent Change*
Castle Hayne Road	South of Sonday Road	13,000	12,500	-4%
	North of McDougald Drive	10,000	10,500	5%
	North of I-140 near site entrance	12,000	12,000	0%
	South of I-140	12,000	14,000	20%
	North of Old Mill Road	14,000	13,500	-4%
	North of Kerr Avenue	17,000	17,000	0%
I-140	West of Castle Hayne Road	16,000	23,500	50%
	East of Castle Hayne Road, West of I-40	18,000	26,500[a]	50%
	East of I-40	14,000	25,500[a]	80%
I-40	North of I-140	30,000	38,000	30%
	South of I-140	27,000	37,500	40%

Source: (NRC, 2012b; NCDOT, 2023a)

Key: % = percent; AADT = annual average daily traffic; GLE = Global Laser Enrichment; I-40 = Interstate 40; I-140 = Interstate 140

Note:

[a] 2019 AADT not available; AADT shown is from 2018.

Since publication of the GLE EIS (NRC, 2012b), AADT traffic volumes on Castle Hayne Road near the GLE site generally remain the same. The greatest increases in traffic volumes occurred on I-140 and I-40, though it is expected that excess daily design capacities still remain for these roadways (USDOT, 2017).

Construction

Traffic impacts from the construction and operation of the proposed 6 million SWUs GLE facility was evaluated in the GLE EIS (NRC, 2012b). Section 4.2.10 of the GLE EIS noted that a new entrance, an extension of the existing North Entrance to the site off of Castle Hayne Road, would be provided for motor vehicle traffic. As noted in Section 4.2.10.1 of the GLE EIS, it was estimated that approximately 35 truck round trips per day (or 70 vehicle trips per day) would be added to the local traffic on average over the construction period. Additionally, as presented in Table 4-11 of the GLE EIS, it was estimated that commuting workers would result in an average increase of up to 1,428 daily vehicle trips (or 680 vehicle trips during the peak a.m. commute hour) for peak construction activities. The GLE EIS noted the heaviest traffic volumes would occur in the immediate vicinity of the site entrance on Castle Hayne Road and near the on-ramp and off-ramp of I-140. The GLE EIS concluded the increased traffic volumes during construction would have SMALL to MODERATE impacts.

Operation

As discussed in Section 4.2.10.2 of the GLE EIS (NRC, 2012b), it was estimated that operation of the proposed GLE facility would require approximately 2,100 truck round trips (the GLE EIS noted that approximately 6 truck round trips per day, on average [or 12 vehicle trips per day]) for radiological transportation for any single year. Although the GLE EIS did not provide truck volume estimates for nonradiological transportation, it is assumed that any resulting truck volumes would be substantially smaller than traffic generated from operational personnel, especially during peak commute hours when roadways experience the highest traffic volumes. The GLE EIS estimated that approximately 350 permanent operations personnel would generate 140 vehicle trips during the a.m. peak commute hour and 735 average daily vehicle trips as presented in Table 4-11 of the GLE EIS. The GLE EIS concluded the increased traffic volumes during operation would have SMALL to MODERATE impacts.

Construction and operation of a new HALEU enrichment facility at the GLE site is assumed to occur in the same areas designated for development of the uranium enrichment facility evaluated in the GLE EIS and would, therefore, impact the same roadways analyzed in the GLE EIS (NRC, 2012b). Given that the size of the HALEU enrichment facility would be substantially smaller than the proposed GLE facility (1.1 million SWUs versus 6 million SWUs), it is anticipated that new traffic volumes during construction and operation would be less than or similar to those estimated in the GLE EIS. Therefore, impacts on Castle Hayne Road would be within the level of impacts determined in the GLE EIS as recent AADT volumes on this roadway near the site generally remain the same. However, I-140 and I-40 experienced high increases in AADT volumes since 2008 and, therefore, traffic congestion and delays could be detected during peak commuting hours but would be within the daily design capacity of these roadways. Therefore, overall traffic impacts during construction and operation of the HALEU facility would have SMALL to MODERATE impacts.

3.3.13.4 New HALEU Enrichment Facility (Generic Site)

Site selection for a HALEU enrichment facility is expected to include criteria for adequate site access and transportation infrastructure. These could include existing and projected AADT volumes and corresponding level of service values on principal roadways serving the site; weight and size restrictions along potential truck routes; and major land development and/or infrastructure projects that would directly impact the principal roadways. Any project-related traffic studies conducted for the Proposed Action would be coordinated with local, county, and state transportation departments. Traffic impacts would vary based on site-specific conditions but would likely be SMALL to MODERATE for construction for both industrial and undeveloped sites.

3.3.14 Socioeconomics

Major industrial projects have the potential to affect the socioeconomic dynamics of the communities in or around which they are situated. Capital expenditures and the migration of workers and their families into a community may influence factors such as regional income; employment levels; local tax revenue;

housing availability; and area community services such as healthcare, schools, and law enforcement. The proposed action includes potential construction and operation of a new HALEU enrichment facility at three uranium enrichment sites, all of which have been evaluated in previous NEPA documents. These previous documents include a thorough characterization of each site's ROI with respect to population, employment, income, tax structure and revenue, housing, and community services (e.g., schools, hospitals/medical facilities, law enforcement and firefighter services). Where appropriate, this information is incorporated by reference.

The Technical Report analysis uses the same regions of influence as used in previous NEPA analyses to evaluate socioeconomic impacts, while considering projected workforce requirements for a potential new HALEU enrichment facility and more recent socioeconomic data, to identify any significant updates or changes in overall growth trends (increase or decrease) that could affect the analysis and potential impacts from the proposed facility. In general, the projected direct and indirect jobs from construction and operations activities associated with the Proposed Action, and the associated in-migrating population that might move into the area as a result, are either similar to (e.g., construction) or smaller (i.e., operations) than the levels projected in previous NEPA analyses.

The evaluation of employment impacts typically includes estimating the level of direct and indirect employment created by the proposed action. Direct employment refers to jobs created by the proposed construction activities and facility operations. Indirect employment refers to jobs created in the ROI to support the needs of the workers directly employed by the proposed action and jobs created to support site purchase and non-payroll expenditures. The number of direct jobs created in each stage is estimated based on anticipated labor inputs for various engineering and construction activities. Indirect employment was typically estimated using an economic model known as an input-output model (RIMS-II). The relative magnitude of the impact on regional employment is assessed by comparing total project-generated employment to current regional employment levels. The methodologies for assessing socioeconomic impacts in each of these areas—both quantitative and qualitative approaches—are generally similar and described in detail in each of the previous analyses. They are still valid for this analysis and incorporated by reference, as noted in each of the site-specific discussions.

To tailor the affected environment discussion to a level commensurate with the potential for impact, the characterization of socioeconomic data in the Technical Report focuses primarily on population, employment and unemployment, income and housing data, where the potential for adverse impact is greatest. With respect to impacts on community services, it is assumed that the potential impacts from an in-migrating population on existing population levels in the ROI would serve as a surrogate for analyzing potential impacts on each of the community services that support that population currently. As such, this analysis does not include a discussion of community services within the ROI where the potential increase in population would be very small (e.g., generally less than 0.1% of the existing population). At such small levels it is assumed that the level of community services currently available to the population would be sufficient to accommodate the small population influx resulting from the proposed action. Detailed characterizations of these services have been included in previous NEPA documents (and show growth rates in staffing levels since the previous analysis). These descriptions are considered sufficient for purposes of the Technical Report and incorporated by reference. Only where concerning trends were identified during the data update effort that could affect the potential for impact, such as where levels of services have declined in recent years, are new data introduced in the site-specific discussions below.

Similarly, it is assumed that the potential increases in income levels and tax revenues (e.g., corporate tax, sales tax, state income tax), which would be considered a beneficial impact from the proposed action on the economy, would be commensurate with both the number of new jobs the project creates and the associated in-migrating population associated with those new jobs. In general, the pay for these jobs would be considerably higher than the median household income of many of the counties within the ROI. This analysis does include updated income information (median household and per capita), but it does not include updated discussions of tax structures and distribution regarding principal sources of revenue within each ROI. Each has been characterized in previous documents and these discussions are considered sufficient for purposes of the Technical Report; they are incorporated by reference as noted in the following site discussions.

This section describes select and current socioeconomic conditions within the ROI of the proposed action for three different locations. The ROI for each site is defined as a multi-county region encompassing the area where the majority of proposed workers for HALEU enrichment would be expected to reside and spend most of their salary, and in which a significant portion of site purchase and non-payroll expenditures from the construction, operation, and decommissioning phases of the proposed action are expected to take place.

3.3.14.1 UUSA Site – Eunice, New Mexico

The ROI for a potential new HALEU enrichment facility at the UUSA site in Lea County, New Mexico, would encompass a 75-mile area surrounding the existing UUSA facility, including Lea County, New Mexico, and Andrews and Gaines Counties, Texas, as well as portions of Eddy County, New Mexico, and Ector, Loving, Winkler, and Yoakum Counties, Texas. The majority of impacts are expected to occur in Lea County, given its larger population and workers living in closer proximity to the current facility, and to a lesser extent, in Andrews and Gaines Counties, Texas. Portions of the other counties are within the ROI but are not expected to be impacted to any great extent. Therefore, for purposes of this analysis and consistent with past NEPA analyses for this site (NRC, 2005a; NRC, 2015) the ROI herein is characterized with respect only to Lea County, New Mexico, and Andrews and Gaines Counties, Texas. As explained in the 2005 NEF EIS, the ROI was expanded to include a 120-km (75-mile) radius around the proposed site to capture higher-paying skilled construction jobs that may not be found in the immediate area surrounding the proposed site but could be filled outside of this area. Because of the region's rural road system, workers often commute longer distances than the 80 km (50 miles) assumed for other parts of the country.

The 2005 NEF EIS for the original uranium enrichment facility projected an 800-person peak construction workforce (direct), with an additional 1,200 indirect workers, for a total of 2,000 peak jobs; these figures were used to determine an average of approximately 400 direct workers and 592 indirect workers, for a total of nearly 1,000 average annual jobs (NRC, 2005a). Similarly, the 2015 UUSA EA (NRC, 2015) on the proposed UUSA facility expansion also projected a stable construction workforce of 800 workers for the first 5 years of construction (presumably direct workers; no indirect workers are called out in the EA).

The 2005 NEF EIS projected an operations workforce of 210 personnel, which was estimated to support an additional 173 indirect jobs in the ROI, for a total of 383 jobs (NRC, 2005a); the 2015 UUSA EA for the proposed facility expansion (NRC, 2015) projected an increase of only 8 employees (from 250 to 258) to cover operations at both the original and expanded facility.

New HALEU enrichment facility workforce requirements include:

- **Construction** – The proposed HALEU enrichment/production capabilities are significantly smaller than levels previously proposed (and currently licensed) for the UUSA facility in the 2005 NEF EIS (NRC, 2005a). Therefore, the Leidos Team assumes that a new HALEU enrichment facility would likely require a smaller footprint than the facility (or facilities) previously analyzed and would likely result in a slightly smaller construction workforce. However, the construction workforce requirements analyzed for the proposed facility expansion in 2012, which significantly increased enrichment production levels compared to the original facility, assumed the same number of peak construction workers (800) as analyzed in the 2005 NEF EIS (800) (NRC, 2005a). Therefore, this analysis assumes the same peak construction workforce of 800 workers for a new HALEU enrichment facility, to conservatively bound the analysis.

- **Operation** – Given that enrichment capabilities already exist on the site, and the proposed expansion activities require only a very small increase in operations personnel (8 workers, or 3.2% of the existing workforce), this analysis assumes that the operations workforce would be approximately 20% of the operations workforce analyzed in the 2005 NEF EIS (210) (NRC, 2005a), a conservative assumption, which would result in an increase of 42 workers. The potential increase in workers seems reasonable given the potential to transition over some of the existing workforce to support HALEU enrichment activities, and the ability to incorporate economies of scale and process and manufacturing modifications in facility design to help further reduce the operations workforce requirements.

Table 3-12 summarizes the change in population, employment and housing data for the ROI since 2000, on which the original facility evaluation was based.

Table 3-12. Socioeconomic Data for the Region of Influence 2000–2022 (UUSA – Eunice, New Mexico)

ROI	***2000*** *(NRC, 2005a)*	***2010*** *(USCB, 2023a)*	***2020–2022*** *(USCB, 2023a; USCB, 2023b; USCB, 2023c)*
Population	82,982	97,039	114,663 in 2020 112,967 in 2022
Labor force	33,573	--	50,358 (2021)
Employment	30,778	--	47,409
Construction	2,105	--	5,126
Unemployment rates	8.3	--	6.7 (2021)
Housing			
Total units	34,215	--	41,946
Occupied units	28,981	--	36,889
Vacant units	5,234	--	5,047
Housing, owner occupied	--	--	25,975
Percent vacancy rate/owner occupied	--	--	1.4% (368 vacant homes)
Number of rental units	--	--	11,981
Percent vacancy rental rate units	--	--	8.7% (1,043 vacant rental units)

Key: % = percent; -- = no data provided; NRC = U.S. Nuclear Regulatory Commission; NM = New Mexico; ROI = region of influence; USCB = U.S. Census Bureau; UUSA = Urenco USA

Note: No data was provided in source documents for areas shaded in gray.

Lea County is the most populated county in the ROI; its population in 2020 was 74,455. The county seat in Lovington had a population in 2020 of 11,668. About 20% of the population in Lea County lives in unincorporated areas. The county population has fluctuated over the past several decades due to the expansion and contraction of the oil industry. Since 2000, Lea County population has risen steadily, and experienced a 15% growth rate between 2010 and 2020. However, the population has declined by 2.7% in the last 2 years. And while population levels in Andrews and Gaines Counties have remained more stable, the overall ROI population also dropped between 2020 and 2022, by 1.5%. If present trends continue, the population would be projected to decline through the remainder of the decade, although for the ROI as a whole, the population would remain stable if the populations of Andrews and Gaines Counties increase (Gaines County has shown a steady increase through 2022) (USCB, 2023a).

The total number of housing units in the ROI has increased by 27.3% between 2000 and 2021, although the vacancy rate has decreased, from 15.3% in 2000 to 12% in 2021. This data compares to a housing vacancy rate of 14.9% in New Mexico and 10.4% in Texas in 2021. The number of vacant housing units has dropped slightly for the ROI since 2000: from 5,234 to 5,047 (USCB, 2023c).

The median household income in the ROI has fluctuated like the population levels, tied to shifts in employment from relatively high-paying jobs in the oil and gas industry to lower-paying jobs in the service sector. In 2021, the median household income in Lea County ($62,319) exceeded the median household income for New Mexico ($54,020); and the median incomes in Andrews and Gaines Counties exceeded the median household income in Texas ($67,321). Andrews County had the highest median household income within the ROI at $80,518. Petroleum production, processing and distribution, and agriculture were the dominant industries in the ROI in 2021, along with the educational services and healthcare (each industry makes up approximately 20% of the median household income); construction also comprises a large percentage of the median income in Gaines County (19%) (USCB, 2023b).

Unless otherwise noted (based on previous NEPA analysis), for purposes of the Technical Report, socioeconomic impacts are defined as follows:

- Employment/economic activity: SMALL is < 0.1% increase in employment; moderate is between 0.1% and 1% increase in employment; and large is defined as greater than (>) 1% increase in employment.
- Population/housing impacts: SMALL is < 0.1% increase in population growth or < 20% of vacant housing units required; moderate is between 0.1% and 1% increase in population growth and/or between 20% and 50% of vacant housing units required; and large impacts are defined as > 1% increase in population growth and/or > 50% of vacant housing units required (DOE, 1999; NRC, 2013a).

Construction

The type of construction workers needed would be expected to include electricians, carpenters, pipe fitters, plumbers, and other skilled and unskilled workers. While a large proportion of construction workers would be expected to come from within the ROI, as construction progresses there would be a gradual shift from structural trades to mechanical and electrical trades. The majority of these higher-paying skilled jobs would be expected to be filled outside the immediate area. The 2005 analysis (NRC, 2005a) assumed that 15% of the peak construction workforce (800) would be obtained from outside the region (approximately 120 workers, or 800 × 0.15); that 65% of those in-migrating would bring their families, which would include, on average, a worker, a spouse, and one school-age child. This would result in a total population increase in the area at peak construction of about 280 residents and half as many on average over the entire construction period.

However, the NRC, in its 2015 UUSA EA (NRC, 2015) for the proposed expansion—which also identified a peak construction workforce of 800 and even defined a smaller ROI that included only Lea County, New Mexico, and Andrews County, Texas—determined that impacts on employment (and all other socioeconomic impacts from proposed expansion/construction) would be SMALL. They came to this impact level for several reasons including: UUSA anticipates only modest changes in employment during construction; UUSA construction employment represents a relatively small percentage of the total labor force in the ROI; and, unlike in the original analysis, all UUSA construction employees are likely to come from communities within the ROI because this would be essentially the same, already present labor force that was used for the construction of the presently licensed facility, meaning no in-migrating population). Using the same reasoning above and assuming the same local workforce would be available to support future construction of a new HALEU enrichment facility, then the socioeconomic impacts from construction of any new HALEU enrichment facility would also be expected to be SMALL. However, in the event some new workers would in-migrate, the Leidos Team has continued with the results of an upper bound, or more conservative analysis, similar to that conducted for the original facility in 2005.

An increase of 280 residents would represent only 0.02% of the ROI population in 2022 (USCB, 2023a). Impacts on the population and to the supporting community services would be SMALL.

The nearly 400 new construction jobs (8-year average) would represent about 12% of the Lea, Andrews, and Gaines Counties construction labor force and 7.8% of the construction labor force of the combined 8-county region. However, compared to the total labor force in the ROI, which totals over 50,000, the proposed worker influx would represent only 0.9% of the ROI labor force (400 jobs on average), and 0.8% in the combined county area (USCB, 2023b). Therefore, the impact on local employment during construction operations would be MODERATE.

The direct spending or local purchases made by UUSA would generate indirect impacts in other local industries—additional output, earnings, and new jobs. Estimating these indirect impacts is typically done using a regional input-output model and multiplier as described in the 2005 NEF EIS (NRC, 2005a). The multipliers measure the total (direct and indirect) changes in output (i.e., spending, earnings, and employment). The original analysis concluded that the projected increases in annual construction spending levels would generate additional annual output of $67.9 million and earnings of $18.7 million for each year the facility is under construction (2005 NEF EIS Section 4.2.8 and Appendix F). Additional spending on goods, services and wages would create an additional 582 indirect jobs on average, rising to nearly 1,200 indirect jobs during peak construction year. The economic impacts of construction to the ROI were determined to be MODERATE, and this same level of impact would be expected from the proposed action. It should be noted that this impact would be beneficial to the local and regional economies.

Similarly, the tax revenue impacts of construction activities to Lea County and the city of Eunice would be expected to be MODERATE, as determined in the 2005 analysis (NRC, 2005a), given the size of current property tax collections and gross receipts taxes received from the State of New Mexico; this impact would also be considered a beneficial one.

The original analysis also found the impacts on housing to be SMALL based on the 15.3% vacancy rate in 2000. The number of vacant housing units has dropped slightly since the 2005 analysis (from 5,234 units to 5,047) (NRC, 2005a). But an influx of 120 workers (peak) or an average of 60 workers (average) during the period of construction would represent only a 2.4% or 1.2%, respectively, of the available housing units. Therefore, impacts from the proposed action also would be expected to be SMALL.

Operation

It is not known what percentage of proposed operations workforce (42) would in-migrate into the area, but assuming half (21) would come in and 65% would bring their families (with one school-age child), as assumed in the construction impact analysis, then approximately 45 persons would in-migrate into the area. This estimate represents 0.04% of the ROI population. An influx of 21 new workers to the ROI would represent 0.04% of the labor force in the ROI; and 21 workers seeing housing would represent 0.4% of the vacant housing units available. The creation of permanent jobs would lead to some additional demands for public services. However, this increase in demands would be SMALL in the ROI given the expected level of in-migration. In summary, because of the small population increase from proposed operation of the HALEU enrichment facility, all socioeconomic impacts would be SMALL.

3.3.14.2 Centrus Site – Piketon, Ohio

It is assumed that any proposed new HALEU enrichment facilities would be located at the DOE Portsmouth site in Piketon, Ohio (formerly the Portsmouth Gaseous Diffusion Plant site). NEPA documents for enrichment activities at the site include one for Centrus Energy Corporation's proposed ACP (NRC, 2006b), and DOE's HALEU Demonstration Project (NRC, 2021c). The ROI for the Proposed Action includes the same four counties in southern Ohio as defined in the other NEPA documents: Jackson, Pike, Ross, and Scioto Counties. It is the same as that evaluated previously by the NRC for the proposed NRC license and license amendment for the proposed American Centrifuge Project, also to be located at the DOE Portsmouth site in Piketon, Ohio (NRC, 2006b; NRC, 2021c). These four counties were selected primarily on the basis of the residential locations of USEC (now Centrus) workers at the DOE reservation in 1995—where 92% of the workers resided—when the Portsmouth Gaseous Diffusion Plant was in operation (it closed in 2001).

As reported in the 2006 ACP EIS (NRC, 2006b), the USEC (now Centrus) employed a total of 1,223 workers at the site, as of January 2004. According to the more recent 2021 ACP Amendment EA (NRC, 2021c), the licensee (American Centrifuge Operating, LLC) employed 67 workers at the time the license amendment request (LAR) was submitted.

Estimated Workforce: (USEC, 2006, pp. Tables 4.10-3 and 4.10-4); (NRC, 2006b)

The 2006 ACP EIS (NRC, 2006b) projected a USEC peak construction workforce of 900 workers (direct), with an additional 2,088 indirect jobs linked to construction and 374 new (direct construction contractor) jobs, for a total of 3,362 average annual jobs.

The 2006 ACP EIS (NRC, 2006b) projected an operations workforce of 600 personnel, which was estimated to support an additional 950 indirect jobs in the ROI.

There are several Workforce Assumptions in the Technical Report:

- Because of the substantially smaller scale of the proposed project compared to the ACP, it is assumed that any new facility footprint would be considerably smaller, thus requiring a smaller construction workforce than analyzed in the 2006 ACP EIS. In addition, it is assumed that economies of scale and process and manufacturing modifications would further reduce the operations workforce requirements.
- For purposes of this analysis, it is assumed that (1) the peak construction workforce requirements would be approximately one-third of the construction workforce (direct) analyzed previously: 300 workers (direct) with an additional 820 indirect jobs linked to construction (2.73 multiplier), for a total of 1,120 average annual construction jobs in the ROI; and (2) the operations workforce would be approximately 20% of the operations workforce (direct) analyzed previously: 120 direct workers and an additional 190 indirect jobs (1.6 multiplier), for a total of 310 average annual operations jobs in the ROI.
- In the previous analysis, NRC assumed that the majority of construction and operations jobs would be filled by USEC employees transitioned from the Portsmouth Gaseous Diffusion Plant (NRC, 2006b; USEC, 2006). Because of the substantially smaller on-site workforce today, which dropped from 1,223 in 2005 to 67 in 2020, at the time the LAR was submitted (NRC, 2006b; NRC, 2021c), the Technical Report considers the full projected workforce estimates (direct and indirect) in assessing socioeconomic impacts from construction and operation activities.

A review of past NEPA documentation for the Piketon site (NRC, 2021c) indicates that the ROI experienced negative growth between 2008 and 2020; our review of the most recent U.S. Census Bureau (USCB) data (2021–2022 data) reveals that this decline has continued, with respect to population, employment, and housing (at least in terms of vacancy rates and housing availability). Table 3-13 summarizes the change in these data for the ROI since 2000, on which the original evaluation was based, and shows the decline since 2010.

Table 3-13. Socioeconomic Data for the Region of Influence 2000–2022 (Centrus – Piketon, Ohio)

ROI	*2000 (NRC, 2006b)*	*2010 (ACO, 2020)*	*2018–2020*	*2021 (except 2022 for population)*	*Percent Change (as specified below)*
Population					
Population	212,876	219,497	210,842 (2020) [a]	208,391 (2022) [a]	-5.1% (2008–2022)
Employment					
Labor force	--	96,333 (2008)	84,186 (2018) [b]	87,076 (2021) [c]	-9.6%
Employment	96,347	85,485 (2008)	82,108 (2018) [b]	81,171 (2021) [c]	-5%
Unemployment rates	7.7 / 5.5 (2002)	8.1 (2008)	6.0 (2018) [b]	6.7 (2021) [c]	--
Housing					
Total housing units	--	82,358 (2010)	--	91,867 [d]	+ 11.5%
Occupied	--	--	--	80,446 [d]	
Vacant	--	--	--	11,421 [d]	
Housing, owner occupied	58,246	58,264	--	56,369 [d]	-3.2%
Percent vacancy rate/owner occupied	1.8 1,048	2.1	--	1.45% (817 vacant homes) [d]	-22%
Number of rental units	22,824	25,547	--	24,977 [d]	+9.4%
Percent vacancy rental rate units	8.6 1,963	8.7	--	3.6% 900 (vacant rental units) [d]	-54%

Key: % = percent; -- = no data provided ACO = American Centrifuge Operating; NRC = U.S. Nuclear Regulatory Commission; ROI = region of influence; USCB = U.S. Census Bureau

Notes: No data was provided in source documents for areas shaded in gray.

[a] Source is USCB (2023a)

[b] Source is ACO (2020)

[c] Source is USCB (2023b)

[d] Source is USCB (2023c)

Population in the host county (Pike) and three of the major population centers in the ROI (Piketon, the closest town to the site; Portsmouth, and Jackson) all dropped slightly, while Chillicothe, the largest population center in the ROI, increased, from 21,901 in 2010 to 22,059 in 2022 (USCB, 2023a).

County-specific employment trends, by industry, were updated for the current period (USCB, 2023b), as summarized below. Previously, Pike County showed a substantially higher rate of manufacturing employment and Scioto County showed the highest rate of services employment (NRC, 2006b). In 2021, Jackson County showed the highest rate of manufacturing employment (20%) compared to 13.7% in Pike County (down from 38.5% in 2000); and all four counties showed their highest rate in education/healthcare community services. Services employment ranged from 25% in Jackson County to a high of 31.3% in Scioto County; service employment in Pike County was a close second at 29.2%. Construction employment ranged between 5.7% in Ross County to 10.1% in Jackson County. Total construction employment in the ROI is 6,079; this is an increase over the total ROI construction workforce in 2000 (4,458), although construction workforce data were not available for Jackson County for 2000 (556 construction workers in 1990) (NRC, 2006b).

The ROI unemployment rate decreased, from 8.1% in 2008 to 6.7% in 2021, although it is higher than Ohio's average unemployment rate of 5.2% in 2021 (USCB, 2023b).

Owner-occupied housing units account for 70% of the total occupied housing units, while renter-occupied units accounted for 30%, a breakout similar to what it was in 2000. However, the vacancy rate in the ROI—owner-occupied, and rental—has dropped to 2.1% in 2021 (down from 3.6% in 2000), indicating that just over 1,700 units are available for occupancy (down from approximately 3,000 in 2000) (USCB, 2023c).

A closer look reveals that the number of housing units in 2021 are slightly higher for total rental units, but slightly lower for owner-occupied units; and the number of available housing units has decreased overall since 2000. Owner-occupied vacancy rates for the ROI decreased overall, dropping from 1.8% in 2000 to 1.4% in 2021, with the corresponding decrease in the number of vacant owner-occupied units, from 1,048 in 2000 to 817 in 2021. While the number of rental units increased in the ROI, from 22,824 in 2000 to 24,977 in 2021, and increasing in every county except Jackson, the rental vacancy rates decreased in each county and in the ROI between 2000 and 2021. The rental vacancy rate in the ROI decreased from 8.6% in 2000 to 3.6% in 2021, resulting in a corresponding decrease in the number of available rental units, from 1,963 in 2000 to 900 in 2021 (USCB, 2023c).

While the number of schools and teachers in a 5-mile radius of the site has declined since the 2005 analysis, there remains within the ROI a total of 76 public schools and 10 private schools with approximately 31,400 students and 2,300 teachers (ODOD, 2023). The region's student-to-teacher ratio stood at 13.6 in 2021 (ODOD, 2023). In addition, Pike Community Hospital, the only registered (70-bed) hospital identified for the county in the 2006 ACP EIS, is now known as Adena Pike Medical Center. It has 25 beds and is 1 of 3 critical access hospitals in Ohio (Adena Health, 2023); there are 19 physicians in the county (ODOD, 2023). Within the ROI, there are a total of 5 hospitals (with 757 beds) and 394 physicians; there were 329 physicians in the ROI in 2000.

Law enforcement and fire station/firefighter resource information were identified for the ROI in the 2006 ACP EIS (NRC, 2006b). Firefighter data either has not changed much or was not updated; the closest career fire departments include Portsmouth and Chillicothe Fire Departments. Note that the Federal Bureau of Investigation data source for law enforcement officers no longer includes data for the counties within the ROI so the previous data, which are carried forward below, cannot be verified. According to the 2006 ACP EIS (NRC, 2006b), Pike County, where the DOE reservation is located, has 19 officers and provides law enforcement to the site. Other counties in the ROI have a total of 101 full-time officers: 16 in Jackson, 32 in Piketon, and 53 in Scioto. The data for fire stations and firefighters in the ROI do not appear to have noticeably changed.

The previous analysis also included a detailed description of the existing tax/revenue structure and distribution within the ROI, including the general structure of the state income tax, state sales tax, and county-level tax revenues (Section 3.9.4 of the 2006 ACP EIS) (NRC, 2006b). This information was not updated but is considered relevant and applicable to the Proposed Action and is incorporated by reference.

Construction

The Leidos Team has reviewed previous environmental evaluations, the licensee's Environmental Report, and independent sources (e.g., Census Bureau data) and made a determination of the potential impacts of new HALEU enrichment activities at the Piketon site based on current socioeconomic and demographic information. As noted previously, the previous analysis identified SMALL impacts based on the assumption that the majority of construction workers would be transitioned over from a robust on-site workforce that is not present at the site today. Current on-site employment levels have dropped substantially since 2005. According to the NRC, the ACP employed 67 workers at the time the LAR was submitted in 2020 (NRC, 2021c). For purposes of this conservative analysis for the proposed action, it is assumed that all jobs would employ new workers to support construction-related activities (no transitioning from existing on-site workforce). This analysis does incorporate the same assumptions as used in the previous analysis, however, relating to a potential in-migrating workforce and population, including:

- An average of 75% of construction-related employment commonly derives from within the ROI (DOE, 1999), which means 25% of the construction-related jobs (direct and indirect) would be filled from outside the region.
- All workers would move in as family households.

If 25% of the 1,120 construction-related jobs (direct and indirect) are filled from outside the region, a total of 280 workers (in-migrating) may be expected to move into the region. If all workers are assumed to move in as family households and the average national family household size is assumed to be 3.15 (USCB, 2023a), the population influx into the ROI would be 882 persons. This represents 0.4% of the region population in the year 2020 (USCB, 2023a). The estimate used for household size is conservative because it represents the average size of a family household (3.13), rather than the average size of all households (2.4 for Ohio and 2.6 for the United States). This conservative assumption may result in an overestimate of the impacts on community services. The impacts of this population influx to existing population characteristics in the ROI would be considered SMALL.

The total number of persons employed in the ROI in the year 2021 was 81,171, and in Pike County, the host county for the proposed project and DOE's HALEU Demonstration Project, was 10,185 (USCB, 2023b); these numbers are lower than employment levels in 2000. The employment expected to be generated by the site preparation and construction phase of the proposed action represents 1.1% of the total employment in the ROI and 8.6% of Pike County employment in the year 2021. The unemployment rate for the ROI and for Pike County were 6.7% and 5.2%, respectively, in 2021. Based on these figures, the impacts on regional employment from construction activities are considered SMALL, although the county-specific impacts for Pike County could be MODERATE.

Comparing only direct construction jobs (280) to construction workforce numbers in the ROI for 2021 (6,059), the projected construction workforce estimate would represent 4.6% of the total construction workforce; the impacts on the regional construction industry would be SMALL to MODERATE.

Workers employed by the project are expected to live and spend most of their salary in the ROI, and a significant portion of site purchases and non-payroll expenditures also are expected to occur in the ROI. The previous analysis calculated potential impacts on tax revenues by using per capita income levels in the ROI as an estimate of the average salary associated with jobs created by the construction phase of the proposed action. As described in the 2006 ACP EIS (NRC, 2006b), state income tax, state sales tax, and county-level tax revenues would be expected to increase as a result of the increased workforce and in-migrating population associated with the construction phase of the Proposed Action. However, the increases were determined to be small, and the impacts were characterized as SMALL (Section 4.2.8.2 of the 2006 ACP EIS) (NRC, 2006b). Because the percentage increase in population and employment numbers in the ROI also would be considered generally small under the Proposed Action, the overall impacts on regional tax revenues would be SMALL.

The average rental vacancy rate in the ROI is 3.6% (down from 8.6% in 2020) for rental property and there are approximately 24,977 rental units in all. This data equates to an availability of approximately 900 rental housing units, based upon 2021 USCB data. Adding in the vacant housing from owner-occupied units (available for sale), 817 units at a 1.45% vacancy rate in the ROI, would increase the vacant housing units to 1,717. If 280 workers and their families move into the region, then construction activities are likely to increase the demand for available vacant housing by 280 units out of a total of 1,717 (rental and owner-occupied) units, or 16.3%. Thus, the regional impact from this influx of workers on available housing units in the ROI would be considered LARGE, resulting in housing shortages and potential increases in rental rates. However, these forecasted impacts are a conservative finding based on the assumption that all operations workers in-migrate to the ROI and bring their families, and that no new housing units are constructed in the area prior to the start of project construction.

A total of 280 family households may be expected to migrate to the ROI as a result of employment opportunities generated in the construction phase of the proposed action, as discussed above. According to the NRC (2006b), the national average family household size includes an average of 0.95 individuals under the age of 18. Thus, the maximum influx of school-age children would be approximately 266 students, which represents 0.8% of the ROI school population in the year 2021. Impacts on education services in the region would be considered SMALL. Similarly, levels of service of fire, law enforcement, healthcare, and administrative services in the ROI are lower than the state average but are consistent with those levels of service typically found in rural counties. The influx of 882 persons represents an augmentation of the region's population of 0.4% and would have a SMALL effect on fire, law enforcement, healthcare, and administrative levels of service.

Note that while potential impacts on the schools and healthcare in the ROI would be SMALL, impacts on host Pike County may be SMALL to MODERATE given the decrease in the number of schools and enrollment, and hospital beds in that county, including within an 8 km (5-mile) radius of the project site, since 2000.

Operation

The Technical Report assumes that the estimated operations phase of the proposed project is expected to create 120 full-time jobs and 190 indirect jobs in the ROI, for a total of 310 jobs. Because operations jobs would require a more specialized skill set, a larger percentage of the workforce would be expected to in-migrate into the ROI. However, even if all the direct workers (120) and 25% of the indirect workers (approximately 50) in-migrated into the area, and all brought their families (including approximately 160 school-age children), that population increase would still result in a smaller increase in employment (170 workers) and total population (535) in the ROI than what is expected during the construction phase. Therefore, the impacts from the proposed action on population, employment, education, and community services from an in-migrating operations workforce would be considered SMALL, similar to the impacts from construction.

With respect to housing, a population influx into the ROI of 170 families would increase the demand for available vacant housing by 170 units out of a total of 1,817 (rental and owner-occupied) units, or 9.3%. Thus, the regional impact from this influx of workers on available housing units in the ROI would be considered MODERATE to LARGE, resulting in potential housing shortages and potential increases in rental rates. As described for construction, this is a conservative finding based on the assumption that all operations workers in-migrate to the ROI and bring their families, and that no new housing units are constructed in the area prior to the start of project construction (that might later be available to the operations workforce).

3.3.14.3 GLE Site – Wilmington, North Carolina

It is assumed that any proposed new HALEU enrichment facility would be located in the same area considered in the GLE EIS (NRC, 2012b). The ROI for the proposed site in Wilmington, North Carolina, corresponds to the Wilmington Metropolitan Statistical Area, a three-county area comprising Brunswick, New Hanover, and Pender Counties in North Carolina (NRC, 2012b; GEH GLE, 2008). Socioeconomic impacts for this ROI were evaluated previously in the GLE EIS and Environmental Reports related to the proposed GE-Hitachi GLE facility in Wilmington, North Carolina. This socioeconomic ROI was defined as the area where GLE workers and their families were expected to live and spend most of their income. These three counties cover an area of approximately 80 km (50 miles) from the proposed project site; the same ROI is considered for the proposed action in this analysis.

Estimated Workforce: (NRC, 2012b)

The GLE EIS projected a GLE peak construction workforce of 680 workers (direct), with an additional 3,131 indirect jobs linked to construction, for a total of 3,811 average annual jobs.

The GLE EIS projected an operations workforce of 350 personnel, which was estimated to support an additional 382 indirect jobs in the ROI.

There are several Workforce Assumptions in the Technical Report:

- Because of the significantly smaller scale of the proposed project compared to the GLE project, it is assumed that any new facility footprint would be significantly smaller, thus requiring a smaller construction workforce than analyzed in the GLE EIS. In addition, it is assumed that economies of scale and process and manufacturing modifications would further reduce the operations workforce requirements.
- For purposes of this analysis, it is assumed that the peak construction workforce requirements would be approximately one-third of the construction workforce (direct) analyzed previously, or 230 workers (direct) with an additional 1,040 indirect jobs linked to construction, for a total of 1,270 average annual construction jobs in the ROI.
- For purposes of this analysis, it is assumed that the operations workforce would be approximately 20% of the operations workforce (direct) analyzed previously, or 70 direct workers and an additional 76 indirect jobs, for a total of 146 average annual operations jobs in the ROI.

The previous analysis characterized the ROI with respect to socioeconomics using data from 2000 to 2008. This data was updated to the 2020 to 2022 timeframe, where relevant, and summarized in Table 3-14.

The population was 453,722 in 2021 (USCB, 2023a). The increase in the ROI population between 2008 and 2022 was 30.7% (up from 346,900); this represents an average annual rate of 2.2% since 2008. This growth rate was higher than the growth rate for North Carolina, 15.9%, over the same period. Each of the counties in the ROI experienced a similar trend in population growth since 2008. Roughly half of the ROI population is found in New Hanover County, whose population in 2022 was 234,921. The largest population center in the ROI is Wilmington, which had a population of 115,451 in 2020, up from a population of 106,576 in 2010, with a growth rate of 8.3% over that 10-year period.

The ROI population also includes institutional (i.e., school and hospital) populations, including a student enrollment of approximately 18,000 at the University of North Carolina Wilmington (UNCW, 2023); and a transient population consisting of visitors participating in various seasonal, social, and recreation activities within the local area, as described in the previous evaluation. Communities in the ROI experience large increases in population during the summer, with the summer population exceeding the off-season population by up to nearly 15% in 2008 (47,100 people) (GEH GLE, 2012, pp. 3-113); with the influx of summer tourists and temporary workers in the hospitality sector.

Table 3-14. Socioeconomic Data for the Region of Influence 2000–2022 (GLE – Wilmington, North Carolina)

ROI	***2000*** *(NRC, 2012b)*	***2008*** *(NRC, 2012b)*	***2020–2022 2021 unless noted***
Population	274,532	346,990	422,598 (2020) 453,722 (2022) [(a)]
Labor force	139,955	--	204,800 [(b)]
Employment	131,489	120,803 (for 2006; original source is USCB)	193,678 [(b)]
Unemployment rates	3.8 (1999–2008 average)	5.8 (2008) 10.4 (first part of 2009)	5.4 (11,129) [(b)]
Housing			
Total Units	**151,854**	**195,685**	**229,467** [(c)]
Occupied	--	--	178,317 [(c)]
Vacant	--	--	51,150 [(c)]
Housing, owner occupied	82,382	96,078 (2005–2007 – 3-year average)	123,821 [(c)]
Percent vacancy rate/owner occupied	1.8 1,048	--	--
Number of rental units	32,293	46,858	54,496 [(c)]
Vacant units (Seasonal and recreational use)	37,170 (22,808)	52,749	--
Percent vacancy rental rate units	8.6 1,963	--	--

Key: -- = no data provided; GLE = Global Laser Enrichment; NRC =U.S. Nuclear Regulatory Commission; USCB = United States Census Bureau

Notes:

[a] Source is USCB (2023a)

[b] Source is USCB (2023b)

[c] Source is USCB (2023c)

Total employment in the ROI stood at 193,678 in 2021. Over the past couple of decades, there has been a shift from government, construction, and farm sectors toward service and retail trade, manufacturing, and construction sectors within the ROI. Currently, the service sector remains the highest percentage of employment in the region. The unemployment rate for the ROI in 2021 was 5.4%, which was very similar to that for the state of North Carolina at 5.3%. Ranging between $62,362 in New Hanover County and $65,681 in Pender County, the median household income for the ROI and each county is slightly higher than the state, at $60,516 (USCB, 2023b).

Housing stock in the ROI has grown over the years, although vacancy rates seem to be in a general decline. The overall vacancy rate in 2021 was 22.3%, with 51,150 vacant housing units in the ROI. This data compares to a 27% vacancy rate and 52,749 vacant housing units in the ROI in the 2005–2007 timeframe. Currently, there are nearly 230,000 in the three counties, with roughly half of these located in New Hanover County and another third in Brunswick County. The majority of housing units in the region are single-family structures, with approximately half of these located in New Hanover County. There is also a large percentage of mobile homes in Brunswick and Pender Counties, at 20.2% and 23.9%, respectively. The area generally has availability of temporary accommodation (hotels, motels, and mobile home parks) that would help supplement the available housing vacancies if needed.

Construction

The type of construction workers needed would be expected to include electricians, carpenters, pipe fitters, plumbers, and other skilled and unskilled workers. While a large proportion of construction workers would be expected to come from within the three-county region, given the scale of construction activities and the some of the special skill sets required, previous analysis further assumed between 20% and 40% of the construction workforce would be obtained from outside the region. The range was chosen to reflect the underlying uncertainty about what share of the workforce would come from outside the region. Under a conservative assumption for this analysis, 40% of the in-migrating workforce, or approximately 92 workers, would be expected to enter the region during the peak years of the proposed action. It is also assumed, as in the previous analysis, that 65% of individuals moving into the region would bring their families, including, on average, the worker, a spouse, and one school-age child, the estimated population increase resulting from construction activities (direct employment) would be approximately 190 people.

The previous analysis, which included a significantly higher construction workforce and in-migrating population, demonstrated that the impacts on the ROI population, employment, housing, and community services would all be SMALL. Given the smaller construction workforce size and smaller in-migrating population expected under the proposed action, along with the current levels of population, employment, housing, and community services available within the ROI (see also Table 3-14), potential construction impacts from the proposed action on population, employment, housing, and community services within the ROI (and potentially on the host New Hanover County alone), would be considered SMALL.

Given the small number of new employees, the economic impact of constructing the proposed facility would be SMALL, but it would be considered a beneficial impact on the economy during the period of construction.

Operation

The previous analysis assumed that the existing labor force in the region should be able to adequately supply the majority of operation workers, with the exception of engineers, and conservatively assumes that all engineers would be obtained from outside the region. These assumptions resulted in approximately one-third of the operations workforce coming from outside the area. Applying this same assumption to this analysis would result in approximately 25 workers in-migrating into the area. The families that these workers would bring into the area also would increase the ROI population. Applying the same assumption for construction workers to operations workers, where 65% of the in-migrating worker would bring families with an average of 3 persons per household, the ROI population would increase by approximately 50 persons.

The previous analysis, which included a significantly higher operations workforce and in-migrating population, demonstrated that the impacts on the ROI population, employment, housing, and community services would all be SMALL. Given the smaller operations workforce size and smaller in-migrating population expected under the proposed action, along with the current levels of population, employment, housing and community services available within the ROI (see also Table 3-14), potential operational impacts from the proposed action on population, employment, housing and community services within the ROI (and potentially on the host New Hanover County alone), would be considered SMALL.

Facility operations would generate additional income in the ROI, along with increases in income and sales taxes; corporate income tax payments also would increase. Given the small number of new employees, the economic impact of operating the proposed facility would be SMALL, however, it would be considered a long-term beneficial impact on the economy.

3.3.14.4 New HALEU Enrichment Facility (Generic Site)

Construction and Operation

The HALEU enrichment facility could be located at any of the sites discussed above or could be located at a site that does not currently have an enrichment facility, including a greenfield site.

While there are no specific laws or regulations that require socioeconomic factors be considered in the site selection process, from a socioeconomic perspective, proximity of a facility site to a major urban center is advantageous in terms of finding an adequate labor supply as the number of in-migrant workers would be dependent on labor availability within commuting distance of the plant site. For example, the NRC considers socioeconomic factors in the selection and evaluation of a small set of sites (e.g., for nuclear power plant development) against a detailed set of siting criteria to help measure suitability and identify more favorable sites, including information related to workforce labor requirements, location of labor pool, potential number if in-migrants and the economic structure of the affected communities. It is assumed that similar criteria would be applied in selecting a greenfield site for a HALEU enrichment facility.

With respect to potential impacts should the enrichment facility be constructed at a greenfield site; the range of construction and operations workforce requirements would not be expected to change significantly from those evaluated at the other existing industrial sites. Such requirements are generally not dependent on the location of the facility, although a greenfield location may require a slightly larger construction workforce related to new or expanded infrastructure needs (e.g., to connect to existing nearby utilities, roadways, etc.). The trigger for adverse socioeconomic impacts is the need to relocate construction and operations workers and their families into local communities. The severity of socioeconomic impacts is proportional to the level of stress placed on housing and the community services by the relocated workers and their families.

Potential impacts—both adverse and beneficial (e.g., increased job opportunities, income levels, public spending and tax revenues)—would be SMALL to LARGE, depending on the number and distribution of an in-migrating population within the region of influence. In general, potential impacts would be SMALL if the greenfield site were located in close proximity to an urban area(s) with sufficient resources – workers, housing, community services—such that a small in-migrating workforce would be required. If an adequate supply of workers is available within reasonable commuting distance, few (if any) workers would choose to relocate to the site vicinity. A highly populated urban area would probably have a sufficient labor pool to accommodate the demands of enrichment facility construction (and potentially a large percentage of facility operation). It is also more likely to have the required mix of skilled and unskilled laborers, and the more urbanized areas can more readily absorb the influx of workers and their families. By contrast, a sparsely populated area is not as likely to have, or be able to support, an adequate labor pool. In such instances, workers migrating into the area, frequently with their families, can severely impact the available housing market and community services, resulting in MODERATE to LARGE impacts. The degree of impact would also depend on how the in-migrating population is distributed within the region of influence, with LARGE impacts especially if the incoming population choose to concentrate in one area (e.g., small local community) rather than distribute themselves evenly across the region. Similarly, the range of beneficial economic impacts (SMALL to LARGE)—increased jobs, income, tax revenues—would depend on the number of new jobs created, tax revenue generated, etc., and whether the benefits are spread evenly across a region or concentrated in one area or community. Finally, it is important to note again that a more detailed site-specific NEPA analysis of potential impacts on socioeconomic resources would be conducted by the NRC once a potential site(s) has been selected and a design developed.

3.3.15 Environmental Justice

The ROI for environmental justice is the area within a 4-mile radius of the enrichment facilities. This ROI was based on NRC guidelines from the Office of Nuclear Material Safety and Safeguards for facilities located outside of city limits or in a rural area.

On January 27, 2021, President Biden issued Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*, which established the Justice40 Initiative. This initiative mandates 40% of the benefits of Federal climate and clean energy investments to be provided to disadvantaged communities (DOE, 2022a). DOE's analysis considers a census tract that ranks in or above the 80th percentile of the cumulative sum of 36 burden indicators for a state and has at least 30 (DOE, 2022a) as a disadvantaged community. The cumulative burden includes fossil fuel dependence, energy burden, environmental and climate hazards, and socioeconomic vulnerabilities. As shown in Table 3-15, Wrightsboro, North Carolina, is considered disadvantaged.

Table 3-15. The Leidos Team Disadvantaged Communities Ranking

City, County, State	*National Ranking*	*State Ranking*	*DAC Score*
Eunice, Lea, NM	24%	25%	14
Wrightsboro, New Hanover, NC	74%	82%	19
Beaver Village, Pike, OH	53%	63%	17

Key: % = percent; DAC = disadvantaged community; OH = Ohio; NC = North Carolina; NM = New Mexico
Note: Red shading indicates a disadvantaged community.

3.3.15.1 UUSA Site – Eunice, New Mexico

The ROI for environmental justice is the area within a 4-mile radius of the UUSA facility. The potentially affected area includes parts of two counties in New Mexico and Texas. The analysis of minority and low-income populations focuses on USCB data for geographic units (i.e., block groups) that represent, as closely as possible, the potentially affected areas. Table 3-16 shows the minority and low-income composition of the potentially affected area surrounding the existing UUSA facility.

Minority populations were evaluated using the 50% analysis and meaningfully greater analysis for potentially affected block groups within 4 miles of the UUSA facility. If a block group's percentage of minority individuals was greater than 50% or more than 20% of the percentage of the total minority population within the state percentage (block groups were compared to the state percentage in which they were located), then the block group was identified as having a minority population. The total population of New Mexico is 2,109,366, of which 64.0% would be considered members of a minority population. The total population of Texas is 28,862,581, of which 59.3% would be considered members of a minority population. Of the four block groups within the ROI, one block group has a percentage that would meet the meaningfully greater threshold for minority populations (Census Tract 8, Block Group 2). The UUSA facility is located within this block group (Figure 3-12).

Table 3-16. Communities Within Four Miles of UUSA – Eunice, New Mexico

Area Name		***Total Population***	***Minority***	***% Minority***	***Population for Whom Poverty is Determined***	***Low-Income Population***	***% Low Income***
United States		333,036,755	136,997,971	41.1%	325,180,754	42,062,633	12.9%
New Mexico		2,109,366	1,349,449	64.0%	2,067,620	378,896	18.3%
Lea County, New Mexico		72,743	48,525	66.7%	70,064	11,740	16.8%
Census Tract 8		3,516	1,945	55.3%	3,516	315	9.0%
Texas		28,862,581	17,117,549	59.3%	28,260,264	3,965,117	14.0%
Andrews County, Texas		18,184	11,100	61.0%	18,110	2,224	12.3%
Census Tract 9501		2,421	1,024	42.3%	2,421	336	13.9%
Block Group by Tract		***Total Population***	***Minority***	***% Minority***	***Population for Whom Poverty is Determined***	***Low-Income Population***	***% Low Income***
Census Tract 8 (New Mexico)	Block Group 2	1,223	767	62.7%	1,223	94	7.7%
	Block Group 1	1,022	428	41.9%	1,022	27	2.6%
	Block Group 4	566	182	32.2%	566	67	11.8%
Census Tract 9501 (Texas)	Block Group 1	2,421	1024	42.3%	2,421	336	13.9%
ROI (4-mile radius)		5,232	2,401	45.9%	5,232	524	10.0%

Source: (USCB, 2023d)
Key: % = percent; NM = New Mexico; ROI = region of influence; UUSA = Urenco USA
Note: Red shading indicates a disadvantaged community.

The total population of New Mexico for whom poverty is determined is 2,067,620, of which 18.3% would be considered members of a low-income population. The total population of Texas for whom poverty is determined is 28,260,264, of which 14% would be considered members of a low-income population. None of the block groups, of the four block groups within the ROI, have percentages that would meet the threshold for low-income populations. Figure 3-12 displays the block groups in the ROI.

Construction and Operation

Previous NEPA documentation as well the most recent USCB data were evaluated to determine potential impacts associated with new enrichment activities at UUSA. The *Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico, Final Report* (NRC, 2005a) determined that the construction and operation of the enrichment facility would have a SMALL impact on environmental justice populations. The study evaluated populations within a 50-mile radius of the facility and determined that the closest environmental justice population was located in Eunice, New Mexico, approximately 5 miles from the facility. The study further concluded that no disproportionately high and adverse impacts from construction, operation, or decommissioning would occur to minority and low-income populations living near the facility or along the transportation routes into and out of the facility.

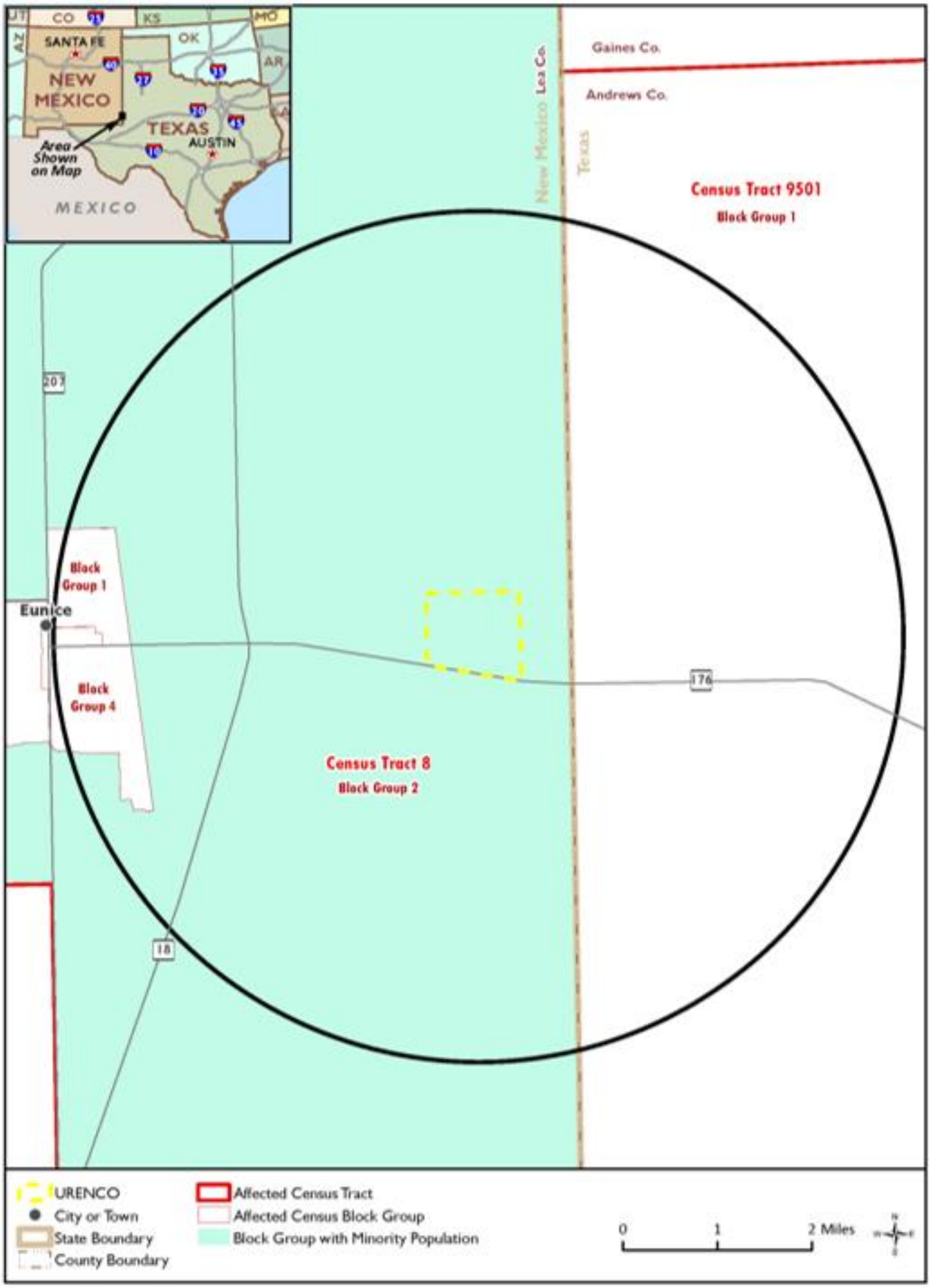


Figure 3-12. Block Groups in the Vicinity of the UUSA Facility

The NRC, in the *Environmental Assessment for the Proposed Louisiana Energy Services, URENCO USA Uranium Enrichment Facility Capacity Expansion in Lea County, New Mexico* (NRC, 2015), determined that census block groups within the ROI do not have significant percentages of minority populations, nor do they have significant percentages of low-income households. Therefore, it was concluded that the proposed action would have no significant impacts on environmental justice populations. The 2015 UUSA EA used an ROI of 4 miles from the site.

The most recent census information (USCB, 2023d) was evaluated to determine if the affected environment had changed since the 2005 NEF EIS (NRC, 2005a) or the 2015 UUSA EA analysis and additional minority or low-income populations were present in the ROI. As shown in Table 3-16, there is one minority and no low-income block groups within the ROI. Although there are minority populations located within the ROI, no disproportionately high and adverse impacts on these populations are anticipated during construction or operation of enrichment facilities at the GLE location (Table 3-17). Impacts are not anticipated as there are no human health impacts anticipated with construction and operation activities. In addition, Table 3-17 shows that impacts associated with other resource areas would range from SMALL to MODERATE.

Table 3-17. Urenco: Summary of Impacts for Historic and Current Uranium Enrichment Activities

Resource	***2005 NEF EIS Impact Determination (NRC, 2005a)***	***2015 UUSA EA Impact Determination (NRC, 2015)***	***2023 Technical Report Impact Determination***
Land Use	SMALL	SMALL	SMALL
Visual and Scenic	SMALL	SMALL	SMALL
Geology and Soils	SMALL	SMALL	SMALL
Water Resources	SMALL	No impact on surface water; SMALL impact on groundwater	SMALL to MODERATE, due to increased water usage in an area with a depleted groundwater aquifer.
Air Quality	SMALL	SMALL	SMALL
Ecological	SMALL	SMALL	SMALL to MODERATE pending site- and project-specific future evaluations.
Historic and Cultural	SMALL	SMALL	SMALL
Infrastructure	NA [(b)]	NA [(b)]	SMALL
Noise	SMALL	SMALL	SMALL
Waste Management	SMALL	SMALL	SMALL
Public and Occupational Health – Normal Operations	SMALL (NRC, 2005a, pp. 4-45 - 4-50)	SMALL	For the smaller capacity facility, similarly sited (relative population and buffer area), impacts are SMALL
Public and Occupational Health – Facility Accidents	Worker impact is high for inadvertent nuclear criticality.	Accidents due to the facility expansion would be expected to be SMALL.	Worker fatality likely from inadvertent nuclear criticality.

Table 3-17. Urenco: Summary of Impacts for Historic and Current Uranium Enrichment Activities

Resource	*2005 NEF EIS Impact Determination (NRC, 2005a)*	*2015 UUSA EA Impact Determination (NRC, 2015)*	*2023 Technical Report Impact Determination*
	Through facility design, passive and active engineered controls, and administrative controls, accidents at an enrichment facility would pose an acceptably low risk to workers, the environment, and the public.		Through facility design, passive and active engineered controls, and administrative controls, accidents at an enrichment facility would pose an acceptably low risk to workers, the environment, and the public. Impacts are expected to be SMALL.
Transportation and Traffic	SMALL to MODERATE [(a)]	SMALL	SMALL to MODERATE [(a)]
Socioeconomics	Impacts on population, housing and community services would be SMALL. Impacts on employment and financing/revenue would be MODERATE (and beneficial).	SMALL impacts, from construction and operation	SMALL but MODERATE economic impacts, which would be considered beneficial impact
Environmental Justice	SMALL	Expanded UUSA facility construction and operations would not be expected to result in disproportionately high and adverse impacts on minority or low-income populations.	SMALL Although there is a minority population within the ROI, impacts would not be disproportionately high and adverse.

Key: EA = Environmental Assessment; NA = not applicable; NEF EIS = National Enrichment Facility Environmental Impact Statement; NRC = U.S. Nuclear Regulatory Commission; ROI = region of influence; UUSA = Urenco USA

Notes:

[a] MODERATE impacts estimated during construction of facilities.

[b] Infrastructure was not separately analyzed in past NEPA documentation and was discussed as part of water, traffic, socioeconomics, and waste management resources.

3.3.15.2 Centrus Site – Piketon, Ohio

The ROI for environmental justice is the area within a 4-mile radius of the Centrus facility. The potentially affected area includes parts of two counties in Ohio. The analysis of minority and low-income populations focuses on USCB data for geographic units (i.e., block groups) that represent, as closely as possible, the potentially affected areas. Table 3-18 shows the minority and low-income composition of the potentially affected area surrounding the existing Centrus facility.

Minority populations were evaluated using the 50% analysis and meaningfully greater analysis for potentially affected block groups within 4 miles of the Centrus facility. If a block group's percentage of minority individuals was more than 50% or more than 20% of the percentage of the total minority population within the state percentage (block groups were compared to the state percentage in which they were located), then the block group was identified as having a minority population. The total population of Ohio is 11,769,923, of which 22.2% would be considered members of a minority population. No block groups meet the thresholds for minority populations. Figure 3-13 displays the block groups identified as meeting the criteria for environmental justice minority populations surrounding the Centrus facility.

The total population for whom poverty is determined in Ohio is 11,451,346, of which 13.4% would be considered as low income. Six block groups of the nine block groups within the ROI have met the threshold for low-income populations. Figure 3-13 displays the block groups identified as meeting the criteria for low-income populations surrounding the Centrus facility.

Construction and Operation

Previous NEPA documentation as well the most recent USCB data were evaluated to determine potential impacts associated with new enrichment activities at Centrus. The NRC as documented in NUREG-1834 *Environmental Impact Statement for the Proposed American Centrifuge Plant in Piketon, Ohio* (NRC, 2006b) determined that the construction and operation of the facility would have a SMALL impact on environmental justice populations. The study evaluated populations within a 50-mile radius of the facility and determined that the closest block group with a meaningfully greater environmental justice population was 17 miles from the facility. The study further concluded that no disproportionately high and adverse impacts from construction, operation, or decommissioning would occur to minority and low-income populations.

The NRC, in the *Environmental Assessment for the Proposed Amendment of the NRC License Number SNM-2011 for the American Centrifuge Plant in Piketon, Ohio* (NRC, 2021c), determined that census block groups within the ROI do not have significant percentages of minority populations or low-income households. Therefore, it was concluded that the proposed action would have no significant impacts on environmental justice populations.

The most recent census information (USCB, 2023d) was evaluated to determine if the affected environment had changed since the 2006 ACP EIS (NRC, 2006b) analysis and additional minority or low-income populations were present in the ROI. As shown in Table 3-18, there are no minority block groups within the ROI. Six block groups with low-income populations are located in the ROI including the block group (Census Tract 9522, Block Group 4) that contains the Centrus facility. Although there are low-income populations located within the ROI, no disproportionately high and adverse impacts on these populations are anticipated during construction or operation of enrichment facilities at the Centrus location (Table 3-19). Impacts are not anticipated as there are no human health impacts anticipated with construction and operation activities. In addition, Table 3-19 shows that impacts associated with other resource areas would range from SMALL to MODERATE.

Table 3-18. Communities Within Four Miles of Centrus Energy Corp – Piketon, Ohio

Area Name		Total Population	Minority	% Minority	Population for Whom Poverty is Determined	Low-Income Population	% Low Income
United States		333,036,755	136,997,971	41.1%	325,180,754	42,062,633	12.9%
Ohio		11,769,923	2,617,097	22.2%	11,451,346	1,528,963	13.4%
Pike County		27,271	1431	5.2%	26806	5190	19.4%
Census Tract 9522		5,313	379	7.1%	5,303	1,414	26.7%
Census Tract 9523		5,296	260	4.9%	5,041	885	17.6%
Census Tract 9527		4,119	266	6.5%	4,001	673	16.8%
Scioto County		74,392	5353	7.2%	70905	16891	23.8%
Census Tract 22		4,472	849	19.0%	3,126	486	15.5%
Census Tract 23		4,254	22	0.5%	4,082	849	20.8%
Block Group by Tract		**Total Population**	**Minority**	**% Minority**	**Population for Whom Poverty is Determined**	**Low-Income Population**	**% Low Income**
Census Tract 9522	Block Group 3	1,262	74	5.9%	1,252	246	19.6%
	Block Group 4	1,528	149	9.8%	1,528	573	37.5%
Census Tract 9523	Block Group 1	554	0	0.0%	523	9	1.7%
	Block Group 3	1,748	9	0.5%	1,630	279	17.1%
	Block Group 4	748	9	1.2%	748	142	19.0%
Census Tract 9527	Block Group 1	855	2	0.2%	855	181	21.2%
	Block Group 2	1,502	107	7.1%	1,384	158	11.4%
Census Tract 22	Block Group 3	665	0	0.0%	665	51	7.7%
Census Tract 23	Block Group 3	1,094	0	0.0%	1,094	354	32.4%
ROI (4-mile radius)		9,956	350	3.5%	9,679	1,993	20.6%

Source: (USCB, 2023d)
Key: % = percent; ROI = region of influence
Note: Red shading indicates a disadvantaged community.

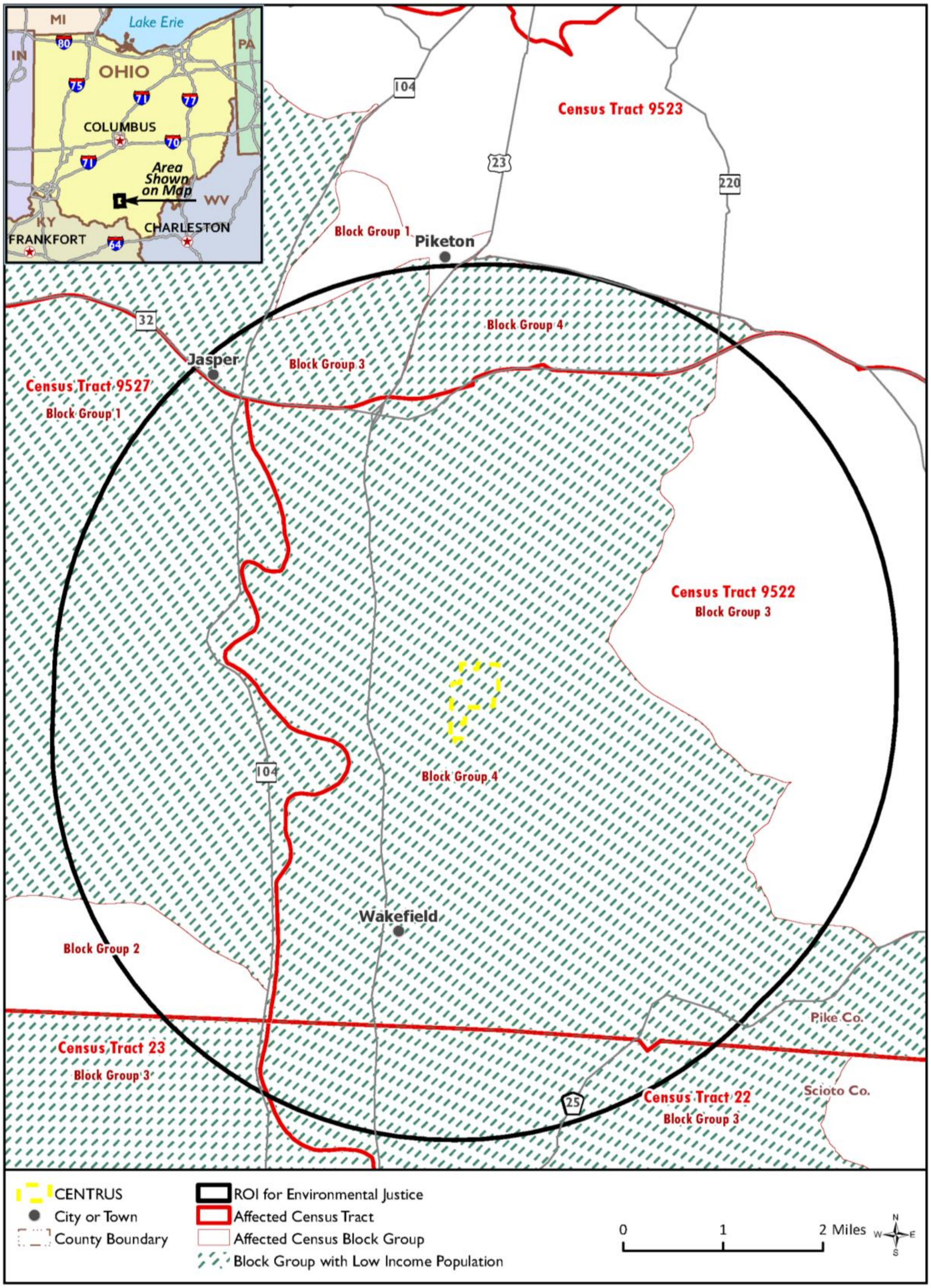


Figure 3-13. Block Groups in the Vicinity of the Centrus Facility

Table 3-19. Centrus: Summary of Impacts for Historic and Current Uranium Enrichment Activities

Resource	*2004 Lead Cascade Facility EA Impact Determination (DOE, 2004a)*	*2006 ACP EIS Impact Determination (NRC, 2006b)*	*2021 ACP Amendment EA Impact Determination (NRC, 2021c)*	*2023 Technical Report Impact Determination*
Land Use	SMALL The existing industrialized area and buildings on the site were utilized.	SMALL Changes converted land use on the Leidos Team reservation from managed lawns, fields, and limited forest buffer to developed areas.	No impact	SMALL Most activity would occur on previously disturbed land. Sites that require conversion of land cover will be in proximity to other developed areas and industrial land use. The project would not impact any surrounding land use such as plans for residential development.
Visual and Scenic	No impact	SMALL	No impact	SMALL
Geology and Soils	No foreseen impact	SMALL	No impact	SMALL
Water Resources	Little to no impact	SMALL	No impact	SMALL
Air Quality	Not significant	SMALL to MODERATE [(a)]	Not significant – See Section 4.2 of the EA.	SMALL
Ecological	No impact	SMALL	No impact	SMALL to MODERATE pending site- and project-specific future evaluations.
Historic and Cultural	No foreseen impact	SMALL	No impact	SMALL
Infrastructure	NA [(c)]	NA [(c)]	NA [(c)]	SMALL
Noise	No input from 2004 EA	SMALL	No impact	SMALL
Waste Management	Not significant	SMALL	Not significant – See Section 4.2 of the EA.	SMALL
Public and Occupational Health – Normal Operations	SMALL	SMALL	SMALL	For the smaller capacity facility, similarly sited (relative population and buffer area), impacts are SMALL.
Public and Occupational Health – Accidents	Data not available	Data not available	Not significant – See Section 4.2 of the EA.	Worker fatality likely from inadvertent nuclear criticality.

Table 3-19. Centrus: Summary of Impacts for Historic and Current Uranium Enrichment Activities

Resource	***2004 Lead Cascade Facility EA Impact Determination (DOE, 2004a)***	***2006 ACP EIS Impact Determination (NRC, 2006b)***	***2021 ACP Amendment EA Impact Determination (NRC, 2021c)***	***2023 Technical Report Impact Determination***
			No new or different type of accident or increase the risk of any accident previously evaluated.	Through facility design, passive and active engineered controls, and administrative controls, accidents at an enrichment facility would pose an acceptably low risk to workers, the environment, and the public. Impacts are expected to be SMALL.
Traffic	Minor impacts	SMALL to MODERATE [(a)]	Not significant – See Section 4.3 of the EA.	SMALL to MODERATE [(a)] impacts
Socioeconomics	SMALL	SMALL to MODERATE [(b)]	Not significant – See Section 4.1 of the EA.	SMALL, but potential MODERATE to LARGE impacts on housing
Environmental Justice	No input from 2004 EA	SMALL	Not significant – See Section 4.1 of the EA.	SMALL Although there are low-income populations within the ROI, impacts would not be disproportionate and adverse.

Key: ACP = American Centrifuge Plant; EA = Environmental Assessment; EIS = Environmental Impact Statement; NEPA = National Environmental Policy Act; ROI = region of influence

Notes:

[a] MODERATE impacts estimated during construction of facilities.

[b] MODERATE impacts due to cessation of the Paducah Gaseous Diffusion Plant.

[c] Infrastructure was not separately analyzed in past NEPA documentation and was discussed as part of water, traffic, socioeconomics, and waste management resources.

3.3.15.3 GLE Site – Wilmington, North Carolina

The ROI for environmental justice is the area within a 4-mile radius of the GLE facility. The potentially affected area includes parts of two counties in North Carolina. The analysis of minority and low-income populations focuses on USCB data for geographic units (i.e., block groups) that represent, as closely as possible, the potentially affected areas.

Minority populations were evaluated using the 50% analysis and meaningfully greater analysis for potentially affected block groups within 4 miles of the Centrus facility. If a block group's percentage of minority individuals was more than 50% or more than 20% of the percentage of the total minority population within the state percentage (block groups were compared to the state percentage in which they were located), then the block group was identified as having a minority population. The total population of North Carolina is 10,367,022, of which 37.9% would be considered members of a minority population. Two block groups of the 14 block groups within the ROI meet the meaningfully greater threshold for minority populations. Figure 3-14 displays the block groups identified as meeting the criteria for environmental justice minority populations surrounding the GLE facility.

The total population for whom poverty is determined in North Carolina is 10,092,759, of which 13.7% would be considered as low income. Three block groups of the 14 block groups within the ROI have met the threshold for low-income populations. Figure 3-14 displays the block groups identified as meeting the criteria for environmental justice low-income populations surrounding the GLE facility.

Construction and Operation

Previous NEPA documentation as well the most recent USCB data were evaluated to determine potential impacts associated with new enrichment activities at GLE. The NRC, as documented in the Environmental Impact Statement for the Proposed GE-Hitachi Global Laser Enrichment, LLC Facility in Wilmington, North Carolina (NRC, 2012b), determined that minor impacts associated with noise, dust, traffic, and employment would occur to environmental justice populations. The study evaluated populations within a 4-mile radius of the facility and determined that the closest block group with a meaningfully greater environmental justice population was less than 1 mile from the facility. Preconstruction, construction, operation, and decommissioning of the proposed GLE facility was not expected to result in disproportionately high and adverse impacts on minority, low-income, or subsistence consumption populations.

The most recent census information (USCB, 2023d) was evaluated to determine if the affected environment had changed since the 2012 GLE EIS (NRC, 2012b) analysis and additional minority or low-income populations were present in the ROI. Two minority block groups are within the ROI. There are also three block groups with low-income populations located in the ROI including the block group (Census Tract 9522, Block Group 4) that contains the GLE facility (Table 3-20). Although there are minority and low-income populations located within the ROI, no disproportionate or adverse impacts on these populations are anticipated during construction or operation of enrichment facilities at the GLE location (Table 3-21). Impacts are not anticipated as there are no human health impacts anticipated with construction and operation activities. In addition, Table 3-21 shows that impacts associated with other resource areas would range from SMALL to MODERATE.

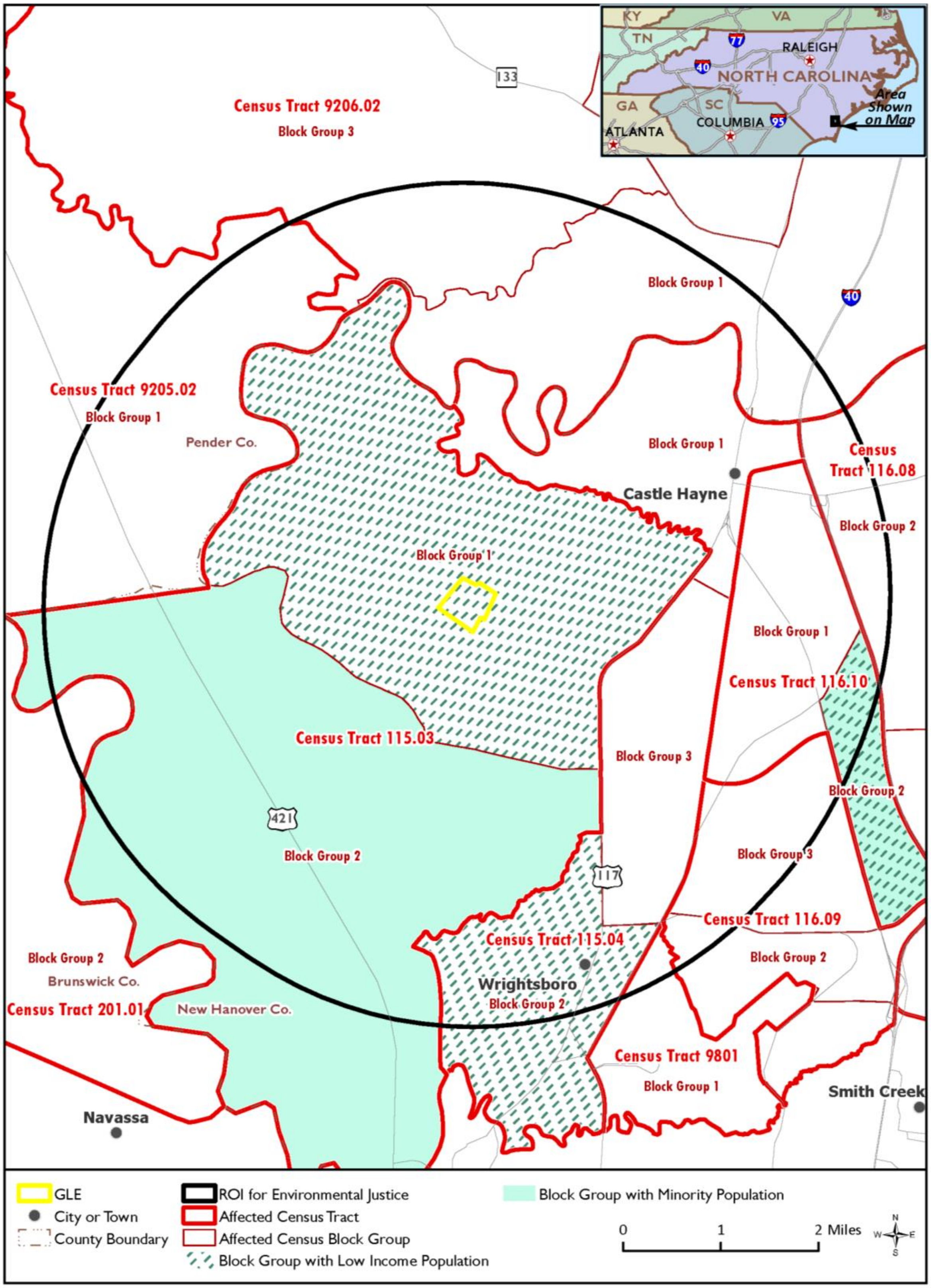


Figure 3-14. Block Groups in the Vicinity of the GLE Facility

Table 3-20. Communities Within Four Miles of the GLE Facility – Wilmington, North Carolina (Block Group by Tract)

Block Group by Tract		Total Population	Minority	% Minority	Population for Whom Poverty is Calculated	Low-Income Population	% Low Income
Census Tract 115.03	Block Group 1	1,556	236	15.2%	1,556	592	38.0%
	Block Group 2	2,335	1,636	70.1%	2,333	111	4.8%
Census Tract 115.04	Block Group 1	1,094	210	19.2%	1,094	116	10.6%
	Block Group 2	2,533	515	20.3%	2,077	434	20.9%
	Block Group 3	989	209	21.1%	934	8	0.9%
Census Tract 116.08	Block Group 2	1,629	329	20.2%	1,625	55	3.4%
Census Tract 116.09	Block Group 2	1,459	27	1.9%	1,459	0	0.0%
	Block Group 3	3,041	361	11.9%	2,994	33	1.1%
Census Tract 116.10	Block Group 1	1,934	612	31.6%	1,401	174	12.4%
	Block Group 2	2,544	1,206	47.4%	2,368	1,049	44.3%
Census Tract 9205.02	Block Group 1	1,715	421	24.5%	1,714	257	15.0%
Census Tract 9206.02	Block Group 1	2,341	292	12.5%	2,341	390	16.7%
	Block Group 3	1294	588	45.4%	1294	123	9.5%
Census Tract 201.01	Block Group 2	1295	589	45.5%	625	69	11.0%
ROI (4-mile radius):		25,759	7,231	28.1%	23,815	3,411	14.3%

Source: (USCB, 2023d)

Key: % = percent; GLE = Global Laser Enrichment; ROI = region of influence

Note: Red shading indicates a disadvantaged community.

Table 3-21. GE GLE: Summary of Impacts for Proposed Uranium Enrichment Activities

Resource	*2004 GLE EIS Impact Statement*	*2023 Technical Report Impact Determination*
Land Use	SMALL	SMALL
Visual and Scenic	SMALL	SMALL
Geology and Soils	SMALL	SMALL
Water Resources	SMALL	SMALL
Air Quality	SMALL	SMALL
Ecological	SMALL to MODERATE	SMALL to MODERATE pending site- and project-specific future evaluations.
Historic and Cultural	SMALL to MODERATE	SMALL to MODERATE
Infrastructure	NA [(b)]	SMALL
Noise	SMALL to MODERATE	SMALL to MODERATE
Waste Management	SMALL	SMALL
Public and Occupational Health – Normal Operations	SMALL	For the smaller capacity facility, similarly sited (relative population and buffer area), impacts are SMALL.
Public and Occupational Health – Facility Accidents	Accidents at the proposed facility pose an acceptably low risk to workers, the environment, and the public. Probability weighted consequence (or risk) from accidents is expected to be SMALL.	Worker fatality likely from inadvertent nuclear criticality. Through facility design, passive and active engineered controls, and administrative controls, accidents at an enrichment facility would pose an acceptably low risk to workers, the environment, and the public. Impacts are expected to be SMALL.
Traffic	SMALL to MODERATE [(a)] impacts	SMALL to MODERATE [(a)]
Socioeconomics	SMALL	SMALL
Environmental Justice	Preconstruction, construction, operation, and decommissioning of the proposed GLE facility is not expected to result in disproportionately high and adverse impacts on minority, low-income, or subsistence consumption populations.	SMALL Although there are minority and low-income populations within the ROI, impacts would not be disproportionate and adverse.

Key: GLE EIS = GE-Hitachi Global Laser Enrichment Environmental Impact Statement; NA = not applicable; ROI = region of influence

Notes:

[a] SMALL to MODERATE impacts estimated during both construction and operation of facilities.

[b] Infrastructure was not separately analyzed in past NEPA and was discussed as part of water, traffic, socioeconomics, and waste management resources.

3.3.15.4 New HALEU Enrichment Facility (Generic Site)

Construction and Operation

Site selection for a HALEU enrichment facility is expected to include criteria related to environmental, socioeconomic, and environmental justice factors. Impacts on environmental justice populations would be dependent on local and regional conditions for a proposed site, the potential high or adverse effects, and the presence of environmental justice communities in the ROI. Based on similar facilities and the application of siting criteria, impacts are expected to be in the SMALL to MODERATE range, and not disproportionate and adverse.

3.4 Summary of Impacts for Uranium Enrichment

For each of the resource areas discussed in this section, impact indicators have been identified. Table 3-22 summarizes the impacts associated with each indicator for locating a HALEU enrichment facility at three uranium enrichment facilities or a generic site.

Table 3-22. Summary of Impacts for Uranium Enrichment

Resource Area	***Impact Indicator***	***Impacts for Locating New HALEU Enrichment Facility at Existing Facility***			***Generic Site***
		Urenco Uranium Enrichment Facility Eunice, NM	***Centrus American Centrifuge Plant Piketon, OH***	***GLE Uranium Enrichment Facility Wilmington, NC***	***New HALEU Enrichment Facility [(a)]***
General	***Annual Production***	***3.7M SWUs***	***7M SWUs***	***6M SWUs***	***1.1M SWUs***
Land Use	Changes to current land uses, compatibility with zoning, surrounding land uses, and land use plans.	SMALL – Development is expected to occur in previously disturbed land. Impacts for a HALEU facility at this site would be similar to those identified in the 10 million SWU facility expansion NEPA review (NRC, 2015, p. 81). No anticipated effects to surrounding land use would occur.	SMALL – Development is expected to occur primarily on previously disturbed land. Any conversion of land cover would be in proximity to other developed areas and industrial land use and would be within those addressed prior NEPA reviews (NRC, 2006b, pp. 4-3). No anticipated effects to surrounding land use would occur.	SMALL – Clearing and grading of land, vegetation removal, improvement of existing roads, and construction of support structures, which would remove mixed pine forest would occur. Impacts would be similar to those identified in the GLE facility NEPA analysis, which considered conversion of 226 acres of undeveloped forest (NRC, 2012b, p. § 4.2.1). Potential impacts to plans for nearby low-density residential development to the north, east, and south could occur but would also be SMALL.	SMALL – Site selection for a HALEU enrichment facility would be expected to include criteria for land use compatibility, and/or location within an industrial land use area. Impacts on land use for siting on existing industrial sites or areas would be SMALL. Impacts related to siting the facility on undeveloped lands would likely be greater as land use changes would occur. Compatibility with surrounding land use and land use plans would depend on site-specific conditions.
Visual and Scenic Resources	Visibility, visual and scenic resources, changes to visual and scenic quality.	SMALL – Impacts from construction and operation activities would be similar to those identified in the 10 million SWU facility expansion NEPA review (NRC, 2015). If	SMALL – Impacts would be within the range of impacts analyzed for the 2006 ACP EIS (NRC, 2006b). Construction would likely occur in areas previously identified for the	SMALL – Construction would occur in those areas designated for development of the uranium enrichment facility evaluated in the GLE EIS (NRC, 2012b). SMALL impacts could	SMALL – Site selection for a HALEU enrichment facility would be expected to include criteria for changes to visual and scenic quality. Siting of the facility on an industrial site or an industrial area would result in SMALL impacts

Table 3-22. Summary of Impacts for Uranium Enrichment

Resource Area	***Impact Indicator***	***Impacts for Locating New HALEU Enrichment Facility at Existing Facility***			***Generic Site***
		Urenco Uranium Enrichment Facility Eunice, NM	***Centrus American Centrifuge Plant Piketon, OH***	***GLE Uranium Enrichment Facility Wilmington, NC***	***New HALEU Enrichment Facility [(a)]***
		previously undisturbed portions of the site are used, impacts would also be SMALL as described in the initial facility EIS (NRC, 2005a).	proposed ACP facilities, which are generally not visible from surrounding areas.	occur to adjacent properties from removal of vegetation that could result in visibility of the facility (NRC, 2012b). These impacts would be mitigated with a vegetation screen.	on scenic resources. Impacts related to siting the facility on undeveloped lands could be greater and would depend on site-specific conditions.
Geology and Soils	Ground disturbance, soil erosion potential, prime farmlands, and sensitive geological resources	SMALL – Impacts from construction and operation activities including land disturbance would be similar to those identified in the 10 million SWU facility expansion NEPA review (NRC, 2015). There are no prime farmlands or sensitive geological resources within the site boundary, and potential soil erosion would be mitigated through BMPs.	SMALL – Impacts would be within the range of impacts analyzed for the ACP (NRC, 2006b). Construction and land disturbance would likely occur in areas previously identified for proposed ACP facilities. There are no prime farmlands or sensitive geological resources within the site boundary, and potential soil erosion would be mitigated through BMPs.	SMALL – Impacts would be within the range of impacts analyzed for the GLE facility NEPA analysis (NRC, 2012b, p. § 4.2.1). There are no prime farmlands or sensitive geological resources within the site boundary. Impacts would include potential soil erosion due to ground disturbance in previously undeveloped areas, which would be mitigated through BMPs.	SMALL – Site selection for a HALEU enrichment facility would be expected to include criteria to avoid prime farmlands, highly erodible soils, and sensitive geological resources. Impacts from siting the facility on an industrial site would be SMALL and unlikely to affect these resources. Impacts related to siting the facility on undeveloped lands could be greater and would depend on site-specific conditions. Ground disturbance, erosion, and increased risk of spills would be expected but would be mitigated through BMPs.
Water Resources	Floodplains, surface water bodies, and groundwater aquifers	SMALL to MODERATE – Impacts to surface waters from construction and operation would be	SMALL – Impacts would be similar to and within the range of those analyzed for the ACP (NRC, 2006b). Impacts to	SMALL – Impacts to water resources resulting from construction and operation would be within the range of those	SMALL – Site selection for a HALEU enrichment facility would be expected to include criteria to avoid floodplains and areas with sensitive

Table 3-22. Summary of Impacts for Uranium Enrichment

Resource Area	***Impact Indicator***	***Impacts for Locating New HALEU Enrichment Facility at Existing Facility***			***Generic Site***
		Urenco Uranium Enrichment Facility Eunice, NM	***Centrus American Centrifuge Plant Piketon, OH***	***GLE Uranium Enrichment Facility Wilmington, NC***	***New HALEU Enrichment Facility [(a)]***
		SMALL, due to a lack of surface water features on-site, the use of BMPs to trap and treat wastewater and stormwater, and compliance with NPDES permit requirements. As future demand for water in the region is anticipated to exceed the recharge rate of the High Plains aquifer, impacts to groundwater associated with increased water demand would be SMALL to MODERATE. These effects would be mitigated through compliance with the Regional Water Plan.	water resources associated with facility construction and operation would be SMALL based on the implementation of BMPs and compliance with NPDES permit requirements. Impacts to the availability of groundwater in the Scioto River aquifer associated with facility water supply would also be SMALL.	analyzed for the GLE facility (NRC, 2012b). That analysis concluded that impacts to water resources would generally be SMALL due to planned systems for runoff, treatment and monitoring, and compliance with required permits.	surface water and groundwater features, and to prioritize sites that have adequate water supply. Impacts from siting the facility on an industrial site would be SMALL as these sites are expected to have limited surface water features, and wastewater and stormwater discharges would comply with applicable NPDES requirements. Impacts related to siting the facility on undeveloped lands could be greater and would depend on site-specific conditions.
Air Quality	NAAQS, air emissions of criteria pollutants, HAPs, radiological compounds, and GHGs.	SMALL – Potential air quality impacts from construction would be SMALL, as it is anticipated that criteria air pollutant concentrations at the property boundary would be below the NAAQS and New Mexico	SMALL – Potential air quality impacts from construction would be SMALL with the implementation of mitigation measure for vehicles and fuels to reduce $PM_{2.5}$. All other criteria pollutants would be below NAAQS.	SMALL – Impacts from the construction and operation of the GLE facility were determined to be MODERATE due to potential exceedances of coarse (PM_{10}) and fine ($PM_{2.5}$) NAAQS at the property boundary during construction (NRC,	SMALL – Since a HALEU enrichment facility would be much smaller than the three existing facilities, it is expected that impacts from construction and operation of the HALEU enrichment facility at these locations would be SMALL. Siting a HALEU enrichment facility on

Table 3-22. Summary of Impacts for Uranium Enrichment

Resource Area	Impact Indicator	Impacts for Locating New HALEU Enrichment Facility at Existing Facility			Generic Site
		Urenco Uranium Enrichment Facility Eunice, NM	Centrus American Centrifuge Plant Piketon, OH	GLE Uranium Enrichment Facility Wilmington, NC	New HALEU Enrichment Facility [(a)]
		state ambient air quality standards. Impacts to air quality from operations would also be SMALL as the area is in attainment with all NAAQS, and facility air emissions would be below applicable regulatory levels.	Impacts to air quality from operations would also be SMALL as the area is in attainment with all NAAQS, and facility air emissions would be below applicable regulatory levels.	2012b, p. § 4.2.4.1). With the implementation of applicable regulatory controls, potential air quality impacts of criteria pollutants and HAPs from operations would be SMALL.	undeveloped lands could require more construction effort to clear and grade the site and therefore could result in higher air quality impacts compared to siting the facility in a cleared area. Effective implement of fugitive dust controls would ensure that construction air quality impacts would be SMALL. Similar to the results of the above analyses, operation of the HALEU enrichment facility would result in SMALL air quality impacts.
Ecological	Disturbance of ecological resources including sensitive habitats or special status species	SMALL – Impacts from construction and operation activities including land disturbance would be similar to those for the 10 million SWU facility expansion NEPA review (NRC, 2015). Federal and state rare, threatened, and endangered species are not known to occur at or near the UUSA site. Construction and operation activities for a HALEU facility in the 10	SMALL to MODERATE – Wetlands, Federal and state rare, threatened, and endangered species are known to occur at or near the site. The 2006 ACP EIS (NRC, 2006b) concluded that impacts to ecological resource would be SMALL through implementation of several BMPs. Construction and operation on the previously disturbed and industrialized areas of	SMALL to MODERATE – wetlands, Federal and state rare, threatened, and endangered species are known to occur at or near the site. Ecological impacts for construction and operation of the GLE facility would be SMALL to MODERATE based on the NRC Analysis (NRC, 2012b). The HALEU facility would have a smaller footprint and likely have the same type and range of effects.	SMALL to MODERATE – Site selection for a HALEU enrichment facility is expected to include criteria to avoid areas with sensitive habitats or special status species. Impacts from siting the facility on an industrial site would likely be SMALL, as construction and operation activity would not be expected to disturb special status species or reduce sensitive habitat. Siting the facility on undeveloped lands would likely have higher

Table 3-22. Summary of Impacts for Uranium Enrichment

Resource Area	*Impact Indicator*	*Impacts for Locating New HALEU Enrichment Facility at Existing Facility*			*Generic Site*
		Urenco Uranium Enrichment Facility Eunice, NM	*Centrus American Centrifuge Plant Piketon, OH*	*GLE Uranium Enrichment Facility Wilmington, NC*	*New HALEU Enrichment Facility [(a)]*
		million SWU planned expansion areas would not be expected to disturb special status species or reduce sensitive habitat.	the site would also be SMALL. However, SMALL to MODERATE impacts could occur pending site- and project-specific future evaluations. Ecological resources would need to re-inventoried for the undeveloped and forested areas that would involve land-disturbing activities to reassess the level of potential impacts and what mitigation would be required.	However, SMALL to MODERATE impacts could occur pending site- and project-specific future evaluations. Ecological resources would need to be re-inventoried to reassess the level of potential impacts and what mitigation would be required.	degree of impacts depending on site-specific conditions. Based on the use of siting criteria, these impacts would likely range from SMALL to MODERATE.
Historic and Cultural	Archaeological resources and sites; historic structures and districts; and traditional cultural properties.	SMALL – Seven prehistoric archaeological sites (campsites) were excavated and recovered prior to NEF construction as mitigation under NEPA and Section 106 process. As a result, impacts on historical and cultural resources at the site were considered SMALL (2005 NEF EIS Section 4.2.2). Construction and operation of a HALEU	SMALL – There are 15 historic properties within the area proposed for the ACP, which included the Gaseous Diffusion Plant enrichment facility. The NRC concluded there would be no adverse indirect or direct effect on these historic properties from the construction or operations of the ACP, that the ACP would not alter the historic setting of the existing Historic	SMALL to MODERATE – The NRC determined potential impacts at the proposed NEF site were expected to be SMALL to MODERATE. One historic property identified within the proposed development area would be avoided, and license conditions required potential effects on historic and cultural resources from any ground-disturbing activities in unsurveyed	SMALL to MODERATE – Site selection for a HALEU enrichment facility are expected to include criteria to avoid areas with known cultural resources, and measure to identify resources and mitigate potential impacts through NHPA Section 106 and NEPA processes. Impacts from siting the facility on an industrial site would likely be SMALL, as construction and operation activity would likely occur in developed or

Table 3-22. Summary of Impacts for Uranium Enrichment

Resource Area	*Impact Indicator*	*Impacts for Locating New HALEU Enrichment Facility at Existing Facility*			*Generic Site*
		Urenco Uranium Enrichment Facility Eunice, NM	*Centrus American Centrifuge Plant Piketon, OH*	*GLE Uranium Enrichment Facility Wilmington, NC*	*New HALEU Enrichment Facility* [(a)]
		facility at this site would also be SMALL as no historic properties remain on the UUSA property (2015 UUSA EA Section 1.5.4.2).	District (NRC, 2006b). Construction and operation of a HALEU facility at this site would also be SMALL, subject to additional NHPA Section 106 consultation and review.	areas (GLE EIS Section 4.2.2.1). Construction and operation of a HALEU facility at this site would also be SMALL to MODERATE for historic and cultural resources impacts would similarly be evaluated and subject to the NHPA Section 106 process.	previously disturbed areas. Siting the facility on undeveloped lands would have a higher potential impact depending on site-specific conditions. Potential effects would be evaluated and subject to the NHPA Section 106 process. Potential effects would likely be mitigated and range from SMALL to MODERATE.
Infrastructure	Disrupted utility operations during construction activities or an increase or decrease in demand for utility services during construction or operations.	SMALL – Electricity and natural gas infrastructure and supply needs to support the initial NEF and improvements to support the expansion to 10 million SWUs were evaluated by the NRC (NRC, 2005a; NRC, 2015). Impacts are expected to be SMALL, as it is anticipated that both service providers have sufficient capacity to support the operation of a 1.1-million-SWU HALEU enrichment facility at this location.	SMALL – Dedicated utilities were installed to support the Portsmouth Gaseous Diffusion Plant that occupied the site prior to the proposed construction of the ACP and had sufficient capacity to serve the ACP (NRC, 2006b, pp. 4-33). Impacts are expected to be SMALL, as it is anticipated that local service providers have sufficient capacity to support the operation of a 1.1-million-SWU HALEU enrichment facility at this location.	Not addressed – Although level of impact was not stated in the 2012 GLE EIS, the NRC did not anticipate that the quantities required would put a strain on the availability of energy resources for local consumers (NRC, 2012b, pp. 8-5). Impacts for a 1.1-million-SWU HALEU enrichment facility at this location are expected to be similar and considered SMALL.	SMALL to MODERATE – Site selection for a HALEU enrichment facility is expected to include criteria for adequate utility capacity and infrastructure. Impacts for siting the facility in industrial areas would be SMALL, as these areas are expected to have existing utility infrastructure and capacity. Impacts could be greater for undeveloped sites, as additional utility infrastructure would likely be required. With the use of siting criteria, these impacts would likely range from SMALL to MODERATE.

Table 3-22. Summary of Impacts for Uranium Enrichment

Resource Area	***Impact Indicator***	***Impacts for Locating New HALEU Enrichment Facility at Existing Facility***			***Generic Site***
		Urenco Uranium Enrichment Facility Eunice, NM	***Centrus American Centrifuge Plant Piketon, OH***	***GLE Uranium Enrichment Facility Wilmington, NC***	***New HALEU Enrichment Facility [(a)]***
Noise	Baseline noise levels, changes to day-night levels, proximity to sensitive receptors, compatibility with adjacent land uses.	SMALL – The NRC concluded that noise impacts from construction and operation of the facility and expansion would be SMALL as noise sources would primarily be from construction activities and the closest residence is 2.6 miles from the site (NRC, 2005a, pp. 3-67). Noise sources from construction and operation of a HALEU facility at this site would be similar and related impacts would be SMALL.	SMALL – The NRC concluded that noise impacts would be SMALL as construction activities for the ACP would result in a 53 day-night average noise level at the nearest residence, which is below applicable land use compatibility guidelines noise and operational noise would be low (NRC, 2006b, pp. 4-39). Noise sources from construction and operation of a HALEU facility at this site would be similar and related impacts would be SMALL.	SMALL to MODERATE – The NRC concluded that noise impacts from construction activities on the site would be SMALL, but that noise from roadway construction would have a MODERATE impact on the nearest subdivision (NRC, 2012b, pp. 2-31). Noise impacts from operations would be SMALL (NRC, 2012b, pp. 2-31). Noise sources from construction and operation of a HALEU facility at this site would be similar and related impacts would be SMALL to MODERATE.	SMALL – Site selection for a HALEU enrichment facility is expected to include criteria for land use compatibility, which would reduce the potential for noise impacts on sensitive receptors. Impacts for siting a HALEU facility in industrial areas would be SMALL, as these areas would likely have existing noise sources and compatible surrounding land uses. Impacts could be SMALL to MODERATE for construction on undeveloped sites, depending on adjacent land use and receptors.
Waste Management	Solid (nonhazardous), hazardous, and radioactive waste/materials	SMALL – Overall waste management impacts for the UUSA facility from construction through and including demolition were determined to be SMALL by the NRC (NRC, 2005a, pp. 4-55 to 4-65 and 4-82). All handling and disposing of waste materials is governed by	SMALL – Overall waste management impacts for the ACP during construction through and including demolition were determined to be SMALL by the NRC (NRC, 2006b, pp. 4-72 to 4-82).	SMALL – Overall waste management impacts for the GLE facility during construction through and including demolition were determined to be SMALL by the NRC (NRC, 2012b, pp. 4-91 to 101, 4-125, 4-144 to 146, and 151).	SMALL – The potential impacts associated with the management of wastes and on available facilities' capacities are similar regardless of the location because the requirements and treatment, storage, and disposal facilities used are consistent. Overall waste management impacts during construction through and

Table 3-22. Summary of Impacts for Uranium Enrichment

Resource Area	*Impact Indicator*	*Impacts for Locating New HALEU Enrichment Facility at Existing Facility*			*Generic Site*
		Urenco Uranium Enrichment Facility Eunice, NM	*Centrus American Centrifuge Plant Piketon, OH*	*GLE Uranium Enrichment Facility Wilmington, NC*	*New HALEU Enrichment Facility [(a)]*
		various Federal and state regulations.			including demolition would be SMALL.
Public and Occupational Health – Normal Operations	Worker injuries or fatalities during construction. Worker and public exposure to radiological and chemical hazards.	SMALL – No construction impacts to the public were identified by the NRC in their prior NEPA reviews for the UUSA facility (NRC, 2005a; NRC, 2015). Operational worker exposure was expected to be within industry standards and regulatory limits. The public is not expected to be impacted by chemical emissions and airborne radiation exposure would be below the EPA limit of 25 mrem per year. Construction and operation of a HALEU facility at this site would similarly be SMALL.	SMALL – Current operations at the Portsmouth site result in low levels of radiation exposure to people in the vicinity of the site that are below the EPA and NRC limits (NRC, 2006b, pp. 3-64, 3-65). Worker exposures are significantly less than the NRC and the Leidos Team worker dose standards of 5 rem per year (10 CFR Part 20) (NRC, 2006b, pp. 3-64, 3-65). Potential impacts to worker for construction of the APC were determined to be SMALL (NRC, 2006b, pp. 4-58, 4-59). Impacts from exposures related to ACP operation were also expected to SMALL and significantly below NRC and EPA thresholds (NRC, 2006b, pp. 4-63 to 4-70). Construction and operation of a HALEU	SMALL – Worker and public exposure to radiological and chemical hazards from current operations at the Wilmington nuclear fuel complex are well below the NRC limits (NRC, 2012b, pp. 3-96 to 3-99). Worker exposure to radiological and chemical hazards during construction of the GLE facility would be well below NRC limits and there would be no measurable exposure to the public (NRC, 2012b, pp. 4-74 to 4-76). Worker and public exposures from GLE operation would all be below respective OSHA, EPA, and NRC limits (NRC, 2012b, pp. 4-77, 4-78 to 4-83). Construction and operation of a HALEU facility at this site would be similar to the GLE facility and SMALL.	SMALL – Site selection for a HALEU enrichment facility is expected to include criteria that would ensure worker exposure hazards would not exceed regulatory limits. For an undeveloped site, impacts from workforce accident and exposure to hazardous chemicals during construction are expected to be SMALL, with no impacts to the public. Worker exposure hazards for construction at an existing site or industrial areas may be higher, if radiological and industrial hazards are present, but SMALL. Risk to the operational staff and to the public from exposure to hazardous chemicals are expected to be negligible for both industrial and undeveloped sites.

Table 3-22. Summary of Impacts for Uranium Enrichment

Resource Area	***Impact Indicator***	***Impacts for Locating New HALEU Enrichment Facility at Existing Facility***			***Generic Site***
		Urenco Uranium Enrichment Facility Eunice, NM	***Centrus American Centrifuge Plant Piketon, OH***	***GLE Uranium Enrichment Facility Wilmington, NC***	***New HALEU Enrichment Facility [(a)]***
			facility at this site would similarly be SMALL.		
Public and Occupational Health – Facility Accidents	Radiological Accidents	Criticality – Potential worker fatality, 0.14 rem at CAB, 44-person rem, 0.03 LCFs Rupture of UF_6 cylinder – worker low, 0.97 rem at CAB, 12,000-person rem, 7 LCFs Earthquake – Potential worker fatality, 0.0017 rem at CAB, 19-person rem, 0.008 LCFs UF_6 Fire – worker 0.020 rem, 0.000072 rem at CAB	Accident analysis not available to the public. Analytical results also indicate that plausible radiological accidents at the proposed ACP pose acceptably low risks.	Criticality – Potential worker fatality, 0.57 rem at CAB, 387-person rem, 0.28 LCFs UF_6 release – worker 13 rem, 3.8×10^{-2} rem at CAB, 67.8-person rem, 5×10^{-2} LCFs	SMALL to LARGE without controls – Criticality could be fatal to the involved worker. UF_6 release could result in radiological exposure with seven LCFs to the public. Chemical exposures could exceed guidelines. Chances of accident occurrence reduced by application of IROFS. Application of IROFS reduces impacts to SMALL.
	Chemical Accidents	Rupture of UF_6 cylinder – 250 mg/m^3 U and 86 mg/m^3 HF at CAB UF_6 Fire – worker 59 mg/m^3 U and 20 mg/m^3 HF, 0.070 mg/m^3 U and 0.024 mg/m^3 HF at CAB	Accident analysis not available to the public. Analytical results also indicate that plausible radiological accidents at the proposed ACP pose acceptably low risks.	UF_6 release – worker 1.8×10^4 mg/m^3 U and 6.25×10^3 mg/m^3 HF, 9.12 mg/m^3 U and 3.45 mg/m^3 HF at CAB	
	Impact	SMALL to LARGE	SMALL with controls	SMALL to LARGE	
Traffic (Transportation)	Roadway capacity, AADT, and new vehicle trips during construction and operation.	SMALL to MODERATE – Impacts would be SMALL to MODERATE for initial UUSA construction, SMALL for the expansion, and SMALL during operation (NRC,	SMALL to MODERATE - Construction of the ACP facility would result in MODERATE impacts, and SMALL impacts during operations (NRC, 2006b). AADT volumes on nearby	SMALL to MODERATE – Construction of the GLE facility would result in SMALL to MODERATE impacts, and SMALL to MODERATE impacts during operations (NRC,	SMALL to MODERATE – Site selection for a HALEU enrichment facility is expected to include criteria for adequate site access and transportation infrastructure. Traffic impacts would vary

Table 3-22. Summary of Impacts for Uranium Enrichment

Resource Area	***Impact Indicator***	***Impacts for Locating New HALEU Enrichment Facility at Existing Facility***			***Generic Site***
		Urenco Uranium Enrichment Facility Eunice, NM	***Centrus American Centrifuge Plant Piketon, OH***	***GLE Uranium Enrichment Facility Wilmington, NC***	***New HALEU Enrichment Facility*** [(a)]
		2005a; NRC, 2015). AADT volumes on nearby roads have notably increased since publication of the 2015 UUSA EA but have sufficient excess capacity. Traffic impacts from a HALEU enrichment facility at this site would likely be MODERATE during construction and SMALL during operation.	roads have not substantially increased since publication of the 2006 ACP EIS and have sufficient excess capacity. Traffic impacts from a HALEU enrichment facility would be MODERATE during construction and SMALL during operation.	2012b). AADT volumes on some nearby roads have substantially increased since publication of the 2012 GLE EIS but still have sufficient excess capacity. Traffic impacts from a HALEU enrichment facility would be SMALL to MODERATE during construction and operation.	based on site-specific conditions but would likely be SMALL to MODERATE for construction for both industrial and undeveloped sites.
Socioeconomics	Regional Income, Employment Levels, Local Tax Revenue Housing Availability, Area Community Services	SMALL – The NRC concluded that socioeconomic impacts from proposed expansion construction of the UUSA facility would be SMALL (NRC, 2015). Socioeconomic impacts for a HALEU facility at this site would similarly be SMALL, however, could be MODERATE for local employment given the relative size of the construction labor force in the ROI. Economic and tax revenue impacts	SMALL to LARGE – The NRC concluded that socioeconomic impacts from construction and operation of the ACP would be SMALL (NRC, 2006b). Workforce impacts were based on the presence of a robust an available on-site workforce for construction that is no longer present. Socioeconomic impacts for a HALEU facility at this site would similarly be SMALL for most areas. However, potential	SMALL – The NRC concluded that socioeconomic impacts from construction and operation of the proposed GLE facility be SMALL (NRC, 2012b). Given the current levels of population, employment, housing, and community services available within the ROI, potential construction impacts from a HALEU facility at this site would also be considered SMALL. Similarly, socioeconomic impacts	SMALL to LARGE – Site selection for a HALEU enrichment facility is expected to include criteria related to availability of local workforces, housing and community services to support a proposed facility. Socioeconomic impacts would be dependent on the size of the in-migrating workforce and its distribution within the region, and local and regional conditions for a proposed site (i.e., ability to absorb population influx), and could range from SMALL to LARGE. Potential impacts (SMALL to

Table 3-22. Summary of Impacts for Uranium Enrichment

Resource Area	***Impact Indicator***	***Impacts for Locating New HALEU Enrichment Facility at Existing Facility***			***Generic Site***
		Urenco Uranium Enrichment Facility Eunice, NM	***Centrus American Centrifuge Plant Piketon, OH***	***GLE Uranium Enrichment Facility Wilmington, NC***	***New HALEU Enrichment Facility [(a)]***
		from construction would be MODERATE and beneficial. Socioeconomic impacts from operations would be SMALL.	SMALL to MODERATE impacts could occur for employment given the relative size of the construction labor workforce. MODERATE to LARGE impacts could occur to housing respectively due available housing rates in relation to the size of the operational and construction workforce.	from operations would be SMALL given the relative size of workforce to ROI. Economic and tax revenue impacts from construction and operation would also be SMALL and beneficial.	LARGE) also would include beneficial economic impacts (increased jobs, income levels, revenue), depending on spread across region or concentrated in one area
Environmental Justice	Disproportionate and Adverse Effects on Minority and Low-Income Populations	SMALL – The NRC determined that no significant impacts to environmental justice populations would occur from the proposed construction or expansion of the UUSA facility (NRC, 2015). The NRC used a 50-mile radius and 4-mile radius for the initial construction and expansion, respectively. Although there is a minority population within the ROI, impacts would not be disproportionately high	SMALL to LARGE – The NRC determined that construction and operation of the ACP facility would have a SMALL impact on environmental justice populations. Review of the most recent census data (USCB, 2023d) indicates there are no minority block groups within the ROI and six block groups with low-income populations. Although there are low-income populations within the ROI, impacts would not be	SMALL – The NRC determined that minor impacts associated with noise, dust, traffic, and employment would occur to environmental justice populations (NRC, 2012b). Review of the most recent census data (USCB, 2023d) indicates two minority block groups and three block groups with low-income populations in the ROI. Although there are minority and low-income populations within the ROI, impacts would not be disproportionately	SMALL to MODERATE – Site selection for a HALEU enrichment facility is expected to include criteria related to environmental, socioeconomic, and environmental justice factors. Impacts to environmental justice populations would be dependent on local and regional conditions for a proposed site, the potential high or adverse effects, and the presence of environmental justice communities in the ROI. Based on similar facilities and the application of siting criteria, impacts are expected

Table 3-22. Summary of Impacts for Uranium Enrichment

Resource Area	***Impact Indicator***	***Impacts for Locating New HALEU Enrichment Facility at Existing Facility***			***Generic Site***
		Urenco Uranium Enrichment Facility Eunice, NM	***Centrus American Centrifuge Plant Piketon, OH***	***GLE Uranium Enrichment Facility Wilmington, NC***	***New HALEU Enrichment Facility [(a)]***
		or adverse. Resource-specific impacts as discussed in this table range from SMALL to MODERATE.	disproportionately high or adverse. Resource-specific impacts as discussed in this table range from SMALL to MODERATE, potentially LARGE for housing availability for workforces.	high or adverse. Resource-specific impacts as discussed in this table range from SMALL to MODERATE.	to be in the SMALL to MODERATE range, and not disproportionate and adverse. Site-specific analysis would be required to verify findings based on location.

Key: ACP = American Centrifuge Plant; AADT = annual average daily traffic; BMPs = best management practices; CAB = controlled area boundary; CFR = Code of Federal Regulations; EIS = Environmental Impact Statement; EPA = Environmental Protection Agency; GHGs = greenhouse gases; GLE = GE-Hitachi Global Laser Enrichment; HALEU = high-assay low-enriched uranium; HAPs = hazardous air pollutants; HF = hydrogen fluoride; I = Interstate; LCF = latent cancer fatality; mg/m^3 = milligrams per cubic meter; NAAQS = National Ambient Air Quality Standards; NC = North Carolina; NEPA = National Environmental Policy Act; NHPA = National Historic Preservation Act NM = New Mexico; NPDES = National Pollutant Discharge Elimination System; NRC = U.S. Nuclear Regulatory Commission; OH = Ohio; OSHA = Occupational Safety and Health Administration; $PM_{2.5}$ = fine particulates; PM_{10} = coarse particulates; ROI = region of influence; SWU = separative work unit; U = uranium; UF_6 = uranium hexafluoride

Notes: Water and wastewater are discussed in Section 3.3.4, *Water Resources*; solid waste, hazardous waste, and radioactive waste are addressed in Section 3.3.10, *Waste Management*; and transportation infrastructure is addressed in Section 3.3.13, *Traffic*.

[a] Potential impacts are based on screening criteria for siting a new HALEU facility at another location that would incorporate environmental and other factors that would result in a site compatible for a uranium enrichment facility, and that the facility would be planned in a manner that either avoids or mitigates potential effects. However, impacts would be dependent upon locations specific factors and could be greater. These impacts would be identified and addressed through the NRC NEPA process.

4 HALEU Deconversion

4.1 Description of the Activity

4.1.1 General Description

The processes for deconversion[20] of uranium hexafluoride (UF_6) to oxide or metal are well-understood technologies and performed routinely for low-enriched uranium (LEU) and depleted uranium (DU). A commercial deconversion facility would start with cylinders of high-assay low-enriched uranium (HALEU) in the form of UF_6 and deconvert the enriched uranium to oxide or metal for fabrication into reactor fuel. The process for deconversion of cylinders of HALEU in the form of UF_6 to oxide or metal would be similar to the processes used for conversion of LEU and DU to oxide or metal. Although the deconversion process is known, additional U.S. Nuclear Regulatory Commission (NRC) National Environmental Policy Act (NEPA) documentation would be needed before construction and operation of a new commercial HALEU deconversion facility or facilities.

There is no deconversion facility in the United States capable of processing HALEU in the quantities required by the Proposed Action. A facility or facilities would need to be constructed. A HALEU deconversion facility would deconvert commercially generated enriched UF_6 into uranium dioxide (UO_2) or metal for advanced nuclear reactor fuel and into fluorine products for potential resale. A commercial HALEU deconversion facility could be co-located with an enrichment facility, co-located with a fuel fabrication facility, co-located with a storage facility, located at other industrial (brownfield) sites, or be located at an undeveloped (greenfield) site. The facility would have to be an NRC Category II facility, with security features meeting NRC requirements for the possession of uranium enriched to between 10% and 20% uranium-235 (U-235). Security could be provided for the facility itself or for the site where the facility is located.

As described in the Request for Proposals for HALEU Deconversion Services (DOE, 2023c), the U.S. Department of Energy (DOE) may choose to enter into multiple deconversion agreements for services. These agreements could be in any amount providing up to a cumulative 290 metric tons (MT) of HALEU metal (at an assumed production rate of 50 MT per year). For the Technical Report, the Leidos Team has assumed a HALEU deconversion facility would process 38 MT of HALEU in the form of UF_6 per year and produce 28 MT of HALEU oxide or 25 MT of HALEU metal. Therefore, at least two HALEU deconversion facilities would be needed to meet the Proposed Action maximum of 290 MT of HALEU metal. The impacts of construction and operation of these facilities would bound the impacts of construction and operation of smaller facilities.

4.1.2 Description of the Processes

To manufacture fuel for advanced nuclear reactors, enriched UF_6 has to be deconverted into UO_2 powder or uranium metal. The processes described in this section are based on the DU deconversion facilities. Similar processes could be used in a HALEU deconversion facility but with modifications to provide for criticality safety. Because of criticality concerns, equipment for a HALEU deconversion facility would be smaller than the equipment for a DU deconversion facility.

Enriched UF_6 is stored and transported as a solid in cylinders specifically designed for these purposes. UF_6 is a solid at temperatures below 52 degrees Celsius (°C) (134 degrees Fahrenheit [°F]). Deconversion typically begins with receipt of enriched UF_6 from an enrichment plant. The UF_6, in solid form, in containers, is heated to gaseous form, and the UF_6 gas is chemically processed to form UO_2 powder or metal.

[20] In the HALEU EIS and this Technical Report, "deconversion" refers to the process of transforming HALEU in the form of UF_6 to HALEU metal or oxide, and the term "conversion" is used to refer to the process of converting uranium ore into UF_6. Other documents that describe the process of transforming LEU or DU into oxide also refer to the process as "conversion."

Deconversion of uranium tetrafluoride (UF_4) to uranium metal is performed by reduction with magnesium or calcium. The reaction is carried out at temperatures above the melting point of uranium: 1,130 °C (2,066 °F). The UF_4 is produced by reacting UO_2 with hydrogen fluoride (HF) gas at 300 °C to 500 °C (572 °F to 932 °F). Deconversion of UF_6 to UO_2 can be performed by one of three processes: (1) integrated dry route (IDR) powder process; (2) ammonium diuranate (ADU) process; or (3) ammonium uranyl carbonate (AUC) process. DOE Paducah, Kentucky, and Portsmouth, Ohio, DU hexafluoride (DUF_6) deconversion facilities use the IDR process, and the proposed International Isotopes Fluorine Products, Inc. (IIFP) facility in Lea County, New Mexico, would use the ADU process.

In the IDR powder process, UF_6 is reduced and hydrolyzed to UO_2 using hydrogen and steam. The IDR technique consists of feeding UF_6 vapor with steam through a jet to form a plume of uranyl fluoride (UO_2F_2) powder, which is then ejected into a rotating kiln where it meets a counter-current flow of hydrogen and steam. The product UO_2 is discharged from the end of the kiln through check-hoppers into product containers. In the ADU process, UF_6 is hydrolyzed by solution in water, ammonia is added to precipitate ammonium diuranate, and the diuranate is reduced to UO_2 with hydrogen at 820 °C (1,508 °F). In the AUC process, gaseous UF_6, carbon dioxide, and ammonia are combined in water, precipitating ammonium uranyl carbonate. The AUC is combined with steam and hydrogen at 500 °C to 600 °C (932 °F to 1,112 °F) to yield UO_2. The flow sheets of ADU and AUC deconversion processes are shown in Figure 4-1 and the flow sheet of the IDR process is given in Figure 4-2.

Additional processes can be included in a deconversion facility to recover fluorine products such as anhydrous hydrogen fluoride (AHF), silicon tetrafluoride (SiF_4), and boron trifluoride (BF_3). The extracted fluoride products can be retained for commercial resale. The fluorine products are potentially valuable for applications in the electronic, solar panel, and semi-conductor markets, among others. In addition, AHF is an important chemical in various industrial applications.

To produce AHF, the UF_6 vapor would be captured in a reaction vessel where it would react with hydrogen to produce UF_4 powder and AHF. The chemical equation for this process is as follows:

$$UF_6 \text{ (gaseous)} + H_2 \text{ (gas)} \rightarrow DUF_4 \text{ (solid)} + 2HF \text{ (anhydrous)}$$

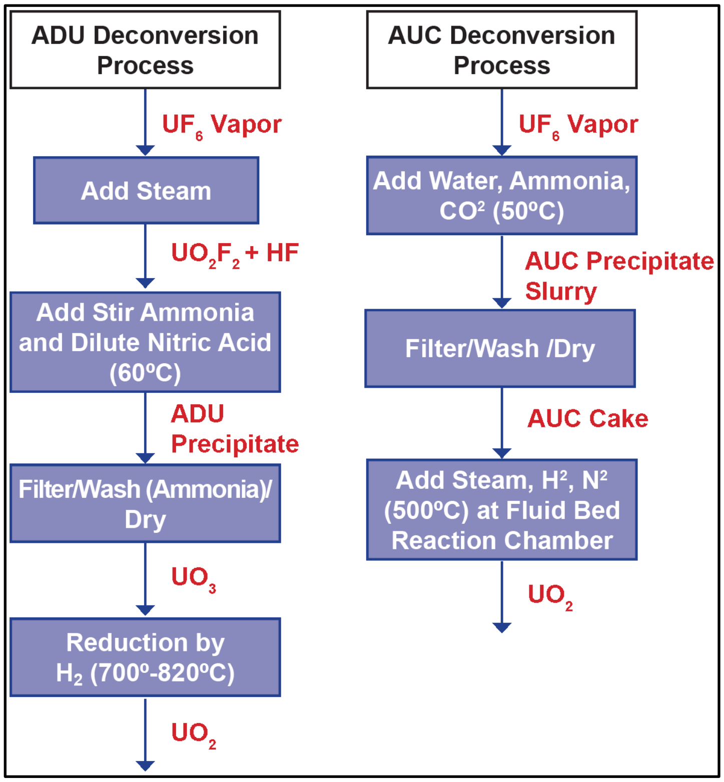
The UF_4 powder would be continuously withdrawn from the bottom of the vessel and fed to the fluorine extraction process (FEP) for further deconversion in either the silicon separation process or the boron separation process. Also, HF can be anhydrous (meaning pure HF without water) or not. In chemical equations, HF is depicted as HF, but the parenthetic expression (anhydrous) is added when appropriate. Hydrofluoric acid is another term for HF combined with water. HF off-gases would be filtered, and any residual UF_6 would be trapped on carbon filters. The AHF would then be condensed to liquid form, and any entrained hydrogen burned. Off-gas treatment would also be required. AHF would be collected to limit inventory should a leak occur. AHF storage vessels would be located in a building designed to contain a leak. Figure 4-3 shows the process flow chart for this process.

To produce SiF_4, the powdered depleted uranium tetrafluoride (DUF_4) would be mixed with powdered silicon dioxide (SiO_2) in a rotary calciner and heated to react to form gaseous SiF_4 and solid triuranium octoxide (U_3O_8), sometimes referred to simply as uranium oxide or yellowcake). The chemical equation for this process is as follows:

$$SiO_2 \text{ (solid)} + UF_4 \text{ (solid)} \rightarrow SiF_4 \text{ (gas)} + U_3O_8 \text{ (solid)}$$

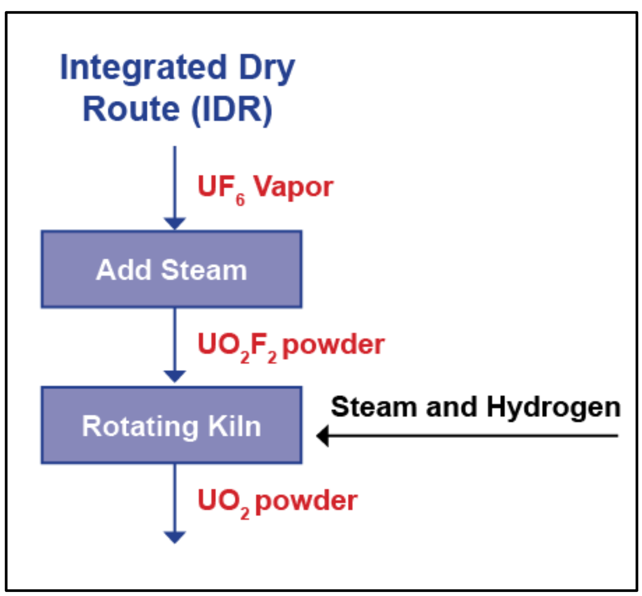
The gaseous SiF_4 would be collected from the calciner, filtered to remove any particulate contamination, and cooled to condense any hydrofluoric acid or other trace gases. The purified, gaseous SiF_4 then would be collected in cold traps. The cold traps would be warmed to vaporize the SiF_4, and the gaseous SiF_4

would be stored in a vessel for subsequent packaging and shipment to customers. Figure 4-4 shows the process flow chart for this process.



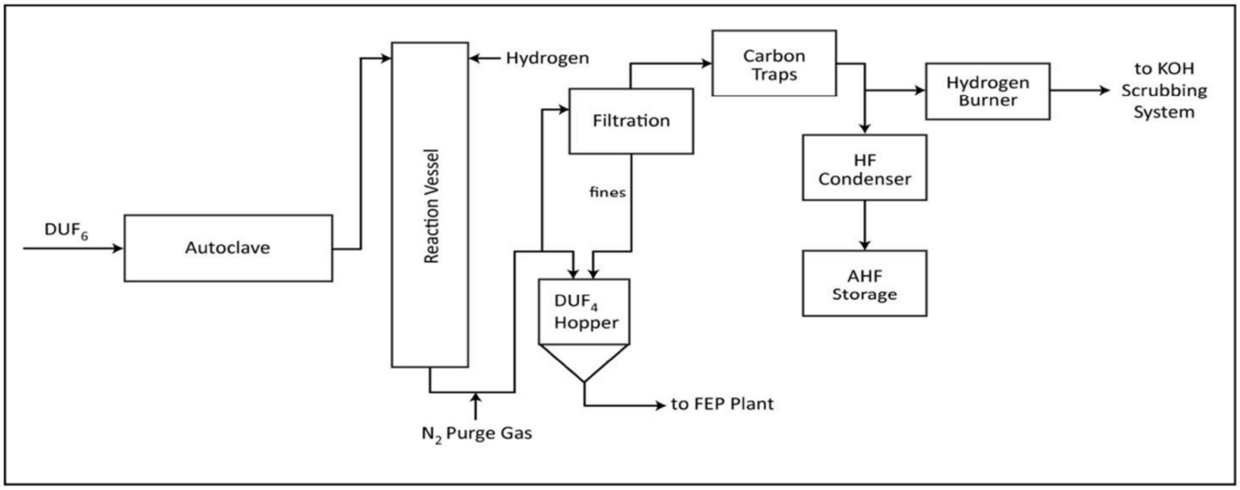
Key: ADU = ammonium diuranate; AUC = ammonium uranyl carbonate; °C = degrees Celsius; CO_2 = carbon dioxide; H_2 = hydrogen; HF = hydrogen fluoride; N_2 = nitrogen; UF_6 = uranium hexafluoride; UO_2 = uranium dioxide; UO_2F_2 = uranyl fluoride; UO_3 = uranium trioxide (uranyl oxide)

Figure 4-1. Flow Sheets of Ammonium Diuranate and Ammonium Uranyl Carbonate Deconversion Processes



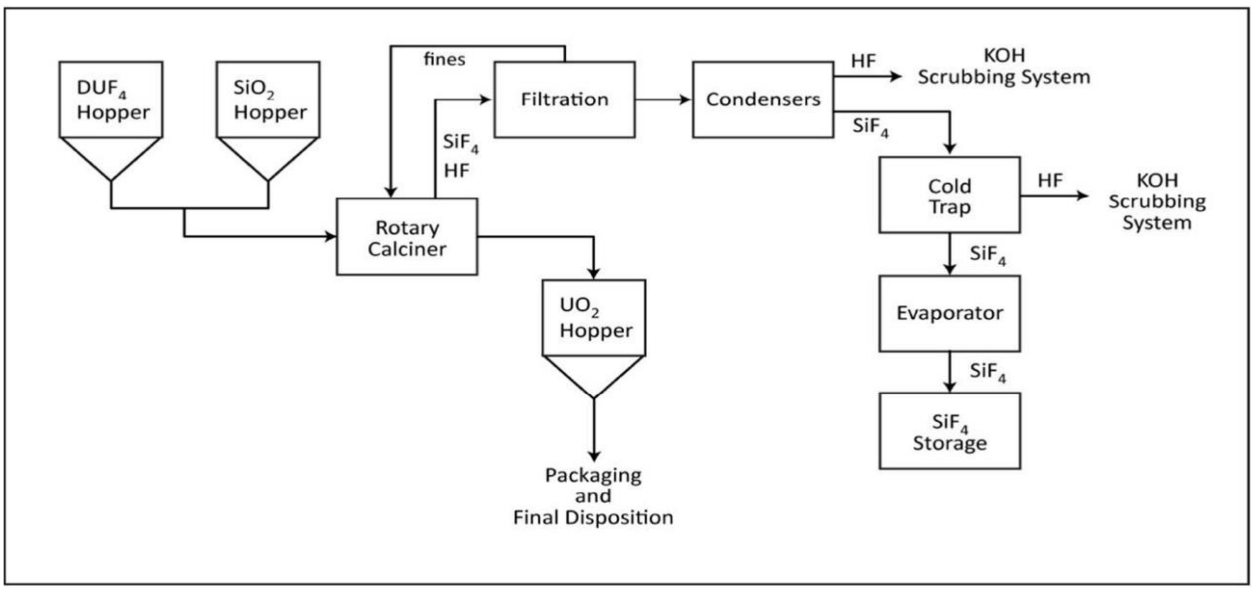
Key: UF_6 = uranium hexafluoride; UO_2 = uranium dioxide; UO_2F_2 = uranyl fluoride

Figure 4-2. Flow Sheet of Integrated Dry Route Process



Key: AHF = anhydrous hydrogen fluoride; DUF_4 = depleted uranium tetrafluoride; DUF_6 = depleted uranium hexafluoride; FEP = fluorine extraction process; HF = hydrogen fluoride; KOH = potassium hydroxide; N_2 = nitrogen

Figure 4-3. Process to Recover Anhydrous Hydrogen Fluoride

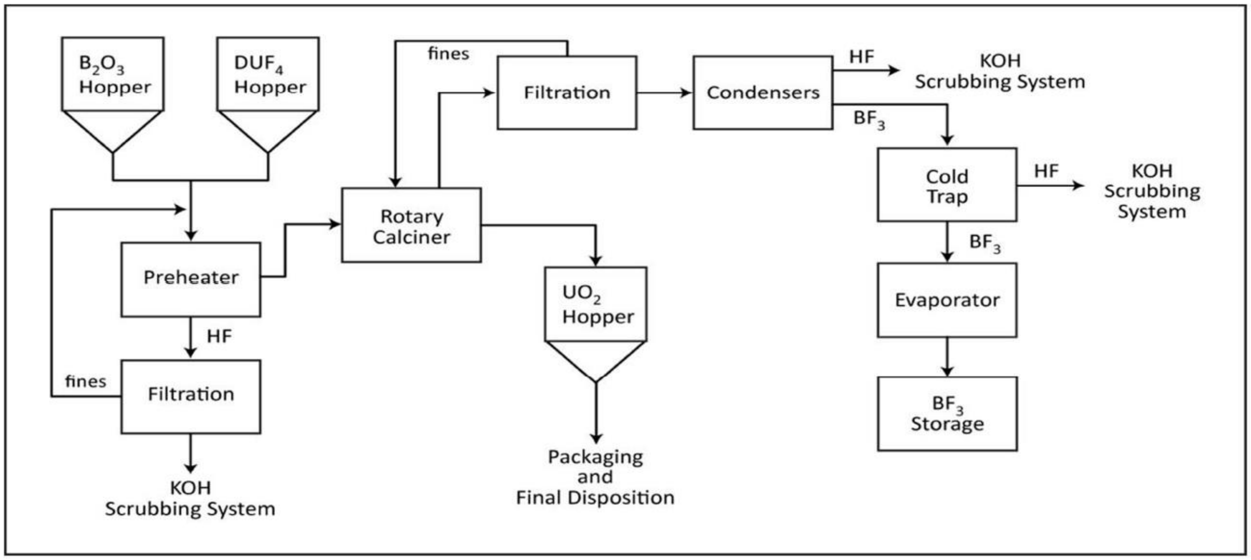


Key: DUF_4 = depleted uranium tetrafluoride; HF = hydrogen fluoride; KOH = potassium hydroxide; N_2 = nitrogen; SiO_2 = silicon dioxide; SiF_4 = silicon tetrafluoride; UO_2 = uranium oxide

Figure 4-4. Process to Recover SIF_4

The BF_3 production process would be very similar to that for SiF_4, except there would be a pre-treatment step in which a feed mixture of boron oxide (B_2O_3) and UF_4 would be heated prior to mixing in the rotary calciner (Figure 4-5). The preheating would remove moisture by reacting the water with the UF_4, releasing gaseous AHF. The gaseous AHF would be filtered and scrubbed in the off-gas system. The remainder of the process would be very nearly the same as for SiF_4 production. The chemical equation for this process is as follows:

$$2B_2O_3 \text{ (solid)} + 3UF_4 \text{ (solid)} \rightarrow 4BF_3 \text{ (gas)} + 3UO_2 \text{ (solid)}$$



Key: B_2O_3 = boron oxide; BF_3 = boron trifluoride; DUF_4 = depleted uranium tetrafluoride; HF = hydrogen fluoride; KOH = potassium hydroxide; UO_2 = uranium oxide

Figure 4-5. Process to Recover BF_3

4.1.3 Potential Facilities

A potential HALEU deconversion facility could be located at an enrichment facility, a fuel fabrication facility, or elsewhere. Economic considerations could factor into deciding where to locate the deconversion facility. The facility would have to be an NRC Category II facility, with security features meeting NRC requirements for the possession of uranium enriched to between 10% and 20% U-235. The technology for HALEU deconversion would be similar to that used at the Portsmouth and Paducah sites for DU conversion. Deconversion to other unique fuel forms that may be required for some advanced reactor fuels may require new technology. The planned IIFP DUF_6 conversion facility provides a source of information for evaluating the environmental impacts of construction and operation of a HALEU deconversion facility.

A new deconversion facility would be typical of specialty industrial chemical facilities. The proposed facility would be enclosed within a security fence. Pole-mounted security lighting would be installed around the entire perimeter. Structures within the security fence would include process, administration, and laboratory buildings; a maintenance shop; security facilities; utilities; cylinder storage pads; and warehouses. The employee parking lot would be outside the security fence.

The HALEU deconversion facility would have a UF_6 Cylinder Storage Pad with bollards to protect the cylinders from vehicles. The pad would be curbed for stormwater collection and provided with underground drains to a stormwater retention basin. There would also be an empty UF_6 Cylinder Storage Pad, which would be the staging area for the shipment of empty cylinders. The main process buildings would be on the proposed facility:

- UF_6 Autoclave Building
- UF_4 Process Building
- UF_4 Container Staging Building
- Decontamination Building
- FEP Building

- FEP Oxide Staging Building
- UF_4 Container Storage Building
- FEP Product Storage and Packaging Building
- AHF Staging Containment Building
- Fluoride Products Trailer Loading Building
- SiO_2 Storage Silo
- Potassium Hydroxide Storage Tank
- FEP and UF_4 Scrubbers and Scrubber Containment Pads

Hydrogen used as a reactant in the deconversion processes would be generated on-site from natural gas using a vendor-supplied steam reforming system. Other than a small surge tank, the site would not store hydrogen gas. All the building area aprons and areas surrounding outside equipment would have concrete curbing dikes designed to contain the largest possible spill of liquid chemicals, based on the volume of chemicals expected to be stored in each building or area. Pads for the storage of hazardous or corrosive chemicals would be coated to prevent leaks penetrating through the pads. The dikes would be equipped with pumps to transfer any spills to the environmental protection process equipment. Radiological hand and foot monitors would be installed at exits of buildings where uranium would be handled. Fluoride and radiological detection systems, local alarms, and alarms in the control rooms would alert workers to potentially hazardous conditions. Auxiliary buildings would generally house the following:

- Materials
- Maintenance shops
- Laboratories
- Steam boilers and supporting utilities
- Electrical utility equipment
- Sanitary water treatment equipment
- Equipment for process water treatment and recycling
- Personnel offices, break rooms, changing rooms, and restrooms

The majority of impacts would occur during land clearing, site grading, and building construction on a site of fewer than 16 hectares (ha) (40 acres).

4.1.4 Existing NEPA Documentation

The Leidos Team reviewed the NRC's *Final Environmental Impact Statement for the Proposed Fluorine Extraction Process and Depleted Uranium Deconversion Plant in Lea County, New Mexico* (NRC, 2012a) (hereinafter referred to as the "Fluorine/DU EIS"). The Fluorine/DU EIS provides the Leidos Team with information and analyses for determining the impacts of construction and operation of a HALEU deconversion facility.

The Leidos Team also considered information contained in DOE's *Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, Ohio, Site (DOE/EIS-0360)* (DOE, 2004b) (referred to as the "Portsmouth DU EIS") and *Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky, Site (DOE/EIS-0359)* (DOE, 2004c) (referred to as the "Paducah DU EIS"). DOE is using these currently operating facilities to convert its inventory of DUF_6 to DU oxide and other compounds suitable for beneficial use or disposal. These Environmental Impact Statements (EISs) analyzed the construction, operation, and decontamination and decommissioning of the proposed DUF_6 deconversion facilities at the Portsmouth and Paducah sites; transportation of DU deconversion products and waste materials to a disposal facility; transportation and sale of the HF produced as a deconversion co-product; and neutralization of HF to calcium fluoride (CaF_2) and its sale or disposal in the event that the HF product is not sold.

4.2 Approach to NEPA Analyses

The Technical Report incorporates by reference resource conditions and impact considerations of the primary existing NEPA documentation sources previously discussed, as well as other online and available sources, as well as Federal and state databases. The analysis also considers information provided by Federal and state regulatory authorities, Tribes, stakeholders and other interested parties during the scoping period.

The intent of the Technical Report is to provide a range of potential impacts that could occur for construction and operation of a HALEU deconversion facility using existing NEPA documentation and other available sources. Fundamental to the approach is the relationship of the production throughput for the DU deconversion facilities with existing NEPA documentation (range from 3,400 MT to 18,000 MT of DUF_6 per year) and the required throughput for the HALEU deconversion facility (38 MT of HALEU in the form of UF_6 per year). Private industry, along with NRC approvals, would determine the actual technique employed, and project-specific NEPA analyses will likely be required for a new HALEU deconversion facility.

4.3 Affected Environment and Environmental Consequences

For comparison purposes, a new HALEU deconversion facility would process 38 MT of HALEU in the form of UF_6 per year and produce 28 MT of HALEU oxide or 25 MT of HALEU metal per year.

4.3.1 Land Use

Construction, operation, and decommissioning of a 3,400 MT per year (MT/yr) DUF_6 deconversion facility was analyzed in the Fluorine/DU EIS (NRC, 2012a). Construction of the 16-ha (approximately 40-acre) facility would convert the entire 259-ha (640-acre) site's land use that previously consisted of cattle grazing, utility rights-of-way, and monitoring wells. The ownership transfer and conversion of the IIFP site would not conflict with any Federal, state, local, or Tribal nation land use plans, or mineral resource exploitation. The facility's operation would remain consistent with the existing land use of the neighboring tracts, which support industrial facilities, natural gas and oil extraction, transmission infrastructure, and agriculture and open land. Although cattle grazing would be restricted on the entire site, this represented only a 0.02% loss of available grazing land in the county. The facility's location was chosen to minimize disruption to existing utility rights-of-way, and the construction did not affect any monitoring wells. Overall, the Fluorine/DU EIS concluded that impacts on land use from construction and operation would be SMALL (NRC, 2012a).

Construction and operation of 18,000 MT/yr UF_6 deconversion facilities at the Paducah site in Kentucky and the Portsmouth site in Ohio to convert DUF_6 to oxide were analyzed in the Paducah DU EIS (DOE, 2004c) and Portsmouth DU EIS (DOE, 2004b). No significant new land disturbance aside from a new cylinder storage yard was required, as construction and operations occurred within the industrialized areas of Paducah and Portsmouth. On the 1,500-ha (approximately 3,714-acre) Portsmouth site, the deconversion facility was constructed on a heavily developed site, with some grassy and pasture areas on the site. The facility at the Paducah site was estimated to occupy a total of 4 ha (10 acres) with up to

18 ha (45 acres) of land disturbed during construction, and converted a grassy field, which modified the previous land use. Overall, construction and operation of the Paducah and Portsmouth deconversion facilities remained consistent with the industrialized sites impacts to land use and were considered SMALL (DOE, 2004b; DOE, 2004c).

Construction and operation of a HALEU deconversion facility would have similar impacts as those described in the Fluorine/DU EIS, although impacts would likely be smaller due to the smaller throughput of the HALEU facility (38 MT/yr of UF_6) versus the IIFP facility (3,400 MT/yr DUF_6). Other potential impacts on land use not mentioned in the Fluorine/DU EIS (NRC, 2012a) include limiting land use due to the potential for soil contamination from spills; however, contamination would be mitigated through proper best management practices (BMPs) appropriate soil monitoring, and site decontamination and decommissioning procedures. A HALEU deconversion facility could be constructed at a HALEU enrichment facility, fuel fabrication facility, or its own individual site. Site-specific characteristics would need to be considered such as local zoning, land use plans, and valuable mineral deposits, which may require additional review or re-zoning to limit impacts.

The construction of a HALEU deconversion facility could have several impacts on the land use of the site and its surrounding area and could vary depending on the specific location and local regulations. General impacts could include land disturbance that alters the physical layout of the site and changes to land use that would exclude it from any previous uses, such as agriculture, grazing, or other industrial uses. Future land use on or near the facility may be restricted due to potential radiological and chemical contamination. Potential impacts on land use can be mitigated through careful planning, site selection, construction practices, and operation procedures, including strict adherence to safety and environmental regulations.

Potential sites and their associated land use impacts for HALEU enrichment and fuel fabrication can be found in Section 3, *Uranium Enrichment*, and Section 7, *HALEU Fuel Fabrication,* respectively. A new HALEU deconversion facility co-located at an existing enrichment or fuel fabrication facility would likely utilize existing buildings and assets, as well as be constructed within existing buildings or on already disturbed land, reducing the potential impacts on land use even further. Based on these considerations, the impacts on land use from construction and operation of a new HALEU deconversion facility would be considered SMALL.

4.3.2 Visual and Scenic Resources

The possible construction, operation, and decommissioning of a 3,400 MT/yr UF_6 deconversion facility in Lea County, New Mexico, was analyzed in the Fluorine/DU EIS (NRC, 2012a). The facility's construction would have a minimal impact on visual and scenic resources in the area. The IIFP site is flat and sparsely developed, and the facility's construction and operation would not be visible from the nearest population center about 23 kilometers (km) (14 miles) away. Construction of the facility would not alter the scenic quality, as the site had already received the lowest rating. The facility would not significantly alter the existing landscape, as the surrounding area is characterized by sporadic natural gas and oil extraction structures, and overhead transmission lines. The tallest structures would be buildings that are 21.3 meters (m) (69.88 feet) high and emission stacks that are 30.5 m (100.06 feet) tall. These heights do not interfere with the 61-m (200.13-foot) threshold requiring lights for aviation safety, are not visible from any recreational or historic facilities, and would not degrade the existing viewscape that includes other industrial facilities. Security lighting at the facility would be directed downward to reduce light pollution. Given the site's low scenic value and the presence of other industrial facilities in the area, any visual impacts during the construction and operation of the facility were concluded to be SMALL.

Construction and operation of a HALEU deconversion facility would have similar impacts as those described in the Fluorine/DU EIS (NRC, 2012a), although impacts would likely be smaller due to the smaller throughput of the HALEU facility (38 MT/yr of UF_6) versus the IIFP facility (3,400 MT/yr DUF_6). Impacts on visual and scenic resources associated with construction of a HALEU deconversion facility would occur from activities such as land clearing, site grading, and building construction. The site's construction would introduce the facilities listed in Section 4.1.3, *Potential Facilities*, along with security fencing and lighting along the perimeter and a parking lot. The facility could alter the landscape especially if the area is currently undeveloped or predominantly natural. Given that construction of the IIFP facility occurred in an area with an existing low scenic quality, it is assumed similarly that a HALEU deconversion facility would not alter the landscape and detract from any natural aesthetics of the area. A HALEU deconversion facility could be constructed at a HALEU fuel fabrication facility, enrichment facility, or its own site. Site-specific characteristics would need to be considered such as landforms, vegetation, water features, and human-made structures. Potential impacts on visual and scenic resources can be mitigated through down-shielding of security lighting, planting of vegetation buffers, construction practices, and operation procedures, including strict adherence to safety and environmental regulations. Potential sites and their associated visual and scenic resource impacts for HALEU enrichment and fuel fabrication can be found in Section 3, *Uranium Enrichment*, and Section 7, *HALEU Fuel Fabrication*, respectively. A new HALEU deconversion facility co-located at an existing enrichment or fuel fabrication facility would likely utilize existing buildings and assets as well as be constructed within existing buildings or on already disturbed land, reducing the potential for impacts on visual and scenic resources even further. Based on these considerations, the impacts on visual and scenic resources from construction and operation of a new HALEU deconversion facility would be considered SMALL.

4.3.3 Geology and Soils

Construction of a new HALEU deconversion facility capable of processing 38 MT of HALEU in the form of UF_6 per year could occur at an enrichment facility, or fuel fabrication facility. A HALEU deconversion facility could also be located at a new site, but additional site-specific NEPA analyses would need to be conducted by the NRC.

International Isotopes Fluorine Products, Inc. Fluorine Extraction Process and Depleted Uranium Deconversion Plant in Lea County, New Mexico

Impacts on geology and soils from the construction, operation, and decommissioning of a 3,400 MT/yr UF_6 deconversion facility was previously analyzed in the Fluorine/DU EIS (NRC, 2012a). Impacts on geology and soils outlined in this document include soil erosion, compaction, and disturbance of 40 acres of land due to construction, excavation, and grading activities. Approximately 42,400 cubic yards of rock and soil would be excavated to dig foundations and level the terrain, and 200 cubic yards of backfill would be required for fill material. However, these impacts are considered to be minimal, limited to the facility boundary (with the exception of the small volume of fill material that would need to be collected from off-site), and mitigated by BMPs outlined in Section 4.1.1.5 of the Fluorine/DU EIS. Impacts on geological features were considered minimal due to most activities occurring in shallow soils. No additional impacts are expected during operation. Overall construction and operations impacts on geology and soils were considered SMALL.

Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky, Site

Impacts on geology and soils from the construction and operation of an 18,000 MT/yr UF_6 deconversion facility was previously analyzed in the Paducah DU EIS (DOE, 2004c). Impacts on geology and soils described in this document include soil erosion, compaction, and disturbance of 45 acres of land due to construction, excavation, and grading activities. The sites discussed are relatively flat, so no significant changes to site topography was expected other than the removal of some previously contaminated soils.

Other potential impacts on geology and soils include contamination from spills, which can be mitigated through proper BMPs, and appropriate soil monitoring, site decontamination, and decommissioning procedures. Examples of BMPs and mitigation measures can be found in Section 5.4 of the Paducah DU EIS.

Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, Ohio, Site

Impacts on geology and soils from the construction and operation of an 18,000 MT/yr UF_6 deconversion facility was previously analyzed in the Portsmouth DU EIS (DOE, 2004b). Impacts on geology and soils described in this document include soil erosion, compaction, and disturbance of 65 acres of land due to construction, excavation, and grading activities. The sites discussed are relatively flat, so no significant changes to site topography was expected other than the removal of some previously contaminated soils. Other potential impacts on geology and soils include contamination from spills, which can be mitigated through proper BMPs, and appropriate soil monitoring, site decontamination, and decommissioning procedures. Examples of BMPs and mitigation measures can be found in Section 5.4 of the Portsmouth DU EIS.

New HALEU Deconversion Facility

Construction and operation of a HALEU deconversion facility would have similar impacts to the construction of a DU conversion facility as described in the Fluorine/DU EIS, Paducah DU EIS (DOE, 2004c), and Portsmouth DU EIS (DOE, 2004b), although impacts would likely be smaller due to the smaller production rate of the HALEU facility (38 MT/yr) versus up to 18,000 MT/yr, at the Portsmouth, Ohio, site. A HALEU deconversion facility could be constructed at a HALEU enrichment facility, fuel fabrication facility, or its own individual site. Site-specific characteristics would need to be considered such as higher erosion potential, sensitive geology, existence of prime farmlands, and valuable mineral deposits, which may require additional review or other BMPs to limit impacts. Potential sites and their associated geology and soils impacts for HALEU enrichment and fuel fabrication can be found in Section 3, *Uranium Enrichment*, and Section 7, *HALEU Fuel Fabrication*, respectively. A new HALEU deconversion facility co-located at an existing enrichment or fuel fabrication facility would also likely utilize existing buildings and assets as well as be constructed within existing buildings or on already disturbed land, which reduces the potential impacts on geology and soils. Based on these considerations, the impacts on geology and soils from construction and operation of a new HALEU deconversion facility likely would be considered SMALL.

4.3.4 Water Resources

As discussed above, the Proposed Action would require the construction of a new HALEU deconversion facility capable of processing 38 MT of HALEU in the form of UF_6 per year to produce 25 MT of HALEU metal or 28 MT HALEU oxide. While the location of a new HALEU deconversion facility is not yet known, it is possible that a new facility would be co-located with a HALEU enrichment facility, or fuel fabrication facility. The affected environment for those sites and site-specific impacts are presented in Section 3, *Uranium Enrichment*, and Section 7, *HALEU Fuel Fabrication*, respectively.

The Leidos Team reviewed the Fluorine/DU EIS (NRC, 2012a) to assess potential water resource impacts associated with the construction and operation of a DUF_6 deconversion facility. The Fluorine/DU EIS determined that impacts on groundwater use and quality associated with the construction and operation of the IIFP facility would be expected to be SMALL and would consist of contamination from leaks or spills of various contaminants, wastewater and stormwater runoff, and the potential for new appropriations to tax the existing groundwater supply in the region (NRC, 2012a, pp. 4-11 to 4-12). As there are no surface water features located at the proposed site of the IIFP facility, there would be no impacts on surface water.

As discussed above, the Leidos Team also considered information contained in DOE's 2004 EIS for the construction and operation of a DUF_6 conversion facility in Portsmouth, Ohio, (DOE, 2004b), and the 2004 DOE EIS for the construction and operation of a DUF_6 conversion facility in Paducah, Kentucky, (DOE, 2004c), as these documents analyzed potential impacts associated with deconversion facilities at both sites. Potential impacts on nearby surface waters associated with construction of DUF_6 conversion facilities at the Portsmouth, Ohio, site were determined to be primarily negligible, and consisted of temporary decreases in water quality resulting from contaminated runoff from the construction sites, and potentially permanent decreases in water quality resulting from increased runoff as previously permeable areas are replaced by impermeable structures and surfaces (DOE, 2004b, pp. 5-27 and 5-48). Impacts on groundwater were determined to be primarily negligible and would result from temporary increases in water use required to facilitate construction activities, potential water quality decreases resulting from the infiltration of contaminated surface waters (contaminated via poorly managed runoff and/or spills of construction materials) and a loss of permeable soils in the area, potentially decreasing groundwater recharge (DOE, 2004b, pp. 5-27 to 5-38). It was determined that no appreciable impacts on water resources would occur due to facility operations at the Portsmouth, Ohio, site. Potential impacts could result through contamination of water resources from spills, leaks, or runoff from the site, the possibility of which would be minimized through the implementation of BMPs (DOE, 2004b, pp. S-42).

Potential impacts on water resources associated with construction of DUF_6 conversion facilities at the Paducah, Kentucky, site were similar to those anticipated at the Portsmouth, Ohio, site, consisting primarily of decreases in surface water quality resulting from spills of construction materials, increases in runoff from construction activity/equipment, and from the increase in impervious surfaces, increased water use, and changes to groundwater recharge, depth, flow direction, and quality, due to permanent changes in soil permeability. It was determined that such impacts would be negligible (DOE, 2004c, pp. 5-27 to 5-28). Operational impacts at this site were likewise determined to be negligible and included increased water use and the possibility of decreased water quality resulting from increased runoff and possible spills.

A HALEU deconversion facility could be constructed at a HALEU enrichment facility, a fuel fabrication facility, or in an entirely new location. It is anticipated that impacts associated with the construction and operation of a HALEU deconversion facility would be similar to those analyzed in the above-referenced EISs, or likely smaller, due to the smaller production throughput of the HALEU deconversion facility. During construction and operation, a consistent supply of water will be required to satisfy potable and nonpotable needs. When designing a new deconversion facility, anticipated water usage during construction and operation would be calculated and weighed against the existing capacity of the region's supplies. In the event that water resources in the proposed location lack the capacity to accommodate construction-related and operational water usage of the new facility, an off-site source of water would be identified.

During construction and operations, the proposed facility would be subject to a pre-approved plan detailing spill prevention methods and the actions to be taken in the event that a leak or spill occurs. Compliance with site-specific National Pollutant Discharge Elimination System (NPDES) permits will limit the potential for stormwater to leave the site untreated, potentially contaminating nearby surface waters and groundwater. Additionally, BMPs would be in place to capture and treat sanitary and process wastewaters prior to leaving the site (NRC, 2012a, pp. 4-11 to 4-12).

Impacts on surface waters that could be expected from the construction and operation of a new deconversion facility would be similar to those analyzed in Section 3, *Uranium Enrichment*, for the construction and operation of a new HALEU enrichment facility. Such impacts from construction include a temporary increase in ground-disturbing activities that may result in soil erosion and sedimentation, creating short-term decreases in the quality of downstream waters. Operational impacts on surface waters would include liquid effluent from sanitary and process wastewaters and stormwater runoff. The potential for these impacts would be mitigated through adherence to NPDES permit conditions and the implementation of BMPs similar to those discussed above and in Section 3.

With the inclusion of site-specific BMPs designed to retain and treat liquid effluent on-site and compliance with all necessary permits, impacts on water resources resulting from the construction and operation of a new HALEU deconversion facility would be expected to be SMALL.

4.3.5 Air Quality

The following section discusses potential air quality impacts that could occur from construction and operation of a HALEU deconversion facility. The analysis of impacts relies on analyses from previous NEPA documents that evaluated the siting of a deconversion facility, as described above in Section 4.1.4, *Existing NEPA Documentation*. Construction and operation of the HALEU deconversion facility at one of these locations would have to comply with the applicable regulatory requirements at that location.

Construction and operation of a HALEU deconversion facility would result in air emissions of criteria pollutants, hazardous air pollutants, radiological compounds, and greenhouse gases. The following evaluates projected emissions relative to air quality conditions within a project region and applicable air pollution standards and regulations. Section 4.3.11, *Public and Occupational Health – Normal Operations*, and Section 4.3.12, *Public and Occupational Health – Facility Accidents*, present estimates of health effects due to radiological air emissions that would occur from the project.

Under the Clean Air Act, the U.S. Environmental Protection Agency (EPA) establishes National Ambient Air Quality Standards (NAAQS) for common air pollutants known as criteria pollutants. The NAAQS represent the maximum allowable atmospheric concentrations that may occur and still protect public health and welfare. The Clean Air Act establishes air quality planning processes and requires states to develop a State Implementation Plan that details how they will maintain the NAAQS or attain a standard in nonattainment within mandated time frames. Under the Clean Air Act, states are allowed to develop their own ambient air quality standards, so long as they are at least as stringent as the NAAQS.

EPA designates all areas of the United States as having air quality better than (attainment) or worse than (nonattainment) the NAAQS. Former nonattainment areas that have attained the NAAQS are designated as maintenance areas.

In addition to criteria pollutants, EPA also regulates hazardous air pollutants that are known or are suspected to cause serious health effects or adverse environmental effects. EPA sets Federal regulations to reduce hazardous air pollutant emissions from stationary sources in the *National Emission Standards for Hazardous Air Pollutants* (EPA, 2023a).

International Isotopes Fluorine Products, Inc. Fluorine Extraction Process and Depleted Uranium Deconversion Plant in Lea County, New Mexico

Presently, EPA categorizes Lea County that surrounds the IIFP site as in attainment of all NAAQS (EPA, 2023b). The New Mexico Environment Department Air Quality Bureau regulates sources of air pollution in New Mexico. Additional descriptions of the air quality resource within the IIFP site region of influence (ROI) are presented in the Fluorine/DU EIS Section 3.5 (NRC, 2012a).

Construction

Air quality impacts from construction of the deconversion facility would occur from (1) combustive emissions due to the use of fossil-fuel-powered equipment, trucks, and worker commuter vehicles, and

(2) fugitive dust emissions due to the operation of equipment on exposed soil. Impacts would occur primarily during site preparation and the building of facility components such as buildings, parking lots, and on-site and off-site access roads.

The analysis of emissions associated with construction of the deconversion capabilities at the IIFP site determined that criteria air pollutant concentrations at the property boundary would exceed the NAAQS for 1-hour levels of nitrogen dioxide (NO_2) and 24-hour levels of coarse (particulate matter less than or equal to 10 microns) (or PM_{10}) and fine particulates ($PM_{2.5}$). Therefore, air quality impacts resulting from construction of the proposed IIFP facility would be MODERATE for NO_2, PM_{10}, and $PM_{2.5}$ emissions and SMALL for all other emissions (Fluorine/DU EIS Section 4.2.4.1).

Operation

Based on the descriptions of the IIFP deconversion facility, air quality impacts from operation of the facility would occur from (1) uranium and fluoride compounds, boron oxide, and calcium carbonate released from rooftop vents; (2) a natural gas-fired boiler for process steam production; (3) a hydrogen generation plant; (4) a diesel-powered electric generator for use in the event of power outages (otherwise, operated 1 hour per month for routine maintenance testing); (5) a fire-water pump (operated 1 hour per month for routine maintenance testing); (6) the transport by truck of enriched feed material and finished fuel forms; and (7) worker commuter vehicles. Mobile sources (trucks and worker commuter vehicles) that operate in association with the deconversion activities would produce dispersed and minor impacts on air quality.

The analysis of emissions from operation of the deconversion capabilities at the IIFP site determined that annual fluoride compound releases would be well below the New Mexico threshold for fluoride emissions (radioactive gaseous effluents are addressed in Fluorine/DU EIS Section 4.1.2.11). In addition, the ambient impact of criteria pollutant emissions from facility operations would be below the NAAQS at the property boundary. To mitigate environmental impacts, potassium hydroxide emissions would be ventilated to stacks that include scrubbing systems. In addition, uranium compound emissions would be ventilated to stacks that include baghouse dust collectors with overall control efficiencies of greater than 99.9% in the collection and removal of particulate uranium (Fluorine/DU EIS Section 2.1.6.4.1 and Chapter 5). These stacks also would be equipped with continuous emission monitoring systems to ensure that concentrations would remain below the facility action levels (Fluorine/DU EIS Chapter 6). Therefore, the Fluorine/DU EIS concluded that potential air quality impacts from the operation of the IIFP would be SMALL to MODERATE (Fluorine/DU EIS Section 4.1.4.2).

Depleted Uranium Hexafluoride Deconversion Facility at the Portsmouth, Ohio, Site

Presently, EPA categorizes Pike County that surrounds the Portsmouth site as in attainment of all NAAQS (EPA, 2023b). The Ohio Environmental Protection Agency regulates sources of air pollution in Ohio. Additional descriptions of the air quality resource within the Portsmouth site ROI are presented in the Portsmouth EIS Section 3.1.3.

Construction

Air quality impacts from construction of the deconversion facility would occur from (1) combustive emissions due to the use of fossil-fuel-powered equipment, trucks, and worker commuter vehicles and (2) fugitive dust emissions due to the operation of equipment on exposed soil. Impacts would occur primarily during site preparation and the construction of facility components such as buildings and parking lots on a disturbed area of up to 65 acres.

The analysis of emissions associated with construction of the deconversion capabilities at the Portsmouth site determined that air pollutant concentrations at the property boundary would exceed the NAAQS for 24-hour PM_{10} and 24-hour and annual $PM_{2.5}$ levels. Project $PM_{2.5}$ impacts exacerbated the NAAQS, as the ambient background concentrations added to project impacts exceeded the NAAQS. The Portsmouth DU EIS includes mitigation measures of best available practices for construction that would reduce emissions of fugitive dust and resulting $PM_{10}/PM_{2.5}$ impacts (Portsmouth DU EIS Section 5.4).

Operation

Air quality impacts from operation of the Portsmouth facility mainly would occur from (1) natural gas-fired furnaces and boilers; (2) uranium and fluoride compounds released from rooftop vents; (3) a diesel-powered electric generator for use in the event of power outages (otherwise, operated one hour per month for routine maintenance testing); (4) the transport by truck of enriched feed material and finished fuel forms; and (5) worker commuter vehicles. Mobile sources (trucks and worker commuter vehicles) that operate in association with the deconversion activities would produce dispersed and minor impacts on air quality.

The analysis of emissions from operation of the deconversion capabilities at the Portsmouth site determined that fluoride compound releases would be well below the Ohio standards for fluoride emissions (radioactive gaseous effluents are addressed in Portsmouth EIS Sections 5.2.3.1 and 5.2.3.2). In addition, the ambient impact of criteria pollutant emissions from facility operations would be below the NAAQS at the property boundary except for $PM_{2.5}$. Similar to construction impact analysis, project $PM_{2.5}$ impacts exacerbated the NAAQS, as the ambient background concentrations added to project impacts exceeded the NAAQS. Levels of criteria pollutants from proposed operations would not require air permits. However, since the Portsmouth deconversion facility would be subject to 40 Code of Federal Regulations (CFR) Part 61, Subpart H, National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities, the facility would require an Ohio Permit to Install and State Permit to Operate (Portsmouth DU EIS Sections 6.2). The conditions associated with these permits would ensure that the facility would not generate any significant air quality impacts.

Depleted Uranium Hexafluoride Deconversion Facility in Paducah, Kentucky

Presently, EPA categorizes McCracken County that surrounds the Paducah site as in attainment of all NAAQS (EPA, 2023b). The Kentucky Division of Air Quality regulates sources of air pollution in Kentucky. Additional descriptions of the air quality resource within the Paducah site ROI are presented in the Paducah EIS Section 3.1.3.

Construction

Air quality impacts from construction of the deconversion facility would occur from (1) combustive emissions due to the use of fossil-fuel-powered equipment, trucks, and worker commuter vehicles, and (2) fugitive dust emissions due to the operation of equipment on exposed soil. Impacts would occur primarily during site preparation and the building of facility components such as buildings and parking lots on a disturbed area of up to 45 acres.

The analysis of emissions associated with construction of the deconversion capabilities at the Paducah site determined that air pollutant concentrations at the property boundary would exceed the NAAQS for 24-hour PM_{10} and annual $PM_{2.5}$ levels. The project $PM_{2.5}$ NAAQS exceedance occurred, as to the ambient background concentrations added to project impacts is nearly equal to the NAAQS. The Paducah DU EIS includes mitigation measures of best available practices for construction that would reduce emissions of fugitive dust and resulting $PM_{10}/PM_{2.5}$ impacts (Paducah DU EIS Section 5.4).

Operation

Air quality impacts from operation of the Paducah facility mainly would occur from (1) natural gas-fired furnaces and boilers; (2) uranium and fluoride compounds released from rooftop vents; (3) a diesel-powered electric generator for use in the event of power outages (otherwise, operated one hour per month for routine maintenance testing); (4) the transport by truck of enriched feed material and finished fuel forms; and (5) worker commuter vehicles. Mobile sources (trucks and worker commuter vehicles) that operate in association with the deconversion activities would produce dispersed and minor impacts on air quality.

The analysis of emissions from operation of the deconversion capabilities at the Paducah site determined that fluoride compound releases would be well below the Kentucky standards for fluoride emissions (radioactive gaseous effluents are addressed in Paducah DU EIS Sections 5.2.2.1 and 5.2.2.2). In addition, the ambient impact of criteria pollutant emissions from facility operations would be below the NAAQS at the property boundary for all pollutants. Levels of criteria pollutants from proposed operations would not require air permits. Since the Paducah deconversion facility would be subject to 40 CFR Part 61, Subpart H, National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities, the facility would require either a Kentucky Federally Enforceable State Origin Permit for Air Quality Permit or State Origin Permit for Air Quality (Portsmouth DU EIS Section 6.2). The conditions associated with these permits would ensure that the facility would not generate any significant air quality impacts.

New HALEU Deconversion Facility

Construction

Air quality impacts from construction of a HALEU deconversion facility would occur from the same types of sources as those evaluated above for the three representative deconversion locations. Impacts would occur primarily during site preparation and the building of facility components such as buildings and parking lots. The above analyses determined that air quality impacts resulting from construction of a proposed deconversion facility could result in exceedances of some NAAQS, mainly for PM_{10} and $PM_{2.5}$ due to fugitive dust emissions. The effort needed to construct the HALEU deconversion facility would be about equal to somewhat less than construction activities evaluated in the representative EISs. With the implementation of mitigation measures identified in these NEPA documents, it is expected that air quality impacts from construction of the HALEU deconversion facility would be SMALL.

Operation

Air quality impacts from operation of a HALEU deconversion facility would occur from the same types of sources as those evaluated above for the three representative deconversion locations. Impacts from criteria pollutants primarily would occur from natural gas-fired boilers and furnaces. The ambient impact of criteria pollutant emissions from facility operations would be below the NAAQS for all pollutants except for $PM_{2.5}$ at the Portsmouth facility. The HALEU deconversion facility fuel throughput and resulting impacts would be substantially smaller than the throughput and impacts evaluated in the above representative EISs. With the implementation of emission control measures and monitoring systems identified in these NEPA documents and adherence to applicable air permit conditions, air quality impacts from operation of the HALEU deconversion facility would be SMALL.

4.3.6 Ecological Resources

The following NEPA documents evaluate construction and operation of deconversion facilities and include example affected environment and impact analyses information used in the Technical Report to determine the likely impacts of construction and operation of a new HALEU deconversion facility.

International Isotopes Fluorine Products, Inc. Fluorine Extraction Process and Depleted Uranium Deconversion Plant in Lea County, New Mexico

There are no wetlands or unique habitats, and no threatened or endangered species on the proposed site. It was determined that impacts on wildlife could occur from fencing around the proposed IIFP facility, restricting wildlife access to the facility. Mitigation measures proposed by the New Mexico Department of Game and Fish were considered to lessen impacts. The NRC determined that the preconstruction, construction, and operation of the proposed facility would not adversely affect ecological resources and defined the potential impacts as SMALL (NRC, 2012a).

Depleted Uranium Hexafluoride Deconversion Facility at the Portsmouth, Ohio, Site

Container storage, maintenance, and handling activities would occur within the industrialized areas of the Portsmouth, Ohio, site. There would be no significant construction on undisturbed land and no routine releases of DU oxide or hazardous materials. As such, potential impacts on biotic resources were expected to be minor.

Potential impacts on biotic resources from a release associated with a potential container breach indicated that groundwater uranium concentrations could exceed the ecological screening value for surface water (i.e., 2.6 micrograms per liter). However, contaminants in groundwater discharging to a surface water body, such as a local stream, would be quickly diluted to negligible concentrations (DOE, 2020).

Depleted Uranium Hexafluoride Deconversion Facility in Paducah, Kentucky

Container storage, maintenance, and handling activities would occur within the industrialized areas of the Paducah, Kentucky, site. There would be no significant construction on undisturbed land and no routine releases of DU oxide or hazardous materials. As such, potential impacts on biotic resources were expected to be minor.

Potential impacts on biotic resources from a release associated with a potential container breach indicated that groundwater uranium concentrations could exceed the ecological screening value for surface water (i.e., 2.6 micrograms per liter). However, contaminants in groundwater discharging to a surface water body, such as a local stream, would be quickly diluted to negligible concentrations (DOE, 2020).

New HALEU Deconversion Facility

Because a deconversion facility site has not been selected, the site-specific analysis of potential impacts on ecological resources is deferred to a subsequent NEPA study prepared by the NRC once a site has been selected and a design developed.

The focus of this analysis is on the general potential impacts on ecological resources that could occur from the development of a deconversion facility. Impacts on ecological resources from the construction of a new HALEU deconversion facility could occur from removal or degradation of vegetation, wildlife habitats, wetlands, and Federal and state-listed species, as well as by contamination by radioactive or hazardous materials via airborne or waterborne pathway.

For the Proposed Action, it is assumed that activities associated with the new HALEU deconversion facility at any of the proposed site locations would occur entirely within the previously developed and disturbed industrialized areas. Impacts on ecological resources would be SMALL if new construction were to occur entirely within previously developed and disturbed lands, as these areas are subject to frequent disturbance from human activity, grounds maintenance, or disruptions from ongoing facility operations, and native habitats are no longer present or have likely degraded overtime. Previously developed and disturbed areas are not likely to support habitat for wildlife other than for those species adapted to human disturbance (such as transient small mammals, insects, and birds).

Any new construction occurring on undeveloped lands could have SMALL to MODERATE impacts on ecological resources depending on the resources disturbed and mitigation and the minimization measures employed. Land-clearing activities as part of new construction would likely result in increased erosion, stormwater runoff, and loss of vegetation. Additionally, impacts on wildlife could include habitat fragmentation, disturbance, and injury or mortality—as habitats within the footprint disturbed by construction would be reduced or altered—and construction activities would also result in habitat fragmentation. Loss of habitat could result in a long-term reduction in wildlife abundance and richness. Habitat disturbance could facilitate introduction, or the spread, of invasive plant species. Wildlife habitat could be adversely affected if invasive vegetation became established in the disturbed areas and adjacent off-site habitats. Construction activities could cause wildlife disturbance, including interference with behavioral activities. Wildlife could respond in various ways, including attraction, habituation, and avoidance. Principal sources of noise would include vehicle traffic and operation of machinery. Regular or periodic noise could cause adjacent areas to be less attractive to wildlife and result in a reduction in use. Construction activities could result in the direct injury or death of certain wildlife species. Wildlife could also be exposed to accidental fuel spills or releases of other hazardous materials. To avoid these impacts on wildlife, any new construction associated with a new HALEU deconversion facility should be placed in other previously developed areas of the site, if possible.

Pending the deconversion facility site selection, an official U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation data request would need to be submitted for the project under Section 7 of the Endangered Species Act (16 United States Code [U.S.C.] 1531-1544) to generate an *Official Species List* and identify if federally designated critical habitats are present. Additional analysis would be required to determine the severity and nature of impacts on the federally protected species as part of the final design and description of the Proposed Action. Removal of native habitats would impact vegetation, wildlife, and possibly special status species. Special status species are defined as those protected under the Endangered Species Act, the Migratory Bird Treaty Act (U.S.C. 703–712), the Bald and Golden Eagle Protection Act (16 U.S.C. 668–668d), and state-listed species.

Migratory birds are protected under the Migratory Bird Treaty Act. Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act. Numerous migratory birds, including some birds of conservation concern and eagles, likely occur or have the potential to occur as transients throughout the vicinity of the proposed facility sites. The USFWS recommends conducting tree-clearing activities outside of the bird nesting season to avoid the need for active nest relocation or destruction, when appropriate. To avoid impacts on migratory birds, tree clearing within undeveloped lands would need to occur outside of the nesting season (late February through early August). Tree-clearing work during the nesting season would require a migratory bird nest survey 72 hours prior to the start of clearing activities. A permit would be required for the purposeful take of an active migratory bird nest. A permit is not required to destroy inactive migratory bird nests.

Wetlands and/or water features (such as streams, lakes, ponds, or other waters) subject to protection under Section 404 of the CWA (33 U.S.C. 1251 et seq.) could occur within the Proposed Action area. Wetlands could be impacted by alteration of surface water runoff patterns, soil compaction, or groundwater flow. Pending facility site selection, formal wetland delineation surveys would be required to determine presence or absence of jurisdictional wetlands. Impacts on federally protected wetlands could require consultation with the U.S. Army Corps of Engineers to obtain a permit. Additionally, subsequent NEPA analysis under these actions may also be required.

A summary of this site-specific NEPA analysis process is provided below.

Site-Specific NEPA Analysis Considerations Summary

Once the final deconversion facility site and design has been selected, a subsequent analysis would be required to complete the following**:**

- Define and assess the affected area/area of impact for ecological resources under implementation of the Proposed Action.
- Identify and describe the ecological resources (including terrestrial and aquatic vegetation, wildlife, special status species, and wetlands) within the affected area/area of impact that would be affected or have potential to be affected (directly or indirectly) under implementation of the Proposed Action. Special status species reviews can be completed through the USFWS's Information for Planning and Consultation and state game and fish department databases. Wetlands, streams, lakes, ponds and other waters that may be impacted (regulated by state and Federal law) may be identified through the USFWS's National Wetlands Inventory dataset; however, formal wetland delineation surveys would be required to determine presence or absence of jurisdictional wetlands.
- Conduct targeted species surveys to identify the presence/absence of special status species within the affected area/area of impact and conduct interagency coordination with the USFWS and applicable state agency/agencies, if warranted.
- Assess the effects of the Proposed Action on significant ecological resources and include a determination of effects for special status species—in accordance with the Endangered Species Act, Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, and applicable state threatened and endangered species laws.
- Identify any necessary mitigations required to avoid or minimize adverse effects to special status species or wetlands.

Impacts on ecological resources are analyzed on a project-specific basis. The severity of impacts, i.e., SMALL to MODERATE, would be dependent on the current ecological conditions of the selected site, in comparison to the disturbance footprint associated with the facility designs. The NRC will perform the requisite NEPA analysis to determine impacts on special status species and wetlands, in accordance with the Endangered Species Act, Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, CWA, and applicable state threatened and endangered species laws in its site selection process, and prior to construction of a new HALEU deconversion facility. The Endangered Species Act Section 7 consultation, Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act analysis includes formal and or/informal consultations with the USFWS, while wetland impacts shall be coordinated with the U.S. Army Corps of Engineers. Local state action agencies shall be contacted for adverse impacts on state threatened and endangered species. Impacts on ecological resources could be expected to be lower (SMALL or none) if construction of a new facility were to occur in an already developed or disturbed site versus an undeveloped or undisturbed site. Locating a HALEU deconversion facility within undeveloped lands could have SMALL to MODERATE impacts on ecological resources, depending on the resources disturbed and the effort to mitigate and minimize potential impacts. An inventory of threatened or endangered species would be developed during site-specific reviews to identify unique or special habitats, and Endangered Species Act consultations conducted with the U.S. Fish and Wildlife Service would assist in reducing/avoiding adverse impacts.

4.3.7 Historic and Cultural Resources

International Isotopes Fluorine Products, Inc. Fluorine Extraction Process and Depleted Uranium Deconversion Plant in Lea County, New Mexico

An archaeological survey of the entire 259-ha (640-acre) IIFP FEP and DU deconversion plant site failed to identify any archaeological resources other than several isolated artifacts that were not considered to be eligible for the National Register of Historic Places (NRHP). Consultation with federally recognized Tribal nations and the New Mexico State Historic Preservation Division (which serves as the State Historic Preservation Officer) did not identify any additional information on historically or culturally significant resources within the area potentially affected by the proposed facility. The NRC determined that the preconstruction, construction, and operation of the proposed facility would not adversely affect historic resources or other cultural resources (e.g., significant archaeology sites) and defined the potential impacts as SMALL (NRC, 2012a).

Depleted Uranium Hexafluoride Deconversion Facility at the Portsmouth, Ohio, Site

DOE determined that impacts on cultural resources could be possible for all three alternative locations for the DUF_6 deconversion facility at the Portsmouth, Ohio, site (DOE, 2004b). Archaeological and architectural surveys had not been finalized for the candidate locations at the time the EIS was prepared, and it was noted that they must be completed prior to initiation of the action alternatives. DOE further noted that if archaeological resources were encountered, or historical or traditional cultural properties were identified, a mitigation plan would be required.

In 2020, DOE completed a *Final Supplemental EIS for Disposition of Depleted Uranium Oxide Product* generated from DOE's inventory of DUF_6 at various sites, including the Portsmouth, Ohio, site (DOE, 2020). By 2020, Portsmouth fulfilled its cultural resource inventory obligations through numerous cultural resources surveys and consultation with the Ohio Historic Preservation Office, between 1996 and 2013. A total of 117 archaeological resources, 196 architectural resources (i.e., buildings and structures), and 2 cemeteries were identified. Of the archaeological resources, three prehistoric sites and two historic era sites were eligible for listing in the NRHP and the rest were not NRHP eligible (DOE, 2020).

Thirty-three of the 196 Portsmouth buildings were considered historic properties, all of which were considered eligible for the NRHP based upon their relationship with the historic Cold War mission of Portsmouth; no traditional cultural resources were identified at the Portsmouth site (DOE, 2020).

DOE determined that impacts on cultural resources could occur if ground disturbance resulted in the discovery of previously unrecorded cultural resources that, once evaluated, were determined to be eligible for listing in the NRHP (DOE, 2020).

Depleted Uranium Hexafluoride Deconversion Facility in Paducah, Kentucky

Although not all of the Paducah site has been surveyed for archaeological resources, there have been a number of investigations finding numerous archaeological sites outside the security fencing. Inside the security fence, all areas are considered to have a "low" to "very low" sensitivity index for the presence of archaeological resources. As a result of the very low sensitivity, and because of the heavily disturbed nature of the facility inside the security fencing, this portion of Paducah was not investigated; existing disturbance greatly reduces the likelihood of finding any cultural resources with intact integrity (DOE, 2020). The architectural resources at Paducah have been inventoried, with 101 historic properties identified as a result, contributing to an NRHP-eligible historic district inside the security fencing. Although some of the historic properties have been demolished, the district retains its eligibility due to its military significance during the Cold War and its role in the development of commercial nuclear power (DOE, 2020).

DOE determined that impacts on cultural resources could occur if ground disturbance resulted in the discovery of previously unrecorded cultural resources that, once evaluated, were determined to be eligible for listing on the NRHP (DOE, 2020).

New HALEU Deconversion Facility

Because a site has not been selected for development of a deconversion facility, the focus of this analysis is on potential impacts, siting considerations, and requirements associated with development of a deconversion facility at a potential site. Site-specific analysis of potential impacts on cultural resources is deferred to subsequent NEPA analysis prepared by the NRC once a site has been selected and a design developed.

The area of potential effects (APE) for development of a deconversion facility includes the footprint of the proposed facility construction and any associated infrastructure improvements, such as road construction, where archaeological sites could be disturbed, and an as-yet-undefined area around the new facility where it would be visible and potentially affect the setting of any nearby NRHP-listed or -eligible properties.

Operation of a deconversion facility would not be anticipated to impact cultural resources; the main impact driver for this resource is construction of a deconversion facility. Construction activities that may impact cultural resources are all ground-disturbing activities, including land clearing, earth moving, excavation, and vehicle and equipment operation on unpaved surfaces. These activities may result in physical disturbance of any surface or subsurface archaeological resources that may be present in the areas disturbed. Direct adverse effects would result if any of the archaeological resources are listed on or eligible for listing in the NRHP.

The amount of land clearance and earth moving required would be dependent upon the type and size of the facility, as well as the need for any additional or ancillary infrastructure (such as parking). Generally, the amount of land clearing and total ground disturbance would be associated with the characteristics of the site chosen for the deconversion facility, in conjunction with the type and size of the facility. Siting a deconversion facility in previously undeveloped locations would require more ground disturbance of previously undisturbed areas, with greater potential for the presence of intact archaeological resources, than would placement of a facility in an area that is already developed or improved. Constructing a new facility within a previously developed or improved area would not be expected to result in significant impacts on archaeological resources as prior development of these areas typically has already impacted any sites that may have been present. Clearing of undeveloped areas for facility development would have a higher potential to result in adverse effects to archaeological resources; however, the degree of the impact would be dependent on the significance (NRHP eligibility) of the site(s) present.

Development of any type of facility also presents the potential for introduction of a visual intrusion into the setting of nearby NRHP-listed or -eligible properties, if there are any within the viewshed of the new facility. Construction of a new facility in proximity to NRHP-listed or -eligible properties could alter characteristics of their surrounding environment (or setting), and adverse effects could result if that setting contributes to the importance of the historic property. Adverse effects would also result if the new facility, through its design or scale, introduced visual elements that are out of character for the period the historic property represents. The degree of the impact would be dependent on multiple factors, including how visible the new facility will be to any NRHP-listed or -eligible properties, which in turn is a function of how close it is and whether there are any intervening obstructions, the size and design of the new facility, and the integrity of the historic setting in which the new facility would be built.

Siting and Development Considerations

Siting and development of a deconversion facility could consider the following factors to minimize the potential for adverse impacts on cultural resources:

- Developed versus Undeveloped Location: Siting the facility in a developed or improved location would minimize the amount of land clearing and disturbance of previously undisturbed ground required for construction of the facility (and potentially for access roads), which would reduce the potential to impact any undisturbed significant archaeological resources. Siting within undeveloped areas should avoid areas of MODERATE to HIGH probability for the presence of archaeological resources. Undeveloped locations are also less likely to have nearby NRHP-listed or -eligible properties in close proximity, thereby reducing the potential impacts on significant historical architectural resources.
- Proximity to NRHP-Listed or -Eligible Properties: Outside of siting within developed or undeveloped areas, both of which could have historic buildings or districts, consideration of the proximity to NRHP-listed or -eligible properties siting could also be considered to avoid or minimize impacts on these historic properties.
- Facility Design: If the proposed deconversion facility is sited within the viewshed of any NRHP-listed or -eligible properties (particularly a historic district), potential adverse effects to those properties could be minimized if the proposed facility is designed to be compatible with the appearance of the nearby historic properties or be consistent with any existing building design covenants or executed agreements.

Site-Specific NEPA Analysis Considerations

Once a site is selected, subsequent analysis would need to consider the following**:**

- Initiating the National Historic Preservation Act (NHPA) Section 106 consultation process early in the planning process.
- Defining the APE.
- Establishing the APE, then take the necessary steps to ensure a reasonable and good faith effort to identify any significant cultural resources, which may include (1) historic properties as defined by the NHPA, (2) cultural items as defined by the Native American Graves Protection and Repatriation Act, (3) archaeological resources as defined by the Archaeological Resources Protection Act, (4) sacred sites as defined by Executive Order 13007, and (5) collections and associated records as defined by Title 36 CFR Part 79.
- Assessing the effects of the undertaking on significant cultural resources, including properties of cultural, historical, or religious significance in the APE, and including determination of adverse effects to historic properties in accordance with 36 CFR 800.5.
- Identifying any necessary mitigations required to avoid or minimize identified adverse effects. The action should seek to avoid or minimize adverse effects to historic properties, including archaeological resources, historic architectural resources, and traditional cultural resources.

Impacts on historic and cultural resources are analyzed on a site-specific basis. The NRC would perform NEPA and NHPA Section 106 analysis, in accordance with 36 CFR 800 in its site selection process, and prior to construction of a new HALEU deconversion facility. The NHPA Section 106 analysis includes consultation with the State and Tribal Historic Preservation Officers, American Indian Tribes, and other interested parties. Impacts on historic and cultural resources could be expected to be lower (SMALL or none) for a new facility proposed for an already developed or disturbed site versus an undeveloped or undisturbed site.

There is currently no deconversion facility in the United States capable of producing HALEU in the quantities required by the Proposed Action, and a facility would need to be constructed. The HALEU deconversion facility could be co-located at a HALEU enrichment facility or fuel fabrication facility, or be located as a stand-alone facility. A deconversion facility could be sited anywhere in the United States that meets NRC siting requirements.

Construction

Construction of a HALEU deconversion facility would likely occur on previously surveyed and disturbed areas and has the potential to impact 16 to 28 ha (40 to 70 acres). Therefore, impacts of construction at an existing uranium fuel cycle facility or industrial site would likely be SMALL. Construction of a HALEU deconversion facility at an undeveloped location has the potential to impact historic and cultural resources. The degree of impact, while limited due to the relatively small size of the facility and the implementation of BMPs, would be dependent upon the historical and cultural characteristics of the selected site. Because of this, the impacts of construction at a previously undeveloped site are expected to be SMALL to MODERATE.

Operation

It is anticipated that no additional land would be disturbed for operations of a HALEU deconversion facility. Therefore, the impacts from operations would likely be SMALL.

4.3.8 Infrastructure

This section discusses potential infrastructure impacts that could occur from construction and operation of a HALEU deconversion facility. Potential locations for a HALEU deconversion facility include the HALEU enrichment facility sites, HALEU fuel fabrication facility sites, other industrial (brownfield) sites, or undeveloped (greenfield) sites.

The general discussion of the proposed HALEU deconversion facility relies on analyses conducted in the Fluorine/DU EIS that would allow IIFP to construct and operate an FEP and DU deconversion plant (NRC, 2012a). Like most NRC NEPA documents, the Fluorine/DU EIS did not assess impacts on infrastructure as part of the NEPA analysis; however, that document did explain the utilities needed and the demands of a deconversion facility as part of the description of the Proposed Action (see Section 2.1.5 of the Fluorine/DU EIS). The infrastructure and utilities needed for construction and operation of a proposed deconversion facility at any of the candidate sites under consideration include electrical power, water, natural gas, steam, compressed air, and nitrogen.

- **Electrical power** – Needed to operate four reaction vessels in the FEP Building, as well as the refrigeration system and reaction vessel in the DU Process Building. The local utility provider in the area of the selected site would provide the needed electricity. New substations, transformers, and transmission lines may be required to support the proposed deconversion activities at the selected site. All electricity supplied to the deconversion facility would be accommodated within the utility provider's available capacity. Minor amounts of ground disturbance may be needed to install this infrastructure and to connect the proposed buildings to existing infrastructure.
- **Water** – Needed in the form of process water, cooling water, and sanitary water. The Fluorine/DU EIS (NRC, 2012a) estimated the volume required to serve operations and personnel to be 10,000 gallons (gal) per day. The source of this water would depend on the site selected. If the proposed facility would be serviced by a local municipal provider, additional water lines may be required to connect to existing infrastructure. This construction would likely require limited areas of ground disturbance and may result in temporary disruption of service to other customers. If groundwater serves as the local water source at the selected site, an additional groundwater well may be

needed. Any well installation or expansion of water treatment infrastructure would comply with associated water use rights agreements, permits, and regulatory requirements.

- **Natural gas** – Needed to operated gas-fired boilers to support process steam generation, the autoclave feed system, and the hydrogen production plant. The local utility provider in the area of the selected site would provide the needed natural gas. All natural gas supplied to the deconversion facility would be accommodated within the utility provider's available capacity. Minor amounts of ground disturbance may be needed to install new distribution lines and to connect the proposed buildings to existing infrastructure.
- **Steam** – Needed to serve as the primary heat source for vaporing DUF_6 in the autoclave, heating some process and warehouse buildings, and warming pipes as necessary to prevent solidification of temperature-sensitive substances. The Fluorine/DU EIS (NRC, 2012a) estimated the facility's steam needs as 1,134 to 1,588 kilograms (kg) (2,500 to 3,500 pounds [lbs]) per hour. This steam would be generated on-site by package boilers.
- **Compressed air** – Needed for a variety of uses, including operation of some instrumentation, control valves, dust collector blow-back, and hopper vibrators. Ambient air would be filtered, compressed, and dried on-site.
- **Nitrogen** – Needed in gas form for purge gas and for cooling pre-condensers in the FEP Building. Liquid nitrogen would be used for the cold traps. The cold nitrogen vapor exiting the product cold traps would be used for the pre-condenser cooling. Gaseous nitrogen leaving the condensers would be collected and compressed to supply gaseous nitrogen to the parts of the facility that require a dry inert gas. The main application would be for purge and seal systems, such as the rotary calciner inlet and discharge seals. It is assumed that the selected site would purchase liquid nitrogen from a vendor to serve the proposed deconversion activity.

Estimates of resources consumed during construction of a deconversion facility in Paducah, Kentucky, include a total of 1,500 megawatt-hours of electricity, 73,000 gal of fuel, and 15,000 gal of propane (DOE, 2004c, pp. 5-40). Further, operation of that facility would require an annual average of 10,000 tons of nitrogen gas, 37,269 megawatt-hours of electricity, 4,000 gal of fuel, 4.4×10^7 standard cubic feet of natural gas, 3.7×10^7 gal of process water, and 3×10^6 gal of potable water (DOE, 2004c, pp. 5-72). It is expected that demands for utilities and infrastructure would be similar for construction and operation of a deconversion facility in Portsmouth, Ohio. Per NEPA documentation for both of these sites (DOE, 2004b; DOE, 2004c), "Resource requirements include construction materials, fuel, electricity, process chemicals, and containers. In general, all alternatives would have a negligible effect on the local or national availability of these resources."

Impacts on infrastructure could occur if an action disrupted utility operations during construction activities or caused an increase in demand for utility services during construction or operations. A significant adverse effect to infrastructure would occur if construction and/or operation of the proposed HALEU deconversion activities caused long-term disruption of utility operations, negatively affected the ability of local and regional utility suppliers to meet customer demands, or required substantial public utility system updates.

Since the HALEU deconversion facility fuel throughput would be substantially smaller than the throughput evaluated in the Fluorine/DU EIS, the associated demand on infrastructure during HALEU deconversion would also be smaller than that considered in the Fluorine/DU EIS (NRC, 2012a). Construction of a new HALEU deconversion facility would require extension of existing utility service to accommodate new structures and to support operations of the proposed deconversion facilities. However, any needed infrastructure improvements or installation of additional utilities would comply with all applicable permits, service agreements, and regulatory requirements. As such, and with implementation of standard BMPs to further reduce or avoid potential impacts, only SMALL impacts on infrastructure would be anticipated from construction and operation of a HALEU deconversion facility at an existing uranium fuel cycle facility site.

Site selection for a new HALEU deconversion facility at another industrial (brownfield) site or at a currently undeveloped (greenfield) site is expected to include criteria for adequate utility capacity and infrastructure. These criteria are expected to include the requirement for sufficient capacity to meet the anticipated initial and projected future utility needs of the HALEU deconversion facility without disrupting service to other customers during construction or operation. Impacts for siting the facility in industrial areas would be SMALL as these areas are expected to have existing utility infrastructure and capacity. Impacts could be greater for undeveloped sites, as additional utility infrastructure would likely be required. Installation of such infrastructure would result in a greater area of ground disturbance and may adversely affect utility service to existing customers. Allocating available utility capacity for the HALEU deconversion facility could limit utility capacity available for future needs. With the use of siting criteria, these impacts would likely to range from SMALL to MODERATE for undeveloped sites.

4.3.9 Noise

Any pressure variation that the human ear can detect is considered "sound," and "noise" is defined as unwanted sound. Sound is described in terms of amplitude (perceived as loudness) and frequency (perceived as pitch). Sound pressure levels are typically measured with a logarithmic decibels (dB) scale. To account for human sensitivity to frequencies of sound (i.e., less sensitive to lower and higher frequencies, and most sensitive to sounds between 1,000 and 5,000 hertz), an A-weighted decibels (denoted by dBA) (Acoustical Society of America, 1985, pp. 19-20), is widely used. This scale has a good correlation to a human's subjective reaction to sound. Most noise standards, guidelines, and ordinances use the A-weighted scale.

The day-night average sound level (L_{dn}) is the average over a 24-hour period, with the addition of 10 dB to sound levels from 10:00 p.m. to 7:00 a.m. to account for the greater sensitivity of most people to nighttime noise. The L_{dn} scale is widely used for community noise assessment and has been adopted by several government agencies (e.g., Federal Aviation Administration, Department of Housing and Urban Development, and the NRC). In general, a 3-dB change over an existing noise level is considered a barely discernible difference, and a 10-dB increase is subjectively perceived as a doubling in loudness and almost always causes an adverse community response (NWCC, 2002, p. 48).

Background noise is defined as the noise from all sources other than the source of interest. The background noise level can vary considerably, depending on the location, season, and time of day. Background noise levels in a busy urban setting can be as high as 80 dBA during the day. In isolated outdoor locations with no wind, vegetation, animals, or running water, background noise may be under 10 dBA. Typical noise levels in rural settings are about 40 dBA during the day and 30 dBA during the night, which correspond to an L_{dn} of 40 dBA. In wilderness areas, typical noise levels can be below 35 dBA (Harris, 1991, pp. 5.16-5.17).

At the Federal level, the Noise Control Act of 1972 and subsequent amendments (Quiet 4 Communities Act of 1978, 42 U.S.C. 4901–4918) delegate the authority to regulate noise to the states and direct government agencies to comply with local noise regulations. EPA guidelines recommend L_{dn} of 55 dBA as sufficient to protect the public from the effect of broadband environmental noise in typically quiet outdoor residential areas and farms (EPA, 1974a, p. 4). For protection against hearing loss in the general population from nonimpulsive noise, EPA recommends an equivalent noise level of 70 dBA or less over a 40-year period.

Noise-sensitive areas are created to represent common noise environments within the same activity category, and are represented by receptors, which represent a discrete or representative location within the noise-sensitive area. Activity categories include land uses, such as residences, hotels, motels, active sport areas, schools, places of worship, hospitals, parks, and others. Construction and operation of a HALEU deconversion facility would have to comply with applicable Federal, state, or local guidelines and regulations on noise.

Existing uranium deconversion facilities and existing NEPA documentation for those facilities are discussed below. The NEPA documents evaluate construction and operation of uranium deconversion facilities and include example affected environment and impact analyses information used in the Technical Report to determine the likely impacts of construction and operation of a new HALEU deconversion facility.

International Isotopes Fluorine Products, Inc. Fluorine Extraction Process and Depleted Uranium Deconversion Plant in Lea County, New Mexico

The area surrounding the Lea County, New Mexico, IIFP plant is primarily rural. Four industrial commercial facilities are located approximately 1.6 km (1 mile) to 5 km (3.1 miles) from the site. The nearest residence is approximately 2.6 km (1.6 miles) northwest of the site. No recreational facilities are within 10 km (6 miles) of the proposed site.

Noise would come predominantly from construction equipment and traffic. Construction activities would be temporary and limited to daytime working hours. Noise levels during operations would be within the U.S. Department of Housing and Urban Development guidelines. The NRC staff has determined that the proposed facility would not affect ambient noise levels. The NRC staff finds that impacts due to noise would be SMALL, based on the distances to surrounding residences and recreational areas and the rate at which noise is attenuated with distance (NRC, 2012a, pp. 4-21).

Depleted Uranium Hexafluoride Deconversion Facility at the Paducah, Kentucky, Site

The Paducah site is in a rural setting, and no residences or other sensitive receptor locations (e.g., schools, hospitals) are located in the immediate vicinity of any noisy on-site operations. (The nearest sensitive receptor is located about 2 km (1 mile) from the proposed conversion facility.) Ambient noise levels around the site are relatively low. Measurements taken at the nearest residence ranged from 44 to 47 dBA when the site was in full operation. At nearby residences, noise emissions from the plant were reported as undetectable from background noise (DOE, 2004c).

Under the action alternatives, estimated noise levels at the nearest residence (located 1.3 km [0.8 miles] from the construction location) would be below the EPA guideline of 55 dBA as L_{dn} for residential zones during construction and operations (DOE, 2004c, pp. 5-26 to 5-27).

Depleted Uranium Hexafluoride Deconversion Facility at the Portsmouth, OH, Site

The Portsmouth site is in a rural setting, and no residences or other sensitive receptor locations (e.g., schools, hospitals) exist in the immediate vicinity of any noisy on-site operations. (The nearest sensitive receptor is located about 2 km [1 mile] from the conversion facility.) Ambient sound level measurements around the site are not currently available; the ambient noise level around the site is relatively low, however, except for infrequent vehicular noise. In general, the background environment is typical of rural areas; L_{dn} from the population density in Pike County is estimated to be about 40 dBA (EPA, 1974b, p. 29).

Under the action alternatives, estimated noise levels at the nearest residence (located 0.9 km [0.6 miles] from the alternative locations) would be below the EPA guideline of 55 dBA as L_{dn} for residential zones during construction and operations (DOE, 2004b, pp. 5-36 to 5-37).

New HALEU Deconversion Facility

The HALEU deconversion facility could be co-located with a HALEU enrichment facility or fuel fabrication facility, or located at other industrial (brownfield) or undeveloped (greenfield) sites. The HALEU deconversion facility would likely be in an existing industrial area or another relatively remote area, away from existing residences and other sensitive noise receptors like schools, churches, or hospitals.

Construction

Noise would come predominantly from construction equipment and traffic. Construction activities would be temporary and limited to daytime working hours.

Because the construction equipment noise will attenuate within a short distance, the nearest residences and other land uses are not likely to be adversely affected by construction noise. Therefore, impacts due to construction noise would be SMALL.

Operation

Noise from the operation of a new HALEU deconversion facility would be minimal, occur mostly inside the buildings, and be attenuated by distance. Noise at the nearest residences and recreational areas is not likely to increase due to operation of the proposed HALEU deconversion facility. Therefore, impacts from operations noise would be SMALL.

BMPs to reduce noise-related impacts include the following:

- Maintain equipment in good working order in accordance with manufacturer's specifications.
- Limit noisy activities to the least noise-sensitive times of the day (such as daytime between 7:00 a.m. and 7:00 p.m.) and weekdays; limit idle time for vehicles and motorized equipment.
- Employ noise-reduction devices (e.g., mufflers) as appropriate.
- Provide a noise complaint process for surrounding communities.

4.3.10 Waste Management

The following section discusses potential impacts on waste management from HALEU deconversion activities that would support the Proposed Action described in Section 4.1, *Description of the Activity*.

Construction and Operation

Industrial (i.e., construction debris), hazardous, and radioactive wastes would be generated. All wastes generated have a disposal path forward. The generated wastes do not have any unique or problematic characteristics that would preclude use of the existing disposition paths. All wastes would be managed in accordance with applicable regulatory requirements. The waste quantities generated are a small portion of the total quantities of waste generated annually by all generators. Available commercial facilities' capacities can accommodate the lifecycle disposition requirements for all the waste categories. Impacts would be SMALL since all wastes generated have a disposal path and represent a fraction of the available capacities of the commercial waste management facilities.

4.3.11 Public and Occupational Health – Normal Operations

This section addresses the public and occupational health impacts from the construction and operation of a HALEU deconversion facility at any of several sites including enrichment facility sites and fuel fabrication facility sites. The analysis of impacts relies on analyses from previous NEPA documents that evaluated the siting of a uranium deconversion facility.

Fluorine Extraction Process and Depleted Uranium Deconversion Plant

The Lea County deconversion facility was to be built on an undeveloped plot of land. There are no existing sources of radiological or hazardous nonradiological materials. Therefore, there are no effluent sources that would result in a prior radiological or nonradiological risk to human health. In the United States, the average person receives a dose of just over 300 millirem (mrem) per year from background radiation (NRC, 2012a, pp. 3-86 to 3-87).

Construction

Construction worker impacts result from normal workplace-related events resulting in injury or fatality. The impact analysis in the Fluorine/DU EIS used U.S. Department of Labor, Bureau of Labor Statistics information on workplace accidents to assess the nonradiological risk to workers. Based on the total number of full-time construction workers, workplace injury estimates of six worker injuries for the full duration of construction and no fatalities (0.014 expected fatalities) during the construction period were developed (NRC, 2012a, pp. 4-21).

As there are no on-site sources of radiological or hazardous nonradiological releases at this site, the only source of radiological exposure is from background radiation. The construction workers and the public would not receive any dose related to construction activities. These impacts would be representative for any undeveloped site that might be selected as the location for the deconversion facility.

Operation

The primary radioactive release from the proposed facility would be uranium, releases ranging from an expected release of 1.1×10^{-4} curies (Ci) per year to a bounding estimate of 2.3×10^{-4} Ci per year, less than 0.5 kg (1.1 lbs) of uranium per year. Both the UF_6 feed and uranium oxide product would be depleted uranium; releases would have the isotopic content of depleted uranium (NRC, 2012a, pp. 4-45).

The major sources of potential radiation exposure are the gaseous discharges from the plant scrubber systems for the depleted uranium tetrafluoride and fluorine extraction processes and the dust collector scrubber system. The dose from these airborne effluents to the maximally exposed individual (MEI) (a hypothetical individual assumed to residing at the most exposed point on the plant boundary), was estimated to range from 0.003 mrem per year for an adult to 0.014 mrem per year for an infant. The dose to the nearest resident was estimated to range from 0.002 mrem per year for an adult to 0.009 mrem per year for an infant. These values are less than the regulatory limits of 100 mrem per year from 10 CFR 20.1301(a), *Dose limits for individual members of the public*, 25 mrem per year in 40 CFR 190.10, *Standards for normal operations* (i.e., at a fuel cycle facility), and the 10 mrem per year limit for dose from airborne emissions in 10 CFR 20.1101, *Radiation protection programs*. The expected population dose, based on the 2065 population, was estimated to be 0.04 person-rem per year. This is a small percentage of the dose from natural background radiation for this population (NRC, 2012a, pp. 4-45 to 4-50).

The Fluorine/DU EIS identified the potential for direct radiation exposure due to transportation and storage of depleted UF_6 cylinders to some members of the public. The dose to the nearest resident was estimated to be less than 1.04 mrem per year and the dose to the MEI about 21 mrem per year. The total annual dose from all exposure pathways would be less than, but in the case of the MEI a significant fraction of, the limit of 100 mrem per year in 10 CFR 20.1301 (NRC, 2012a, pp. 4-46).

No sources of liquid radiological effluents were identified; therefore, there would be no public health impacts from liquid effluents.

Nonradiological airborne effluents would consist of HF, boron trifluoride, and silicon tetrafluoride (in total about 120 kg [265 lbs] per year) released during the deconversion of fluorine product manufacturing processes. Releases of fluorine compounds at this rate would not present a risk to public health, being below regulatory criteria (NRC, 2012a, pp. 4-51 to 4-52).

Radiological impacts on workers would result from activities involving the handling of uranium cylinders, uranium process activities, and decontamination and maintenance of equipment. The proposed facility would adhere to the principles of as low as reasonably achievable (ALARA) for the protection of workers. Analyses performed for deconversion activities at the DOE Portsmouth, Ohio, and Paducah, Kentucky, facilities were presented as representative of the worker doses that might be incurred at this facility. For those facilities, the dose for workers was conservatively estimated to be about 75 mrem per year for involved workers in the deconversion facility. The average dose for workers at the cylinder yards was estimated to range from 430 mrem per year to 690 mrem per year. These doses would be well below the regulatory limit of 5 rem per year in 10 CFR 20.1201 (NRC, 2012a, pp. 4-51).

The worker risks associated with exposure to hazardous nonradiological chemicals would primarily be associated with accidental exposure to UF_6 and the products produced when it comes in contact with the humidity in air (HF and UO_2F_2). A combination of engineered protective features; containment systems for gases, ventilation systems, and the use of personal protective equipment including respiratory protection as needed; would be used. Worker exposure to in-plant gaseous releases would not exceed 29 CFR 1910, Subpart Z limits and would be minimal (NRC, 2012a, pp. 4-52).

Exposure to uranium is known to result in kidney damage in humans mostly due to high acute exposures, whether inhaled or ingested. There is evidence that kidney damage due to high occupational exposures can eventually heal after the exposure ends. Non-malignant respiratory diseases (e.g., fibrosis, emphysema) have been observed in human and animal studies. Extremely high exposure may be lethal (may cause renal or respiratory failure). Uranium exposure to children is expected to have the same impacts as on adults, but there is no evidence that children are more susceptible than adults. Neurobehavioral changes have been observed in animal studies of high exposures and conflicting evidence suggests a potential decrease in fertility among the subject animal. However, human studies have not confirmed these same effects. Occupational Safety and Health Administration (OSHA) limits for insoluble and soluble airborne uranium in the workplace are 0.25 and 0.05 milligrams per cubic meter (mg/m^3) for an 8-hour time weighed average. (ATSDR, 2012)

The various forms of fluorine (e.g., fluorine gas, HF, and hydrofluoric acid) all are potentially harmful either through exposure in the air or inhalation. (Ingestion is not a typical form of exposure.) Exposure to high concentrations of fluorine gas can make it hard to breathe, cause lung damage, and be fatal. At lower levels, it is still very irritating and very dangerous to the eyes, skin, nose and lungs. HF is also a very irritating gas. While not as dangerous as fluorine, HF can have impacts similar to those of fluorine. Exposure to large amounts of it can cause death. At lower concentrations effects include eye, nose, and skin irritation. Large amounts when inhaled can also harm the lungs and heart. Exposure to hydrofluoric acid is typically through skin contact and it can burn the eyes and skin; deep, painful wounds may develop over several days. When not treated properly, serious skin damage and tissue loss can occur. A large amount of hydrofluoric acid on the skin can affect the heart and lungs and can lead to death. OSHA has set a legally enforceable limit of 0.2 mg/m^3 for fluorine, 2.0 mg/m^3 for HF, and 2.5 mg/m^3 for fluoride in workroom air to protect workers during an 8-hour shift over a 40-hour work week. The National Institute for Occupational Safety and Health recommendations for air levels are the same as the OSHA limits, except in the case of HF—it recommends a level of 2.5 mg/m^3. (ATSDR, 2003)

Handling of all chemicals and wastes would be conducted in accordance with the site Environment, Health, and Safety Program, which would conform to 29 CFR 1910 OSHA standards. No worker exposures exceeding the OSHA Standards for Toxic and Hazardous Substances (29 CFR 1910, Subpart Z) are anticipated.

The proposed facility would be a major industrial site and normal workplace-related events (occupational accidents) can result in injury or fatality. The impact analysis in the Fluorine/DU EIS addressing the facility used U.S. Department of Labor, Bureau of Labor Statistics information on workplace accidents to assess the nonradiological risk to workers. Based on the total number of full-time facility workers, workplace injury estimates of three worker injuries per year and no fatalities (0.003) during the operational period were developed (NRC, 2012a, pp. 4-53).

Depleted Uranium Hexafluoride Deconversion Facility in Portsmouth, Ohio

Air releases of radionuclides from current operations at the Portsmouth site result in low levels of radiation exposure to people in the vicinity of the site. Ambient air monitoring data were used to calculate a dose to a hypothetical person living at the monitoring station. The highest net dose calculation is 0.0019 mrem per year, which is well below EPA's *National Emission Standards for Hazardous Air Pollutants* limit of 10 mrem per year, and NRC dose limit of 100 mrem per year. Based on data for releases to the air for the year 2002, the estimated radiation dose to the MEI from all site operations was 0.031 mrem per year. These estimated MEI doses are well below EPA and NRC limits (NRC, 2006b, pp. 3-64 to 3-65).

Considering dose impacts from other than airborne releases results in an estimated 2 mrem per year dose to the MEI. This dose, while still lower than EPA and NRC standards, includes several other exposure pathways, including from liquid effluents and ingestion of radionuclides (NRC, 2006b, pp. 3-64 to 3-65; DOE, 2004b).

The on-reservation worker average whole-body dose is less than 10 mrem per year. However, in the depleted uranium deconversion facility EIS, cylinder yard worker exposure is estimated to be 64 mrem per year (DOE, 2004b, pp. pp 5-33). Both estimates are significantly less than NRC and DOE worker dose standards of 5 rem per year (10 CFR 20) (NRC, 2006b, pp. 3-64 to 3-65).

OSHA has permissible exposure limits for chemicals emitted into the air. Two of the chemicals of interest at this site are HF and uranium. Concentrations of both are below OSHA limits (NRC, 2006b, pp. 3-66).

For other nonradiological pollutants, EPA has established levels at which the hazard from these pollutants is deemed to be insignificant. A hazard quotient based on concentrations of these pollutants compared to these quantities of less than one indicates the pollutant is present in quantities not of significant risk. In an assessment of several media (air, soil, surface water, sediment, and groundwater), the hazard quotients were less than one (NRC, 2006b, pp. 3-65 to 3-66).

There have been no industrial fatalities at this site. Injuries from industrial accidents at the facilities (between two and three for 2002 and 2003) are lower than the Bureau of Labor Statistics' national average for similar facilities (3.4 in 2002) (NRC, 2006b, pp. 3-69).

Construction

Construction worker impacts result from normal workplace-related events resulting in injury or fatality. The impact analysis in the Portsmouth DU EIS (DOE, 2004b) addressing the facility used U.S. Department of Labor, Bureau of Labor Statistics information on workplace accidents to assess the nonradiological risk to workers. Based on the total number of full-time facility workers (164), workplace injury estimates of 11 worker injuries per year and no fatalities during the operational period were developed (DOE, 2004b, pp. 5-43).

No nonradiological impacts from effluent releases to workers were identified. Although occupational exposure to fugitive dust containing particulates and emissions from construction equipment is expected, concentrations are small enough to result in a SMALL impact. Off-site exposure through water and air pathways is possible; releases to waterways would be small and the off-site concentrations of air pollutants would be less than on-site (NRC, 2006b, pp. 4-59).

The primary modes of exposure for construction personnel would be (1) inhalation of radiological dust; (2) external exposure to radionuclides deposited in the soil; (3) external exposure to radionuclides; contained in soil suspended in the air; and (4) direct radiation exposure from existing sources nearby on the site such as the cylinder storage yards. The major contributor to construction worker maximum annual dose was identified as direct radiation; this source could contribute 88 mrem per year to the total individual worker dose of 89 mrem per year. The total maximum possible dose to construction workers from all four pathways is less than the 100 mrem per year limit in 10 CFR 20.1301(a)(1) (NRC, 2006b, pp. 4-59).

Operation

The primary radioactive release from the proposed facility would be uranium, released during the deconversion process, ranging from an expected release of less than 0.6 lbs of uranium per year. Both the depleted UF_6 feed and uranium oxide product would be depleted uranium; releases would have the isotopic content of depleted uranium (DOE, 2004b, pp. 5-77).

During normal operations, the facility would emit only small amounts of contaminants through air emissions; no contaminated liquid effluents would be produced during the dry conversion process. There would be no public health impacts from liquid effluents. The major sources of potential radiation exposure to the public are the gaseous discharges from the deconversion plant ventilation system exhaust stack. The dose from these airborne effluents to the MEI was estimated to be less than 2.1×10^{-5} mrem per year. This value is less than the regulatory limits of 100 mrem per year from 10 CFR 20.1301(a) (Dose limits for individual members of the public), 25 mrem per year in 40 CFR 190.10 (Standards for normal operations [fuel cycle facility], and the 10 mrem per year limit for dose from airborne emissions in 10 CFR 20.1101. The expected population dose was estimated to be 6.2×10^{-5} person-rem per year. This is a small percentage of the dose from natural background radiation for this population (DOE, 2004b, pp. 5-62).

Nonradiological airborne effluents would consist of HF and uranium compounds released during the deconversion process. Releases of uranium (less than an ounce per year) and fluorine compounds (about 57 kg [125 lbs]) per year would not present a risk to public health, being below regulatory criteria (DOE, 2004b, pp. 5-77).

Radiological impacts on workers would result from external radiation associated with activities involving the handling of uranium cylinders as well as the deconversion processes. The proposed facility would adhere to the principles of ALARA for the protection of workers. Worker doses were estimated using information on the operation of the Framatome facility in Richland, Washington (DOE, 2004b). The Framatome facility handles LEU, which has a higher specific activity than depleted uranium (nearly a factor of 10 higher) but the Portsmouth facility would have a higher processing rate (about four times higher). The Portsmouth DU EIS concluded the Framatome facility worker impacts reasonably estimates the worker dose for the Portsmouth deconversion facility. For those facilities, the dose for workers was conservatively estimated to be about 75 mrem per year for involved workers in the deconversion facility. The average dose for individual workers at the cylinder yards was estimated to range from 510 mrem per year to 600 mrem per year. These doses would be well below the regulatory limit of 5 rem per year in 10 CFR 20.1201. The total dose to all workers was estimated to be about 13 person-rem per year, about a quarter of which was received by cylinder yard workers (DOE, 2004b, pp. 5-60 to 62).

Workplace levels of hazardous chemicals would be monitored to ensure that concentrations are kept below levels that would have any health impacts. Airborne concentrations would be kept within applicable health standards. No adverse health effects to workers or the general public from nonradiological chemicals are expected (DOE, 2004b, pp. 5-64).

The proposed facility would be a major industrial site, and normal workplace-related events (occupational accidents) can result in injury or fatality. The impact analysis in the Portsmouth DU EIS addressing the facility used U.S. Department of Labor, Bureau of Labor Statistics information on workplace accidents to assess the nonradiological risk to workers. Based on the total number of full-time facility workers (175), workplace injury estimates of 142 worker injuries and no fatalities during the operational period were developed (DOE, 2004b, pp. 5-76).

Depleted Uranium Hexafluoride Deconversion Facility in Paducah, Kentucky

The MEI receives an estimated dose of 1.9 mrem per year. This value is less than the regulatory limits of 100 mrem per year from 10 CFR 20.1301(a) (dose limits for individual members of the public), 25 mrem per year in 40 CFR 190.10 (standards for normal operations [fuel cycle facility], and the 10 mrem per year limit for dose from airborne emissions in 10 CFR 20.1101. Cylinder yard workers received an average dose of 2,547 mrem per year, well below the regulatory limit of 5 rem per year (10 CFR 835) (DOE, 2004c, pp. 3-26).

Estimated hazard quotients for UF_6 contaminants around the Paducah site are lower than the concentrations that would result in adverse health impacts, with the exception of groundwater. However, no public exposure is expected from this contamination because no contaminated water is used for drinking water; alternative sources of drinking water have been provided for the potentially impacted public. Worker exposure to hazardous chemicals is maintained below limits set by OSHA for permissible exposure limits for uranium compounds and HF in the workplace (29 CFR 1910, Subpart Z) (DOE, 2004c, pp. 3-26).

Construction

Construction worker impacts result from normal workplace-related events resulting in injury or fatality. The impact analysis in the EIS addressing the facility used U.S. Department of Labor, Bureau of Labor Statistics information on workplace accidents to assess the nonradiological risk to workers. Based on the total number of full-time facility workers (164), workplace injury estimates of 11 worker injuries per year and no fatalities during the operational period were developed (DOE, 2004c, pp. 5-22).

No nonradiological impacts from effluent releases to workers were identified. Although occupational exposure to fugitive dust containing particulates and emissions from construction equipment are expected, concentrations are small enough to result in a SMALL impact. Off-site exposure through water and air pathways is possible, releases to waterways would be small and the off-site concentrations of air pollutants would be less than on-site resulting in a SMALL public health impact (NRC, 2006b, pp. 4-59).

Two locations were identified on-site that would result in the highest dose rate for workers. Assuming a construction worker worked full time at one of the locations, the estimated dose to this worker would be between 35 and 40 mrem per year (DOE, 2004c, pp. 5-22).

Operation

Nonradiological airborne effluents would consist of HF and uranium compounds released during the deconversion process. Releases of uranium (less than an ounce per year) and fluorine compounds (about 73 kg [160 lbs]) per year would not present a risk to public health, being below regulatory criteria (DOE, 2004c, pp. 5-46 & 5-60).

Radiological impacts on workers would result from external radiation associated with activities involving the handling of uranium cylinders as well as the deconversion processes. The proposed facility would adhere to the principles of ALARA for the protection of workers. Worker doses were estimated using information on the operation of the Framatome facility in Richland, Washington. The Framatome facility handles LEU, which has a higher specific activity than depleted uranium (nearly a factor of 10 higher) but the Paducah facility would have a higher processing rate (about five times higher). The EIS concluded the Framatome facility worker impacts reasonably estimate the worker dose for the Paducah deconversion facility. For those facilities, the dose for workers was conservatively estimated to be about 75 mrem per year for involved workers in the deconversion facility. The average dose for individual workers at the cylinder yards was estimated to range from 430 mrem per year to 690 mrem per year. These doses would be well below the regulatory limit of 5 rem per year in 10 CFR 20.1201. The total dose to all workers was estimated to be about 16 person-rem per year, about one-third of which was received by cylinder yard workers (DOE, 2004c, pp. 5-42 through 5-45).

Workplace levels of hazardous chemicals would be monitored to ensure that concentrations are kept below levels that would have any health impacts. Airborne concentrations would be kept within applicable health standards. No adverse health effects to workers or the general public from nonradiological chemicals are expected (DOE, 2004c, pp. 5-46).

The proposed facility would be a major industrial site, and normal workplace-related events (occupational accidents) can result in injury or fatality. The impact analysis in the EIS addressing the facility used U.S. Department of Labor, Bureau of Labor Statistics information on workplace accidents to assess the nonradiological risk to workers. Based on the total number of full-time facility workers (175), workplace injury estimates of 197 worker injuries and no fatalities during the operational period were developed (DOE, 2004c, pp. 5-76 & 5–77).

New HALEU Deconversion Facility

Construction

Human health impacts during construction are site dependent. Impacts from the construction of the HALEU deconversion facility at a site that does not have an existing fuel cycle or other nuclear related facility would be expected to have impacts limited to those associated with any construction activity. These impacts would be limited to injuries and fatalities to construction workers from occupational-related accidents. No radiological or chemical-related human health impacts would be expected.

Should the construction occur on the site of an existing nuclear fuel cycle facility, human health impacts could also include impacts on workers from radiological materials present due to existing facility operations (e.g., enrichment or fuel fabrication activities). As demonstrated in the previous discussions, this potential exposure is often predominantly associated with the storage of fuel cycle radiological material. At the enrichment and fuel fabrication facilities, this is most likely UF_6, either depleted or enriched.

Based on the impacts identified for construction at the facilities discussed, no impacts on the general public (radiological or nonradiological) related to construction would be expected. There would be no release of radiological or hazardous nonradiological materials in sufficient quantities to pose a threat to public health.

Radiological impacts on workers would be very site specific. Also, the location of the deconversion facility on the site has the potential to affect worker radiological impacts. The majority of the construction worker doses at the two UF_6 deconversion facilities (Portsmouth and Paducah) is the result of direct radiological exposure to material, DUF_6 stored on-site. The further from these stored materials, the less the direct dose to construction workers. Proper consideration of ALARA principles should allow for the location of the HALEU deconversion facility to minimize this dose to construction workers.

The HALEU deconversion facility would be designed to process about 38 MT of HALEU[21] (in the form of UF_6). This is a small fraction of the throughput for each of the deconversion facilities described. The HALEU deconversion facility would therefore be at least no larger than the smallest of these facilities—the Lea County FEP and DU deconversion facility, with processing capacity of 3,318 MT of UF_6 per year. Accidental injuries and fatalities during construction should be bounded by the estimates for that facility.

Estimated impacts associated with the construction and operation of a HALEU deconversion facility are shown in Table 4-1.

Table 4-1. Projected HALEU Deconversion Facility Human Health Impacts

Impact Area	*Lea County Deconversion Facility*	*Portsmouth UF_6 Deconversion Facility*	*Paducah UF_6 Deconversion Facility*	*HALEU Deconversion Facility*
Construction				
Worker injury/fatality	6/0	11/0	11/0	< 10/0
Worker average dose mrem/yr	0	89	35-40	< 100
Operation				
Public				
MEI mrem/yr	0.003	2.1×10^{-5}	3.9×10^{-5}	0.001
Nearest resident mrem/yr	0.002/1,000	---	---	---
Population person-rem/yr	0.04	6.2×10^{-5}	4.7×10^{-5}	4×10^{-5} to 0.04
Workers				
Accidental injury/fatality	120[(a)]/0	142/0	197/0	150/0
Average dose mrem/yr	75	75	75	< 100
Dose to cylinder yard workers mrem/yr	430–690	510–600	430–690	430–690

Key: < = less than; HALEU = high-assay low-enriched uranium; MEI = maximally exposed individual; mrem/yr = millirem per year; UF_6 = uranium hexafluoride

Note:

a Three injuries per year over 40 years.

Operation

There are two competing factors that would impact the radiological impacts on the public from operation of the HALEU deconversion facility relative to the impacts identified for the three deconversion facilities previously discussed. First, the throughput for the HALEU facility would be significantly less than the throughput for those facilities (38 MT of UF_6 versus 3,318 MT, 18,000 MT, and 14,300 MT for the Lea County, Portsmouth, and Paducah facilities, respectively) (DOE, 2004b, pp. 2-12; DOE, 2004c, pp. 4-3; NRC, 2012a, pp. 2-5). Assuming similar emissions per MT processed and similar ventilation filtration systems, the public health impacts from operation of the HALEU deconversion facility should scale with the quantity of material processed.

However, the isotopic content of the UF_6 being processed is different for the HALEU deconversion facility than for the three depleted uranium processing facilities. The HALEU, in addition to being enriched in U-235, would be enriched in uranium-234 (U-234). U-234 is more radioactive than the other isotopes of uranium. This means that the same quantity (by weight) of HALEU would have a higher Ci content than

21 Deconversion facility analysis is based on a single deconversion facility capable of treating the UF_6 produced by a single enrichment facility (producing 25 MT of HALEU in the form of 38 MT of UF_6).

depleted uranium. The HALEU release of the same quantity of uranium would have higher health consequences.

As shown in Table 4-2, the total Ci content of a gram of HALEU is a little less than 30 times that of depleted uranium. Therefore, the release of a gram of HALEU would result in the release of about 30 times more curies than the release of a gram of depleted uranium and about 30 times the dose.[22]

Table 4-2. Uranium Activity of Depleted Uranium and HALEU

Uranium Isotope	*Specific Activity (Ci/g)*	*DU*		*HALEU*	
		Weight percent	*Total Activity (Ci/g)*	*Weight percent*	*Total Activity (Ci/g)*
U-238	3.35×10^{-7}	0.998	3.34×10^{-7}	0.803	2.69×10^{-7}
U-235	2.16×10^{-6}	0.002	4.32×10^{-9}	0.195	4.21×10^{-7}
U-234	6.24×10^{-3}	0.00001	6.24×10^{-8}	0.0018 [(a)]	1.10×10^{-5}
Total Activity	---	100	4.0×10^{-7}	100	1.17×10^{-5}

Key: Ci/g = curies per gram; DU = depleted uranium; HALEU = high-assay low-enriched uranium; U- = uranium
Note:
[a] Assuming the enrichment of U-234 is proportional to the enrichment of U-235 and accounting for the difference in mass between the two isotopes.

To estimate the HALEU deconversion facility public impact from exposure to radiological material (either airborne releases or direct radiation) a few assumptions about the location of a new facility are needed. To be able to use the assessments for the three deconversion facilities it is necessary to assume that the HALEU facility would be at one of the three sites or a site similar in size to the existing/proposed deconversion facilities. A sufficient buffer area between the site boundary and the structures housing operations would be necessary. These assumptions allow the placement of the MEI at a location similar to that used in the analyses of the three facilities. The assessment assumes that the population distribution and density around the facility would be similar to that of the three deconversion facilities. The total population dose can reasonably be expected to be much less than a person-rem.

Combining the effects of the lower throughput for the HALEU deconversion facility and the higher activity of released uranium, the health impacts should be lower for the HALEU facility than that estimated for the three depleted uranium deconversion facilities. Airborne releases should result in individual doses of much less than a mrem per year. Impacts from direct radiation to the public would be dependent upon the location of the facility (particularly any cylinder storage yards) with respect to distance from a controlled site boundary. Incorporating the impact of a direct dose to the public into the design layout of the HALEU facility would serve to limit this dose to an individual located at the site boundary. With similar population density and distributions, the population dose at a new facility should be similar to that if the HALEU deconversion facility were located at any of the three deconversion sites.

All three of the deconversion facilities discussed previously used surrogate data for the worker dose assessment. Data from the Framatome fuel fabrication facility in Richland, Washington, was cited. More recent data on worker doses from fuel cycle facilities is available in the annual NRC *Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities* reports. Data in the most recent report for all fuel fabrication facilities show an average worker dose of 90 mrem for the year 2020 (NRC, 2022a). As part of the fuel fabrication process, all of these facilities perform UF_6 conversion to uranium oxides. As stated previously, the HALEU deconversion facility is expected to be smaller than the three

[22] The three uranium isotopes have slightly different dose conversion factors (dose per unit intake [internal]: Ci to rem). However, the differences are relatively small and are ignored in this assessment.

deconversion facilities discussed previously. As such, the total workforce should be no larger than the workforce of the smallest of the three, 140 workers (NRC, 2012a, pp. 4-53).

At a minimum, the HALEU deconversion facility would be expected to implement a radiation protection program in accordance with that would employ ALARA considerations to limit the worker dose. These doses should be well below NRC regulatory limit of 5 rem in 10 CFR 20.1201 and any lower administrative limit see by the facility operator.

None of the three deconversion facilities discussed identified releases of hazardous chemicals in quantities that would impact public health. Design of the HALEU deconversion facility should incorporate ventilation filtration capabilities similar to those in those these facilities. With the HALEU deconversion facility being smaller than any of these three facilities, operation of the facility should not result in adverse public health impacts. Handling of all chemicals and wastes would be conducted in accordance with the site Environment, Health, and Safety Program, which would conform to 29 CFR 1910 OSHA standards. No worker exposures exceeding the OSHA Standards for Toxic and Hazardous Substances (29 CFR 1910, Subpart Z) are anticipated.

As previously stated, the HALEU deconversion facility would be at least no larger than the Lea County FEP and DU deconversion facility. Accidental injuries and fatalities during operation should be bounded by the estimates for that facility.

4.3.12 Public and Occupational Health – Facility Accidents

At the enrichment plant, HALEU is created by enriching UF_6 up to 19.75% U-235. The UF_6 must then be deconverted to uranium metal, oxides, or salts prior to fabrication into fuel for advanced nuclear reactors. The operation of the deconversion facility would involve risks to workers, the public, and the environment from potential accidents. The facility would be licensed under 10 CFR 40, *Domestic Licensing of Source Material*, and would also be subject to 10 CFR 70, Subpart H, *Additional Requirements for Certain Licensees Authorized to Possess a Critical Mass of Special Nuclear Material*.

Companies holding licenses under 10 CFR 70, *Domestic Licensing of Special Nuclear Material*, must perform an integrated safety analysis (ISA) and submit a summary to the NRC for approval. An ISA (1) identifies potential accident sequences during operations of a deconversion facility, (2) designates items relied on for safety (IROFS) to either prevent such accidents or mitigate their consequences to an acceptable level, and (3) describes management measures to provide reasonable assurance of the availability and reliability of IROFS.

The performance requirements in 10 CFR 70, Subpart H, define acceptable levels of risk of accidents at nuclear fuel cycle facilities such as the deconversion facility. The regulations in Subpart H require reduction of the risks of credible high- and intermediate-consequence events, and ensure that under credible abnormal conditions, all nuclear processes are subcritical. Table 4-3 defines the accident consequence categories used for the accident analysis. Table 4-4 defines exposure thresholds, by receptor, and for intermediate- and high-consequence accidents, for each chemical species analyzed.

The risks associated with HALEU deconversion are both radiological and chemical. The process to deconvert HALEU in the form of UF_6 involves radioactive material and a number of volatile and soluble chemicals. These radioactive material and chemical forms contribute to risks associated with inhalation if a release occurred. In addition, the deconversion process uses hydrogen gas (a gas that is flammable and could create an explosion hazard). Deconversion of HALEU in the form of UF_6 also poses a nuclear criticality hazard.

Table 4-3. Accident Consequence Categories

Category	*Workers*	*Off-Site Public*	*Environment*
Category 3: High Consequences	• Individual Radiation Dose: ≥ 100 rem • Individual Chemical Dose = endanger life (> AEGL-3, 10-min exposure) • 75 mg soluble uranium intake	• Individual Radiation Dose: ≥ 25 rem • Chemical Dose = long-lasting health effects (> AEGL-2, 30-min exposure) • 30 mg soluble uranium intake	
Category 2: Intermediate Consequences	• Individual Radiation Dose: ≥ 25 rem • Individual Chemical Dose = long-lasting health effects (> AEGL-2 but < AEGL-3, 10-min exposure)	• Individual Radiation Dose: ≥ 5 rem • Chemical Dose = mild transient health effects (> AEGL-1 but < AEGL-2, 30-min exposure)	Radiological release > 5,000 times values in Table 2 of 10 CFR 20
Category 1: Low Consequences	Accidents of lower radiological and chemical exposures than Category 2	Accidents of lower radiological and chemical exposures than Category 2	Radiological releases lower than Category 2

Source: (NRC, 2012a, pp. 4-59, Table 4-33)

Key: > = greater than; ≥ = greater than or equal to; < = less than; AEGL = acute exposure guideline levels; CFR = Code of Federal Regulations; mg = milligrams; min = minute; rem = roentgen equivalent man

Table 4-4. Chemical Consequence Exposure Thresholds

Chemical	*Intermediate Consequences*				*High Consequences*			
	Worker Exposure		*Public Exposure*		*Worker Exposure*		*Public Exposure*	
	Level of Concern	*Concentration, mg/m³*	*Level of Concern*	*Concentration, mg/m³*	*Level of Concern*	*Concentration, mg/m³*	*Level of Concern*	*Concentration, mg/m³*
HF	AEGL-2 10 min	77.8	AEGL-1 30 min	0.82	AEGL-3 10 min	139	AEGL-2 30 min	28
SiF_4	AEGL-2 10 min	27	AEGL-1 30 min	0.21	AEGL-3 10 min	81	AEGL-2 30 min	18
BF_3	AEGL-2 10 min	47	AEGL-1 30 min	2.5	AEGL-3 10 min	140	AEGL-2 30 min	47
UF_6	AEGL-2 10 min	28	AEGL-1 30 min	3.6	AEGL-3 10 min	216	AEGL-2 30 min	19
UO_2F_2	AEGL-2 10 min	28	AEGL-1 30 min	3.6	AEGL-3 10 min	216	AEGL-2 30 min	19
UF_4	AEGL-2 10 min	28	AEGL-1 30 min	3.6	AEGL-3 10 min	216	AEGL-2 30 min	19
UO_2	ERPG-2 10 min	201	ERPG-1 30 min	0.68	ERPG-3 10 min	180	ERPG-2 30 min	32

Source: (NRC, 2012a, pp. 4-59, Table 4-34)

Key: AEGL = acute exposure guideline levels; BF_3 = boron trifluoride; ERPG = Emergency Response Planning Guideline; HF = hydrogen fluoride; mg/m^3 = milligrams per cubic meter; min = minutes; SiF_4 = silicon tetrafluoride; UF_4 = uranium tetrafluoride; UF_6 = uranium hexafluoride; UO_2 = uranium oxide; UO_2F_2 = uranyl fluoride

Note: Concentration values established by the American Industrial Hygiene Association that meet certain human response criteria similar to those for AEGLs.

The hazards identification process results in identifying radiological or chemical characteristics that have the potential for causing harm to workers, the public, or the environment. The hazards of concern for the deconversion facility relate to an inadvertent nuclear criticality and either a release of HF (loss of confinement of UF_6), or chemicals that may generate HF. HF is a clear, colorless, corrosive, fuming liquid. In high concentrations, a release could form dense white vapor clouds. Both direct releases of HF and releases from a byproduct reaction involving other fluoride species (UF_6, UF_4, SiF_4, and BF_3) could pose accident risks. In general, the loss of confinement of UF_6 would initially result in the moisture in the air reacting with the UF_6 to form UO_2F_2 and HF as byproducts. UO_2F_2 is a significant inhalation problem because of its dispersible and small particle size. HF can also be released as the byproduct of UF_4 or be generated by the exposure of SiF_4 or BF_3 to air. The HF, which is in a gaseous form, and UO_2F_2 could be transported through the facility and ultimately beyond the site boundary. Both HF and UO_2F_2 are toxic chemicals with the potential to cause harm to the workers or the public.

The ISA may include probabilities or likelihood categories (such as "highly unlikely," "unlikely," or "not unlikely") for each accident scenario. The analysis described in this section does not include an estimate of the probability of occurrence of accidents, which, in combination with consequences, would reflect the overall risk from an accident. Instead, analyzed accidents are assumed to occur and consequences of each accident are reported. The accidents evaluated are a representative selection of the types of accidents that are possible at the deconversion facility. The accident sequences selected vary in severity from high- to low-consequence events and include accidents initiated by natural phenomena (i.e., seismic event), operator error, and equipment failure. Possible initiators for accidents at the deconversion facility include process upsets, seismic events, and extreme weather events, such as tornadoes. A number of potential accident scenarios could occur at the facility (NRC, 2011c; NRC, 2012a):

- Generic inadvertent nuclear criticality
- Seismic event causing multiple process containment failures: This scenario would occur across multiple processes and result in high consequences; the evaluation of collective effects would utilize an estimate of the total facility source term.
- Liquid UF_6 cylinder drop: This scenario would include a breach and release of liquid UF_6.
- SiF_4 release: This scenario could be caused by over-pressurization of a nitrogen loop with secondary cold trap breach.
- UF_4 collection drum spill
- UF_4 vacuum transfer line rupture: This scenario would occur outside of the building.

The results of the ISA are intended to give assurance that the potential failures, hazards, accident sequences, and scenarios, as well as facility features and procedures have been investigated in an integrated fashion, so as to adequately consider common-mode and -cause situations. For credible events with a potential for high consequences, the ISA provides a detailed evaluation of plant features and procedures that would mitigate those consequences. The impacts of accidents with the potential to release radioactive materials or chemicals, and affect public health and the environment, would be mitigated by the protective measures identified in the ISA.

Operating procedures for the deconversion facility would be designed to ensure the high and intermediate accident scenarios would be "highly unlikely" and "unlikely," respectively. The combination of responses by IROFS, which mitigate or prevent emergency conditions, and the implementation of emergency procedures and protective actions in accordance with the facility emergency plan, would limit the consequences and reduce the likelihood of accidents that could otherwise extend beyond the proposed facility site and property boundaries.

Accident consequences have not been calculated for a HALEU deconversion facility, but the consequences would be considered from both a radioactive material and chemical hazards perspective if calculations were performed. To provide perspective for the HALEU deconversion facility, impacts from accidents at the Portsmouth (DOE, 2004b), the Paducah (DOE, 2004c), and the proposed IIFP (NRC, 2012a) DU deconversion facilities are presented. Because the accidents for the DU facilities do not consider enriched uranium, impacts from an enrichment facility (NRC, 2011c) are also presented. The enrichment facility handles materials similar to those handled at a deconversion facility. Deconversion activities are also performed at fuel fabrication facilities discussed in Section 7, *HALEU Fuel Fabrication*.

International Isotopes Fluorine Products, Inc. Fluorine Extraction Process and Depleted Uranium Deconversion Plant in Lea County, New Mexico

Construction

Accidents during construction are standard industrial hazards. Accidents from standard industrial hazards are not part of the accident analysis for a deconversion facility. Occupational hazards are addressed in Section 4.3.11, *Public and Occupational Health – Normal Operations*.

Operation

The IIFP facility is proposed to deconvert DU and recover fluorine products. As such, impacts from the IIFP facility are primarily related to the chemical hazards of a deconversion facility. Table 4-5 summarizes the consequences for accidents at the IIFP FEP and DU deconversion facility (NRC, 2012a, pp. 4-60, 4-61). The most significant accident consequences are those associated with the release of liquefied UF_6 caused by rupturing a cylinder. The facility emergency plan addresses this type of event, as well as all other lower-risk, high-, and intermediate-consequence events. The likelihood of this type of event would be reduced by requiring a robust cylinder design that maintains its integrity during credible drops, shocks, collisions, and thermal events, and an interlock on the autoclave, which would prevent the removal of liquid or partially full cylinders during heating or feed cycles. Through the combination of plant design, passive and active engineered controls, and administrative controls, accidents at the facility would pose an acceptably SMALL risk to workers, the environment, and the public (NRC, 2012, pp. 4-60, 4-61).

Table 4-5. Summary of IIFP Facility Accident Analysis Results

Receptor	*Parameter*	*Worst-Case UF_6 Release*	*Seismic Event Causing Multiple Process Containment Failures*	*Fluorine Compounds Release*	*UF_4 Spill*	*Transfer Line Rupture*
Worker (inside room, 10-min exposure)	HF concentration (mg/m^3)	1.34×10^6		56.5		
	UO_2F_2 concentration (mg/m^3)	5.14×10^6				
	Soluble U intake (mg)	7.94×10^5				
	Dose (rem)	686			0.052	
	SiF_4 concentration (mg/m^3)			73.5		
	UF_4 concentration (mg/m^3)				121	
Worker	HF concentration	1.64×10^4	47.3	0.452		

Table 4-5. Summary of IIFP Facility Accident Analysis Results

Receptor	***Parameter***	***Worst-Case UF_6 Release***	***Seismic Event Causing Multiple Process Containment Failures***	***Fluorine Compounds Release***	***UF_4 Spill***	***Transfer Line Rupture***
(outside building, 10-min exposure)	(mg/m^3)					
	UO_2F_2 concentration (mg/m^3)	6.05×10^4	179			
	Soluble U intake (mg)	9,340	27.6			
	Dose (rem)	8.07	0.02		4.05×10^{-4}	3.48×10^{-4}
	SiF_4 concentration (mg/m^3)			0.588		
	UF_4 concentration (mg/m^3)				0.953	0.817
Public (MEI) (at site boundary, 30-min exposure)	HF concentration (mg/m^3)	7,800	15.7	0.367		
	UO_2F_2 concentration (mg/m^3)	2.93×10^4	59.4			
	Soluble U intake (mg)	1.36×10^4	27.4			
	Dose (rem)	11.7	0.02		0.0017	3.45×10^{-4}
	SiF_4 concentration (mg/m^3)			0.478		
	UF_4 concentration (mg/m^3)				1.33	0.27
Environment (at site boundary, 24 hr avg)	Activity concentration (µCi/mL)	2.72×10^{-7}	4.96×10^{-10}		6.67×10^{-12}	2.17×10^{-12}
Public collective exposure	Dose (person-rem)	16.1	135		0.00317	0.00192
	LCF	0.00351	0.0297		2.63×10^{-6}	1.59×10^{-6}

Key: avg = average; HF = hydrogen fluoride; hr = hour; km = kilometers; LCF = latent cancer fatality; MEI = maximally exposed individual; mg = milligrams; mg/m^3 = milligrams per cubic meter; min = minute; SiF_4 = silicon tetrafluoride; µCi/mL = microcuries per milliliter; U = uranium; UF_4 = uranium tetrafluoride; UF_6 = uranium hexafluoride; UO_2F_2 = uranyl fluoride

Notes: Not all accident sequences resulted in datum for the categories listed in this table. This could be because the sequence was postulated to occur outside of a building or did not involve all the chemicals or radioactive materials listed. No recreational areas are within 10 km (6 miles) of the site. The closest recreation facilities are golf courses 12 km (7.5 miles) east and northeast (NRC, 2012a, pp. 3-9), and a motorsports park, also 12 km (7.5 miles) northeast (NRC, 2012a, pp. 3-9) of the site boundary. The nearest residence is approximately 2.6 km (1.6 miles) northwest of the site boundary. A state-listed historic site, Monument Springs, is approximately 10 km (6 miles) southeast of the site. Site boundary is at 1.6 km (1 mile) (NRC, 2012a, pp. C-8). Exposed population is 112,938 people (NRC, 2012a, pp. 3-62).

Depleted Uranium Hexafluoride Deconversion Facility in Paducah, Kentucky

Construction

Accidents during construction are standard industrial hazards. Accidents from standard industrial hazards are not part of the accident analysis for a deconversion facility. Occupational hazards are addressed in Section 4.3.11, *Public and Occupational Health – Normal Operations*.

Operation

Radiological Impacts

A range of accidents covering the spectrum from high-frequency/low-consequence events to low-frequency/high-consequence accidents was considered for DUF_6 deconversion operations. The accident scenarios considered such events as releases due to cylinder damage, fires, plane crashes, equipment leaks and ruptures, hydrogen explosions, earthquakes, and tornadoes (DOE, 2004c, pp. 5-47 to 5-52).

Potential radiation doses from accidents were estimated for noninvolved workers at the Paducah site and members of the public within an 80-km (50-mile) radius of the site for both MEIs and the collective populations. Impacts on involved workers under accident conditions would likely be dominated by physical forces from the accident itself; thus, quantitative dose/effect estimates would not be meaningful. For these reasons, the impacts on involved workers during accidents are not quantified. However, it is recognized that injuries and fatalities among involved workers would be possible if an accident occurred.

For the off-site public, the location of the deconversion facility within the Paducah site would have very little impact on collective exposures because the area considered (a circle with a radius of 80 km [50 miles]) would be so much larger than the area of the Paducah site. The population dose estimates are based on population distributions from the 2000 census. The collective dose to noninvolved workers, however, would depend on the location of the deconversion facility with respect to other buildings within the site. (DOE, 2004c, pp. 5-47 to 5-52)

The postulated accident estimated to have the largest consequence is the extremely unlikely accident caused by an earthquake involving the deconversion facility. In this scenario, it is assumed that the U_3O_8 storage building would be damaged during the earthquake and that 10% of the stored containers would be breached. Under conservative meteorological conditions, it is estimated that the dose to the MEI member of the public and noninvolved worker from this accident would be approximately 40 rem if it is assumed that the product storage building contained 6 months' worth of production. The estimated MEI dose would result in a lifetime increase in the probability of developing a latent cancer fatality (LCF) of about 0.02 (about 1 chance in 50) in the public MEI and about 0.02 (1 chance in 50) in the worker MEI. (DOE, 2004c, pp. 5-47 to 5-52)

It is estimated that the collective doses from the U_3O_8 storage building earthquake accident would be 300 to 1,270 person-rem to the worker population and 73 person-rem to the off-site general population. These collective doses would result in less than 1 additional LCF in the worker population (0.5 LCF) and in the general population (0.04 LCF). (DOE, 2004c, pp. 5-47 to 5-52)

The accident scenario with the second-highest impacts was the extremely unlikely scenario caused by a tornado strike. In this scenario, it is assumed that a windblown missile from a tornado would pierce a single U_3O_8 container in storage. In this hypothetical accident, and if bulk bags were being used to transport and dispose of the U_3O_8 product, approximately 550 kg (1,200 lbs) of U_3O_8 could be released at ground level. Under conservative meteorological conditions, it is estimated that the dose to the MEI and noninvolved worker would be 7.5 rem. The collective doses would be up to 230 person-rem to the worker population and up to 35 person-rem to the general population. If the emptied cylinders were used rather than the bulk bags as U_3O_8 containers, the resulting doses would be approximately half of the above results. (DOE, 2004c, pp. 5-47 to 5-52)

The following conclusions may be drawn from the radiological health impact results (DOE, 2004c, pp. 5-52):

- No cancer fatalities are predicted for any of the accidents.

- The maximum radiological dose to the noninvolved worker and general public MEIs (assuming that an accident occurred) would be about 7.5 to 40 rem, depending on the quantity of product stored on-site at the time of the accident. This dose could thus be greater than the 25-rem total effective dose equivalent established by DOE as a guideline for assessing the adequacy of protection of public health and safety from potential accidents. Therefore, more detailed analysis during facility design and siting may be necessary.
- The overall radiological risk to noninvolved worker and general public MEI receptors (estimated by multiplying the risk per occurrence by the annual probability of occurrence by the number of years of operations) would be less than 1 for all of the deconversion facility accidents.

Chemical Impacts

This section presents the results for chemical health impacts for the highest-consequence accident in each frequency category for deconversion operations at the Paducah site (DOE, 2004c, pp. 5-52 to 5-59). The estimated numbers of adverse and irreversible adverse effects[23] among noninvolved workers and the general public were calculated separately for each of three alternative locations within the site by using 2000 census data for the off-site population.

The results are presented as the number of people with the potential for (1) adverse effects and (2) irreversible adverse effects. The numbers of noninvolved workers and members of the off-site public represent the impacts if the associated accident occurred. (DOE, 2004c, pp. 5-52 to 5-59)

- Potential Adverse Effects:
  - Corroded cylinder spill, dry conditions (likely), workers

    Assuming the accident occurred once every 10 years (frequency = 0.1 per year), between 33 and 280 workers would potentially experience an adverse effect over the 25-year operational period depending on the location of the accident.
  - Corroded cylinder spill, wet conditions – rain (unlikely), workers

    Assuming the accident occurred once every 1,000 years (frequency = 0.001 per year), between 15 and 18 workers would potentially experience an adverse effect over the 25-year operational period depending on the location of the accident.
- Potential Irreversible Adverse Effects:
  - Corroded cylinder spill, dry conditions (likely), workers

    Assuming the accident occurred once every 10 years (frequency = 0.1 per year), the expected numbers of workers who would potentially experience an irreversible adverse effect over the 25-year operational period would be between 0 and 23, depending on the location of the accident.
  - Corroded cylinder spill, wet conditions – rain (unlikely), workers

    Assuming the accident occurred once every 1,000 years (frequency = 0.001 per year), between 2 and 8 workers would potentially experience an irreversible adverse effect over the 25-year operational period depending on the location of the accident.

[23] An irreversible adverse effect is a health effect resulting from exposure to a substance where the effect does not subside when the exposure stops. An irreversible adverse effect includes the potential of lowering the quality of life, contributing to a disabling illness, or leading to a premature death.

The number of fatalities that could potentially be associated with the estimated irreversible adverse effects was also calculated. Previous analyses indicated that exposure to HF and uranium compounds, if sufficiently high, could result in death to 1% or less of the persons experiencing irreversible adverse effects. Similarly, it was estimated that exposure to sodium hydroxide or ammonia (NH_3) could result in death to about 2% of the persons experiencing irreversible adverse effects. Therefore, if the corroded cylinder spill, wet conditions–rain accident occurred, between 1 and 3 fatalities might be expected among the noninvolved workers depending on location. However, this accident is classified as an unlikely accident, meaning that it is estimated to occur between once in 100 years and once in 10,000 years of facility operation. Assuming that it would occur once every 1,000 years, the risk of fatalities among the noninvolved workers from this accident over the 25-year operational period would be less than 1. (DOE, 2004c, pp. 5-52 to 5-59)

Similarly, if the higher-consequence accident in the extremely unlikely frequency category (corroded cylinder spill, wet conditions–water pool) occurred, between 1 and 4 fatalities might be expected among the noninvolved workers depending on location. However, because of the low frequency of this accident, the risk of a fatality over the lifetime of the deconversion facility would be about 0.001 or less, assuming a frequency of 0.00001 per year. (DOE, 2004c, pp. 5-52 to 5-59)

For the NH_3 tank rupture accident, which belongs to the incredible frequency category (frequency of less than 0.000001 per year), the expected numbers of fatalities among the noninvolved workers would be about 30, if the accident occurred. However, the risk of a fatality would be much less than 1 (about 0.0004, assuming a frequency of 5×10^{-7} per year) over the facility lifetime. Among the general public, between 4 and 7 fatalities might be expected. However, because of the low frequency of the accident, the risk of fatalities would be much less than 1 (about 0.0001). (DOE, 2004c, pp. 5-52 to 5-59)

Even though the risks are relatively low, the consequences for a few of the accidents are considered to be high. These high-consequence accidents are generally associated with the storage of anhydrous NH_3 and aqueous HF on site. The consequences can be reduced or mitigated through design (e.g., by limiting their capacity), operational procedures (e.g., by controlling accessibility to the tanks), and emergency response actions (e.g., by sheltering, evacuation, and interdiction of contaminated food materials following an accident). Reducing the size of the anhydrous NH_3 storage tanks from 9,200 gal to 3,300 gal (34,826 liters [L] to 12,492 L) would reduce the consequences of an ammonia release accident.

Depleted Uranium Hexafluoride Deconversion Facility in Portsmouth, Ohio

Construction

Accidents during construction are standard industrial hazards. Accidents from standard industrial hazards are not part of the accident analysis for a deconversion facility. Occupational hazards are addressed in Section 4.3.11, *Public and Occupational Health – Normal Operations*.

Operation

<u>Radiological Impacts</u>

Potential cylinder accidents could release uranium, which is radioactive in addition to being chemically toxic (DOE, 2004b, pp. 5-9 to 5-14). The potential radiation exposures of members of the general public and noninvolved workers were estimated for a corroded cylinder spill under dry weather conditions and a fire involving several cylinders. For these accidents, the radiation doses from released uranium would be considerably below levels likely to cause radiation-induced effects among noninvolved workers and the general public and below the 25-rem total effective dose equivalent established by DOE as a guideline for assessing the adequacy of protection of public health and safety from potential accidents. (DOE, 2004b, pp. 5-13 to 5-14)

For the corroded cylinder spill accident (dry conditions), the radiation dose to an MEI of the general public would be less than 3 mrem (lifetime dose), resulting in an increased risk of death from cancer of about 1 in 1 million. The total population dose to the general public within 50 miles (80 km) would be less than 1 person-rem, most likely resulting in 0 LCFs. Among noninvolved workers, the dose to an MEI would be 77 mrem, resulting in an increased risk of death from cancer of about 1 in 30,000. The total dose to all noninvolved workers would be about 2.2 person-rem. This dose to workers would result in 0 LCFs. The risk (consequence × probability) of additional LCFs among members of the general public and workers combined would be much less than 1 over the period 1999 through 2039. (DOE, 2004b, pp. 5-13 to 5-14)

The cylinder accident estimated to result in the largest potential radiation doses would be the accident involving several cylinders in a fire. For this accident, it is estimated that the radiation dose to an MEI of the general public would be about 13 mrem, resulting in an increased risk of death from cancer of about 1 in 150,000. The total population dose to the general public within 50 miles (80 km) would be 34 person-rem, most likely resulting in 0 LCFs. Among noninvolved workers, the dose to an MEI would be about 20 mrem, resulting in an increased risk of death from cancer of about 1 in 100,000. The total dose to all noninvolved workers would be about 16 person-rem. This dose to workers would result in 0 LCFs. The risk (consequence × probability) of additional LCFs among members of the general public and workers combined would be much less than 1 over the period 1999 through 2039. (DOE, 2004b, pp. 5-13 to 5-14)

Chemical Impacts

The potential likely accident (defined as an accident that is estimated to occur one or more times in 100 years) that would cause the largest chemical health effects is the failure of a corroded cylinder that would spill part of its contents under dry weather conditions. Such an accident could occur, for example, during cylinder handling activities. It is estimated that about 11 kg (24 lbs) of UF_6 could be released in such an accident. The potential consequences from this type of accident would affect only on-site workers. The off-site concentrations of HF and uranium were calculated to be less than the levels that would cause adverse effects from exposure to these chemicals. Therefore, no adverse effects are expected among members of the general public. It is estimated that if this accident did occur, up to 48 noninvolved workers might experience potential adverse effects from exposure to HF and uranium (mostly mild and transient effects, such as respiratory irritation or temporary decrease in kidney function). It is also estimated that no noninvolved workers would experience potential irreversible adverse effects (such as lung or kidney damage). The number of fatalities following an HF or uranium exposure is expected to be somewhat less than 1% of the number of potential irreversible adverse effects. Therefore, no fatalities are expected. (DOE, 2004b, pp. 5-9 to 5-13)

For assessment purposes, the estimated frequency of a corroded cylinder spill accident is assumed to be about once in 10 years. Therefore, over the no action period, about four such accidents are expected. The accident risk (defined as consequence × probability) would be about 200 workers with potential adverse effects, and no workers with potential irreversible adverse effects. The number of workers actually experiencing adverse effects would probably be considerably less, depending on the actual circumstances of the accidents and the individual chemical sensitivity of the individual workers. In previous accidental exposure incidents involving liquid UF_6 in gaseous diffusion plants, a few workers were exposed to amounts of uranium estimated to be approximately three times the guidelines used for assessing irreversible adverse effects; none of those workers actually experienced irreversible adverse effects. (DOE, 2004b, pp. 5-9 to 5-13)

Accidents that are less likely to occur could have higher consequences. The potential cylinder accident at any of the sites estimated to result in the greatest total number of adverse chemical effects would be an accident involving several cylinders in a fire. It is estimated that about 11,000 kg (24,000 lbs) of UF_6 could be released in such an accident. It is estimated that if this accident occurred, up to 680 members of the general public and 1,000 noninvolved workers might experience adverse effects from HF and uranium exposure (mostly mild and transient effects, such as respiratory irritation or temporary decrease in kidney function). This accident is considered extremely unlikely, estimated to occur between once in 10,000 years and once in 1 million years. If the frequency is assumed to be once in 100,000 years, the accident risk over the no action period would be less than one adverse effect for both workers and members of the general public. (DOE, 2004b, pp. 5-9 to 5-13)

The potential cylinder accident estimated to result in the largest total number of irreversible adverse effects is a corroded cylinder spill under wet conditions, with the UF_6 being released into a pool of standing water. This accident is considered extremely unlikely, expected to occur between once in 10,000 years and once in 1 million years. It is estimated that if this accident did occur, about 1 member of the general public and 110 noninvolved workers might experience irreversible adverse effects (such as lung damage) from HF and uranium exposure. The number of fatalities would be somewhat less than 1% of the estimated number of potential irreversible adverse effects. Thus, no fatalities are expected among the general public, although 1 fatality could occur among noninvolved workers (1% of 110). If the frequency of this accident is assumed to be once in 100,000 years, the accident risk over the period 1999 through 2039 would be less than 1 (0.1) irreversible adverse health effect among workers and the general public combined. (DOE, 2004b, pp. 5-9 to 5-13)

Criticality Accident Involving Enriched Uranium

The HALEU deconversion facility would process enriched uranium whereas the facilities discussed above process DU. Consequently, an inadvertent nuclear criticality is a concern for a HALEU deconversion facility. The criticality accident analysis for the planned but canceled Eagle Rock Enrichment Facility (NRC, 2011c) is used as a surrogate for an inadvertent nuclear criticality in a HALEU deconversion facility. Preventative controls for a nuclear criticality accident would include maintaining a safe geometry of all vessels, containers, and equipment that contain fissile material and ensuring that the amount of such material in these vessels does not exceed set limits. Mitigative controls would include criticality monitoring and alarm systems and emergency response training.

For the criticality accident, a worker within a few feet of the event would likely be killed. A MEI at the controlled area boundary would receive a radiation dose of 0.57 rem total effective dose equivalent, which represents a low consequence to an individual (< 5 rem). The collective dose to the off-site population is estimated to be 451 person-rem. This population dose would cause an estimated 0.3 lifetime cancer fatalities, or less than one fatality. (NRC, 2011c, pp. 4-119)

Accident Impact Summary for HALEU Deconversion Facility

The HALEU deconversion facility could potentially be located at an enrichment site, a fuel fabrication facility, or at a site that does not currently have a deconversion facility. If located with one of these facilities, deconversion could occur within the existing facilities or new structures could be built. The annual production capacity of a HALEU deconversion facility would be less than the capacity of any of the existing facilities discussed above for deconverting depleted uranium. For criticality safety, the HALEU deconversion facility is required to process much smaller quantities of uranium than would be processed at the IIFP (Lea County, New Mexico), Portsmouth, or Paducah facilities. The use of safe-by-design components would prevent an inadvertent nuclear criticality. In addition, the proposed facility emergency plan would address all lower-risk, high-, and intermediate-consequence events. Through the combination of facility design, passive and active engineered controls (i.e., IROFS), administrative controls, and management of these controls, accidents at a deconversion facility would pose an acceptably low risk to workers, the environment, and the public.

Construction

Accidents during construction of a new HALEU deconversion facility are standard industrial hazards. Accidents from standard industrial hazards are not part of the accident analysis for a deconversion facility. Occupational hazards are addressed in Section 4.3.11, *Public and Occupational Health – Normal Operations*.

Operation

The consequences shown above are representative of the accident consequences at a HALEU deconversion facility. The accident scenarios for the HALEU deconversion facility include an inadvertent nuclear criticality, releases of uranium, and releases of hazardous chemicals.

Accident doses could be greater than the 25-rem total effective dose equivalent established by DOE as a guideline for assessing the adequacy of protection of public health and safety from potential accidents. The differences in accident consequences would primarily be due to differences in assumed worker exposure times and in site-specific parameters such as distances to receptors and population distribution. Because the DU deconversion facilities and the enrichment facility would be handling much larger quantities of material than a HALEU deconversion facility, the consequences of accidents in the HALEU deconversion facility would be expected to be similar to or less than the consequences reported above.

The criticality impacts and number of fissions are largely independent of material, enrichment, and configuration. Thus, LEU and HALEU would produce similar criticality impacts. An inadvertent nuclear criticality could be fatal to an involved worker, but the use of critically safe components would make a fatality highly unlikely. The MEI member of the public could receive a dose of less than 1 rem and the collective dose to the public could be on the order of 450 rem with 0.3 LCFs.

The impacts from release of hazardous chemicals could be high with persons experiencing both adverse effects and irreversible adverse effects. Fatalities among workers and the general public could occur as a result of an accidental hazardous material release. However, the risk to the operational staff and to the public from exposure to radioactive material and hazardous chemicals would be negligible with IROFS. Therefore, after consideration of accident consequence and frequency, accidents at a HALEU deconversion facility would be considered to have SMALL impacts.

4.3.13 Traffic

This section discusses potential traffic impacts on nearby roadways resulting from vehicles during construction, operation, and decommissioning of a proposed HALEU deconversion facility. The project would generate new vehicle trips during each phase of the project from trucks (transporting equipment, materials, supplies, and wastes) and personal vehicles of commuting workers. A vehicle trip is defined as a one-way trip movement; a round trip is defined as two vehicle trips. For purposes of the Technical Report, the focus of traffic impacts from a proposed HALEU deconversion facility is limited to the principal roadways leading up to the site.

The number of workers and truck transportation estimates presented in the Fluorine/DU EIS (NRC, 2012a) were used conservatively as an upper bound to analyze traffic impacts during the construction, operation, and decommissioning phases of a new deconversion facility as follows:

- As stated in Section 4.1.1.9 of the Fluorine/DU EIS, the peak number of construction workers on-site at any given time could be 140, which means approximately 140 daily vehicle round trips (or 280 vehicle trips per day) could be generated from personal vehicles. Additionally, 20 delivery or waste disposal trucks could be expected each day, for an additional 40 vehicle trips per day.

Therefore, total daily traffic volumes generated during construction could result in 160 vehicle round trips from combined truck and personal vehicles (or 320 vehicle trips per day).

- As stated in Section 4.1.2.9.1 of the Fluorine/DU EIS, approximately 140 staff personnel over 3 shifts per day could be employed during operation of a deconversion facility. Therefore, traffic volumes from personal vehicles could result in 140 daily round trips (or 280 vehicle trips per day).
- As stated in Section 4.1.2.9.1 of the Fluorine/DU EIS, nonradiological deliveries and waste removal could require 1,950 annual truck roundtrips (or 8 round trips per day, assuming 250 working days per year), for a total of 16 vehicle trips per day. As stated in Section 4.1.2.9.2 of the Fluorine/DU EIS, radiological transport could require approximately 479 annual truck roundtrips (or 2 truck round trips per day, assuming 250 working days in a year), for 4 vehicle trips per day.
- As such, the total combined daily vehicle trips generated by trucks (nonradiological and radiological trucks) and commuting workers during operation would total approximately 152 vehicle round trips (or 300 vehicle trips per day), which is similar to total traffic volumes estimated for construction.
- As discussed in Section 4.1.3 of the Fluorine/DU EIS, it was estimated that 40 employees would be required during decommissioning. Additionally, it was estimated that truck volumes would be similar to volumes occurring during the operation or construction phase.

As discussed in Section 4.1.3, *Potential Facilities*, a new commercial HALEU deconversion facility could be located with an enrichment facility or with a fuel fabrication facility, which are discussed in Section 3, *Uranium Enrichment* and Section 7, *HALEU Fuel Fabrication*, respectively; candidate sites for these facilities are identified in the respective section. As such, recent annual average daily traffic (AADT) data for public roadways near each candidate site was reviewed. AADT is a measure of the average daily number of vehicles that pass through a given segment of roadway and is indicative of traffic conditions (i.e., higher AADT volumes lead to increases in traffic congestion and delays). To evaluate potential traffic impacts, baseline AADT data was combined with project-related traffic volumes and compared against the operating capacities of the roadway segments. Table 4-6 summarizes the baseline traffic volumes and new traffic volumes during construction for the principal roadway segments serving each of the candidate sites. The table also includes design capacities for the roadway segments and estimates on the change in operating capacities of the roadways.

Table 4-6. Roadway Traffic and Design Capacity Volumes During Construction of a Proposed HALEU Deconversion Facility [(a)]

Roadway (Location of Segment)	*Number of Lanes*	*Daily Design Capacity [(b)] (vehicle trips per day)*	*Baseline AADT (vehicle trips per day)*	*New AADT [(c)] (vehicle trips per day)*	*Percent Increase in AADT*	*Percent of Design Capacity*
UUSA (Eunice, New Mexico) [(d)]						
SR-176 (between Main St and SR-18)	2	10,200	5,203	5,523	6%	54%
SR-176 (near project site)	2	19,000	4,801	5,121	7%	27%
SR-18 (between SR-207 and SR-176)	4	42,900	2,892	3,212	11%	7%
SR-18 (between SR-176 and SR-207)	4	42,900	7,104	7,424	5%	17%
Centrus (Piketon, Ohio) [(e)]						
US-23 (between SR-32 and project site)	4	42,900	15,425	15,745	2%	37%

Table 4-6. Roadway Traffic and Design Capacity Volumes During Construction of a Proposed HALEU Deconversion Facility [(a)]

Roadway (Location of Segment)	Number of Lanes	Daily Design Capacity [(b)] (vehicle trips per day)	Baseline AADT (vehicle trips per day)	New AADT [(c)] (vehicle trips per day)	Percent Increase in AADT	Percent of Design Capacity
US-23 (south of project site)	4	42,900	14,783	15,103	2%	35%
SR-32 (east of US-23)	4	42,900	9,348	9,668	3%	23%
SR-32 (west of US-23)	4	42,900	15,007	15,327	2%	36%
GNF-A (Wilmington, North Carolina) [(f)]						
Castle Hayne Road (north of I-140)	4	33,400	12,000	12,320	3%	38%
Castle Hayne Road (south of I-140)	4	33,400	14,000	14,320	2%	44%
I-140 (west of Castle Hayne Road)	4	52,200	23,500	23,820	1%	46%
I-140 (east of Castle Hayne Road)	4	52,200	26,500	26,820	1%	51%
Framatome (Richland, Washington) [(g)]						
Horn Rapids Road (west of Stevens Dr)	2	13,900	2,471	2,791	13%	20%
Stevens Drive (south of Battelle Blvd)	6	44,600	13,910	14,230	2%	32%
SR-240 (Jadwin Ave intersection, southwest alignment)	6	56,100	30,570	30,890	1%	55%
SR-240 (Jadwin Ave intersection, northwest alignment)	2	22,100	16,334	16,654	2%	75%
Kingsgate Way (north of SR-240)	2	8,600	3,930	4,250	8%	49%
Westinghouse Electric (Columbia, South Carolina) [(h)]						
SR-48 (north of project site)	2	13,900	7,500	7,820	4%	56%
SR-48 (south of project site)	2	13,900	4,900	5,220	7%	38%
Nuclear Fuel Services (Erwin, Tennessee) [(i)]						
Carolina Ave (north of Jones Rd)	2	9,300	2,310	2,630	14%	51%
Jackson Love Highway (north of Washington St)	2	10,200	4,851	5,171	7%	61%
Jackson Love Highway (west of Carolina Ave)	2	10,200	6,909	7,229	5%	85%
BWXT (Lynchburg, Virginia) [(j)]						
SR-726 (near project site)	2	13,900	5,600	5,920	6%	69%
US-460 (east of SR-726)	4	53,300	23,000	23,320	1%	54%
US-460 (west of SR-726)	4	53,300	27,000	27,320	1%	64%
X-energy / TRISO-X and Ultra Safe Nuclear Corporation (Oak Ridge, Tennessee) [(k)]						
SR-95 (near New Bedford	4	53,300	19,485	19,805	2%	46%

Table 4-6. Roadway Traffic and Design Capacity Volumes During Construction of a Proposed HALEU Deconversion Facility [(a)]

Roadway (Location of Segment)	Number of Lanes	Daily Design Capacity [(b)] (vehicle trips per day)	Baseline AADT (vehicle trips per day)	New AADT [(c)] (vehicle trips per day)	Percent Increase in AADT	Percent of Design Capacity
Ln)						
SR-95 (near project site)	4	53,300	11,593	11,913	3%	28%
SR-95 (Whipp Rd, near Bear Creek crossing)	2	13,900	6,234	6,554	5%	76%
SR-58 (near the project site)	4	53,300	12,560	12,880	3%	30%

Key: % = percent; AADT = average annual daily traffic; Ave = Avenue; Blvd = Boulevard; BWXT = BWX Technologies, Inc.; con = construction phase; Dr = Drive; GNF-A = Global Nuclear Fuel – Americas; HALEU = high-assay low-enriched uranium; Ln = Lane; ops = operation phase; Rd = Road; SR = State Route; St = Street; US = U.S. Highway; UUSA = Urenco USA

Notes:

a Candidate site locations for a proposed HALEU deconversion facility include candidate sites for a proposed HALEU enrichment facility and fuel fabrication facility.

b These values are taken from the U.S. Department of Transportation's "Simplified Highway Capacity Calculation Method for the Highway Performance Monitoring System" (USDOT, 2017) and represent the maximum daily traffic volumes that can be maintained and still be within the level of service "C."

c For construction, New AADT = Baseline AADT + 320 construction vehicle trips per day.

d Source of Baseline AADT for Eunice, New Mexico: (NMDOT, 2023)

e Source of Baseline AADT for Piketon, Ohio: (ODOT, 2023)

f Source of Baseline AADT for Wilmington, North Carolina: (NCDOT, 2023a)

g Source of Baseline AADT for Richland, Washington: (WSDOT, 2023; City of Richland, 2023)

h Source of Baseline AADT for Columbia, South Carolina: (SCDOT, 2023)

i Source of Baseline AADT for Erwin, Tennessee: (TDOT, 2023)

j Source of Baseline AADT for Lynchburg, Virginia: (VDOT, 2019)

k Source of Baseline AADT for Oak Ridge, Tennessee: (TDOT, 2023)

The "Daily Design Capacity" values presented in Table 4-6 are based on estimates provided in the U.S. Department of Transportation's "Simplified Highway Capacity Calculation Method for the Highway Performance Monitoring System" and represent the maximum daily traffic volumes that can be maintained and still be within an acceptable level of service (LOS). LOS is qualitative measure of a roadway and is designated with a letter, A to F, with A representing the best operating conditions and F the worst. Most engineering or planning efforts usually base design capacities at an LOS of C or D to ensure an acceptable operating service for users. For a more conservative analysis, the "Daily Design Capacity" values in Table 4-6 are based on an LOS of C. An LOS of C typically means that a roadway is operating under stable conditions and is at or near free flow (Transportation Research Board, 1994).

The "New AADT" estimates presented in Table 4-6 represent baseline AADT volumes combined with additional traffic volumes from project-related vehicles occurring during construction. Incremental increases in traffic volumes during operation would be similar to those estimated for construction and, therefore, are not included in the table (total daily traffic volumes during construction and operation would be 320 and 302, respectively). The additional traffic volumes from the project would result in increased roadway congestion, delays, and safety hazards, especially during peak morning and evening commuting hours. An increase in roadway maintenance could also be required as increases in traffic volumes would deteriorate road surface conditions at a faster rate.

Table 4-6 shows that most of the roadways would experience relatively low increases in daily traffic volumes. It is expected that the "New AADT" volumes would be within the "Daily Design Capacity" volumes of these roadways as long as baseline AADT volumes do not substantially increase. Vehicles on roadway segments that are near or at the "Daily Design Capacity" (e.g., State Route 240 in Richland, Washington, and Jackson Love Highway in Erwin, Tennessee) would likely detect noticeable increases in congestion and delays during the peak commute hours.

The Fluorine/DU EIS for the IIFP concluded that impacts on traffic during construction and operations would be SMALL as the total number of daily vehicles would be within the design capacities of the principal local highways that would be serving the project. The DOE EISs for the Portsmouth and Paducah facilities (DOE, 2004b; DOE, 2004c) did not analyze traffic impacts on local roadways.

Because the total daily traffic volumes would not exceed "Daily Design Capacity" volumes as indicated in Table 4-6, it is expected that the level of traffic impacts at all of the candidate sites for a proposed HALEU deconversion facility at a proposed HALEU enrichment facility or fuel fabrication facility would be SMALL during construction and operation. It is assumed that during decommissioning, the maximum labor force at any given time would be considerably lower than the labor force required for construction or operation; additionally, truck traffic during decommissioning would also be comparable to estimates made for the construction and operation phases. Therefore, it is expected that the level of traffic impacts during decommissioning would also be SMALL, as long as baseline traffic conditions remain does not change (i.e., no substantial increases in AADT volumes over the years).

Construction and operation of a HALEU deconversion facility could also occur at another industrial (brownfield) site or at an undeveloped (greenfield) site, which would also generate similar increases in traffic volumes from commuting workers and truck shipments of equipment, supplies, materials, and waste. Although the intensity of impacts would depend on the baseline traffic conditions of the roadways leading up to the proposed site (e.g., existing AADT volumes), it is expected that potential traffic impacts would be SMALL since siting criteria would include an evaluation of roadway conditions to confirm sufficient roadway capacities.

As the schedule progresses closer to final site selection, siting for a new HALEU deconversion facility would have to take into greater consideration additional activities that provide a more accurate representation of existing and future traffic conditions, especially if it would be co-located with a new HALEU enrichment facility or a fuel fabrication facility as both could result in substantial increases in traffic volumes for the construction and operation phases of these facilities. As shown in Table 4-6, a few of the roadway segments would be operating at 75% or greater of their daily handling capacity and would require detailed traffic analyses and mitigation measures.

In addition to the combined traffic volumes from co-locating proposed HALEU facilities, other activities and factors needing consideration in a traffic analysis include, but are not limited to, expanding the ROI to include additional roadways that encompass primary truck and commuter routes; reviewing the weight and size restrictions along potential truck routes; projecting traffic volumes to the years of construction, operation, and decommissioning; and reviewing local and regional land development and transportation projects that could directly impact relevant roadways. Additionally, any project-related traffic study and findings should be coordinated with local, county, and state transportation departments.

4.3.14 Socioeconomics

Major industrial projects have the potential to affect the socioeconomic dynamics of the communities around or in which they are situated. Capital expenditures and the migration of workers and their families into a community may influence factors such as regional income; employment levels; local tax revenue; housing availability; and area community services such as healthcare, schools, and public safety. The Proposed Action includes potential construction and operation of a new HALEU deconversion facility at a site to be determined but which could include enrichment facility sites and fuel fabrication facility sites, as described in Section 3, *Uranium Enrichment*, and Section 7, *HALEU Fuel Fabrication*, respectively. Both sets of sites have been characterized with respect to socioeconomic conditions found within each site's ROI (see Section 3.3.14, *Socioeconomics*, for enrichment sites and Section 7.3.14, *Socioeconomics*, for fuel fabrications sites). The NEPA documents related to those sites are referenced in the applicable sections.

The ROI for each site is defined as a multi-county region encompassing the area where the majority of proposed workers for HALEU fuel fabrication would be expected to reside and spend most of their salary, where project impacts on public services (e.g., housing, education, medical care, and public safety) would most likely occur, and in which a significant portion of site purchase and non-payroll expenditures from the construction, operation, and decommissioning phases of the Proposed Action are expected to take place.

This section evaluates the proposed impacts from construction and operation of a new HALEU deconversion facility; it relies on, and incorporates by reference where appropriate, assumptions and/or evaluations found in three related NEPA documents, including the NRC's Fluorine/DU EIS for a deconversion facility in Lea County, New Mexico (NRC, 2012a); and two related DOE EISs for construction and operation of DUF_6 conversion facilities (DOE, 2004b; DOE, 2004c). Note that the Portsmouth site is also being considered for a potential HALEU enrichment site and DOE is using these currently operating facilities to convert its inventory of DUF_6 to forms suitable for beneficial use or disposal, as part of DOE's environmental cleanup activities at each site.

The socioeconomic impacts of constructing and operating a 3,400-MT/yr UF_6 deconversion facility were analyzed in the Fluorine/DU EIS (NRC, 2012a) for the IIFP FEP and DU deconversion plant in Lea County, New Mexico, and many of the assumptions and findings in that EIS, as summarized hereafter, are applicable to a HALEU deconversion facility. The information is pulled from Fluorine/DU EIS Section 3.9, Section 4.1.1.8, and Section 4.1.2.8.

Changes in population are the key driver of impacts on socioeconomics, and the variables characterized in the Fluorine/DU EIS include population (demography), employment and income, taxes and revenue, housing, and community services (e.g., education, health, and public safety). Two items of note regarding the evaluation of socioeconomic impacts in that EIS:

- The scale of uranium deconversion is significantly higher than that being evaluated for HALEU (3,400 MT DUF_6/yr versus 38 MT DUF_6/yr).
- The ROI described in the Fluorine/DU EIS (NRC, 2012a) for the IIFP deconversion facility in Lea County, New Mexico, is slightly different than the one described for the HALEU enrichment facility in Section 3, *Uranium Enrichment*, based on the description in the 2015 NRC Environmental Assessment (Urenco USA enrichment site Environmental Assessment), even though both are located within a few miles of each other in the same host county, Lea County (NRC, 2015).

Both documents identify expanded ROIs that include essentially the same counties in New Mexico and Texas; however, the Fluorine/DU EIS includes an additional county, Eddy County, and focuses the analysis primarily on just the two New Mexico counties—Lea and Eddy—which are expected to be the most directly affected based on historic workforce housing and commuting patterns in the area. This adjustment appears rational and applicable to an ROI for a HALEU deconversion facility in Lea County, and therefore is considered in this analysis. The basis for this two-county ROI as explained in Section 3.9 and Appendix D of the Fluorine/DU EIS (NRC, 2012a) is as follows: The NRC typically considers counties or a large population center within a 50-mile radius of the site to help define the ROI, which is assumed to be a reasonable commuting distance. A more detailed study of commuting patterns of working residents inside and outside of Lea County and the general proximity of the Waste Isolation Plant in Carlsbad, New Mexico (approximately 50 miles away), which offered additional residents with the appropriate skill set for the IIFP facility, led the NRC to assume that most of the IIFP workforce would come from Lea or Eddy Counties. These two counties were assumed to most likely incur population increases due to the Proposed Action, and the Texas counties were assumed to be unaffected in terms of socioeconomic variables. The NRC staff further assumed that the majority of impacts would be expected to occur in the host county, Lea County, because of its population characteristics, commuting patterns, and amenities. A brief profile of this modified ROI is provided to help understand the results of the impact analysis for the IIFP deconversion facility in the Fluorine/DU EIS.

The 2022 populations for Lea and Eddy Counties, New Mexico, were 72,452 and 60,500, respectively. The Eddy County population grew by nearly 16% between 2010 and 2020 (from 53,829 to 62,314) but saw a decline of 3.1% between 2020 and 2022. Similarly, the Lea County population grew by 15% between 2010 and 2020 (from 64,727 to 74,455), but then declined by 2.7% between 2020 and 2022. County densities were less than 20 persons per square mile in 2020 (17 for Lea County and 14.7 for Eddy County) (USCB, 2023a). According to the Fluorine/DU EIS (NRC, 2012a), the city of Hobbs, New Mexico, was the largest city in southwestern New Mexico and serves as a commercial center for the population within 25 miles of the site; the population of Hobbs in 2020 was 40,508. Other incorporated communities in the county include Eunice (site of potential HALEU enrichment facility), Jal, and Tatum. Carlsbad, the county seat in Eddy County, is the largest city in the county with approximately half of the county population (30,888 in 2020). Other incorporated communities in Eddy County include Artesia, Hope, and Loving. Historically, the population growth rates in the ROI counties have generally lagged the growth rate of New Mexico.

A major employer in the ROI is DOE's Waste Isolation Plant in Eddy County; nearly 600 individuals were employed at the facility in 2008, according to the Fluorine/DU EIS. The unemployment rate in the ROI has consistently remained below the unemployment rate in the state. A variety of types, prices, and settings comprise the housing inventory in the ROI; Lea and Eddy Counties had a total of 28,071 and 26,821 in 2021, respectively. Both counties had similar owner-occupied housing unit rates of 70.6% (Eddy) and 68.4% (Lea) in 2021 (average 2017 to 2021) (USCB, 2023c). Mobile homes accounted for 17% and 14% of the housing in Lea and Eddy Counties, respectively (NRC, 2012a).

Impacts

The major factor influencing socioeconomic impacts of construction and operation of a deconversion facility is the number of construction and operation workers who would relocate to the area with their families. The workforce requirements and assumptions regarding how many would be expected to already reside in the ROI versus how many would in-migrate to the ROI were described in detail for the IIFP deconversion facility (Fluorine/DU EIS Sections 4.1.1.8 and 4.1.2.8 and Appendix D, Tables D-8, Construction, and D-9, Operation) (NRC, 2012a), and for DOE's Portsmouth and Paducah facilities in the DOE EISs (DOE, 2004b; DOE, 2004c); they are summarized hereafter.

Deconversion Facility Workforce Requirements

Construction (Assumptions from the Fluorine/DU EIS):

- 140 workers, 80% of which would be expected to reside within the ROI
- 20%, or 28 workers, would in-migrate to the ROI, including family members
- 70% of the construction workers (20 workers) would bring their families, and assuming 3.23 persons per household (average for New Mexico in 2010), this would result in a population influx of 72 persons into the ROI, including 16 school-age children (assumes 0.8 children per family per U.S. Census data) and a demand of 20 housing units (one unit per family); note that the average persons per household has decreased to 2.6 on average between 2017 to 2022 (USCB, 2023a)

- 12 indirect jobs would result from in-migrating workforce (28 times 0.4324 multiplier for construction)

Operation (Assumptions from the Fluorine/DU EIS):

- 140 workers, 80% of which would reside in the ROI, and 20% (28 workers) would in-migrate, with all workers brining their families (100%); assuming the same number per household (3.23 in 2009), this would result in an influx of 90 persons, including 22 school-age children and a demand for 28 housing units (one per family)
- 51 indirect jobs resulting from in-migrating workforce (28 times 1.8173 multiplier for operations)

Construction and operation assumptions for deconversion facilities at DOE's Paducah and Portsmouth sites (DOE, 2004b; DOE, 2004c) were slightly higher and used different assumptions to calculate the indirect worker totals. This is likely due, in part, to the higher production levels evaluated at these facilities (compared to the 3,400 MT DUF_6 per year evaluated in the Fluorine/DU EIS). Specifically, the Portsmouth EIS evaluated the conversion of 13,500 MT of DUF_6 per year, and the Paducah EIS evaluated the conversion of 18,000 MT of DUF_6 per year. The construction and operations workforce requirements and assumptions are summarized hereafter.

Construction and Operation (Assumptions from the DOE's Paducah and Portsmouth EISs):

- For construction: 190 direct jobs, 100 indirect jobs, for a total of 290 jobs; this would result in a total population influx of 290 persons and a need for 100 housing units.
- For operation: 160 direct workers and 170 indirect workers, for a total of 330 workers, resulting in an influx of 220 new persons and demand for 80 housing units.

The two sets of estimates are not significantly different, but the Leidos Team is basing this analysis in the Technical Report on the IIFP estimates, given they were developed for a smaller deconversion facility and are more recent. The slightly smaller workforce estimates seem more reasonable, given the significantly smaller scale of processing projected for the HALEU deconversion facility (compared to the IIFP facility). Under the action alternatives in both of these EISs, jobs and income would be generated during both construction and operation. No significant impacts, and only minor impacts on regional growth and housing, local finances, and public service employment in the ROI were expected at the Portsmouth and Paducah sites, respectively.

Given the small workforce requirements and resulting population influx associated with both construction (72 workers) and operation (90 workers) activities, the NRC concluded that the potential impacts within the ROI from the IIFP facility would be minimal—representing a 0.06% increase in the ROI population in 2010. The impacts on employment, housing inventories or vacancies, schools, and public services were considered SMALL. Regarding employment, the NRC indicated that the IIFP facility was selected in part because local colleges and universities have existing training programs in partnership with the nearby UUSA centrifuge facility. Such institutions may also be available at other industrial sites being considered for a deconversion facility, given the extent of uranium fuel cycle activities conducted there.

The regional economy also would benefit from the capital investment, expenditures, recurring costs, and increased tax revenues associated with operation of the IIFP facility.

Regarding the proposed HALEU deconversion facility, potential impacts from this facility—whether it be located at one of the enrichment facility sites or fuel fabrication sites (described in Section 3, *Uranium Enrichment*, and Section 7, *HALEU Fuel Fabrication*)—would be expected to be similar to those identified in the Fluorine/DU EIS. Therefore, given the small in-migrating population expected to move into the area, and the fact that all the potential sites are well-established industrial sites—many with a long history of operating in the area with a seasoned existing workforce that has experience in nuclear activities—the socioeconomic impacts associated with a HALEU deconversion facility would be expected to be SMALL in the ROI. In addition, the economic impacts (e.g., increased jobs, income, and tax revenues) would be considered beneficial to the local and regional economy. However, if a larger-than-analyzed workforce moved into the ROI and settled in rural counties with low population numbers and densities, potential impacts may be SMALL to MODERATE. Adverse effects would be felt locally in the areas of housing (availability) and community services (e.g., education, medical, fire, and police resources). At the same time, the corresponding increases in income, spending, and tax revenues that would result from a larger workforce would help benefit the local economy, and the increased revenues could be used to enhance existing public services that may be deficient.

With respect to potential impacts should the deconversion facility be constructed at another industrial site or a greenfield site, the construction and operations workforce requirements would not be expected to change greatly as they would not be expected to be dependent on the location of the facility. While a greenfield location may require a slightly larger construction workforce related to new or expanded infrastructure needs (e.g., to connect to existing nearby facilities), the numbers would not be expected to exceed the upper construction workforce estimates analyzed in previous NEPA documents where potential socioeconomic impacts within the region of influence were determined to be minor or SMALL. Similarly, the potential beneficial socioeconomic impacts (e.g., creation of jobs and income and tax revenues) would also be expected for any HALEU deconversion site, regardless of location. The potential for adverse socioeconomic impacts on local or regional housing and community services would depend on existing population and employment levels, housing inventories, etc. within a region of influence for another brownfield or greenfield site, and the percentage of workers (and number of family members) that would be expected to in-migrate to the area. Potential impacts could be SMALL to MODERATE, depending on the number and distribution of an in-migrating population within the region of influence. In general, potential impacts would be greater (MODERATE) on local communities with small populations where an in-migrating population might tend to concentrate. The more rural region of influence analyzed in the Fluorine/DU EIS rural location would be expected to provide an upper bound for impacts that could occur at another industrial or greenfield site location. However, site-specific analysis of potential impacts on socioeconomic resources is deferred to subsequent NEPA analysis prepared by the NRC once a site has been selected and a design developed.

4.3.15 Environmental Justice

At this stage in project development, the location of the deconversion facility is not known. A potential deconversion facility could be located at a HALEU enrichment facility, a fuel fabrication facility, or elsewhere. Impacts relating to environmental justice for the potential enrichment facilities are described in Section 3, *Uranium Enrichment*, and the potential fuel fabrication facilities are described in Section 7, *HALEU Fuel Fabrication*.

Since the HALEU deconversion facility location is not known, a preliminary analysis on the types of construction and operation impacts that might be anticipated to occur to environmental justice populations in the vicinity of the facility are described hereafter. Environmental consequences that are dependent on final locations and site-specific designs are only mentioned in general terms. For facilities that have environmental justice populations within 4 miles, detailed site-specific analyses would be required in NRC NEPA documents prepared once facility design plans are developed.

Construction

Minority and low-income populations could be directly or indirectly affected by the construction of a deconversion facility. For example, construction of a deconversion facility in an urban area with minority or low-income populations proximate to the construction site could increase exposure to dust and other particulates related to land disturbance and construction. Increased demand for rental housing during construction could disproportionately affect low-income populations. However, demand for rental housing could be mitigated if the facility is constructed near a metropolitan area. Construction would also create employment opportunities for minority and low-income individuals. Construction could affect minority and low-income populations residing in the vicinity of the site from increased air emissions, noise, and truck and construction worker traffic. These impacts would be temporary and only occur for the duration of construction.

Existing NEPA documentation from a site with an existing deconversion plant or with processes similar to deconversion describe impacts from similar to much larger construction projects. The EISs selected and described below help to bound impacts from construction of the deconversion facility. The Fluorine/DU EIS for the IIFP FEP and DUF_6 deconversion plant in Lea County, New Mexico (NRC, 2012a, pp. 4-18 to 4-19), notes the following impacts related to construction activities.

- Site preparation and construction are projected to result in SMALL to MODERATE impacts and would be localized. The nearest minority or low-income population identified is 14 miles from the proposed site. The NRC staff concluded that because potential impacts to all resource areas would be SMALL or MODERATE and localized, and the identified minority and low-income populations are not located close to the proposed site, impacts would be SMALL for any populations in the region and not be disproportionately high and adverse for minority or low-income populations.

The Paducah DU EIS (DOE, 2004c, pp. 5-42) notes the following impacts related to construction activities:

- Despite the presence of disproportionately high percentages of both minority and low-income populations within 50 miles (80 km) of the site, no environmental justice impacts from constructing a conversion facility at the Paducah site are anticipated. Similarly, no evidence indicates that minority or low-income populations would experience adverse impacts from the proposed construction in the absence of such impacts in the population as a whole.

The Portsmouth DU EIS (DOE, 2004b, pp. 5-59) notes the following impacts related to construction activities:

- Despite the presence of disproportionately high percentages of both minority and low-income populations within 50 miles (80 km) of the site, no environmental justice impacts from constructing the deconversion facility at the Portsmouth site are anticipated. Similarly, no evidence indicates that minority or low-income populations would experience adverse impacts from the proposed construction in the absence of such impacts in the population as a whole.

Impacts associated with the construction of a HALEU deconversion facility would be anticipated to be less than those associated with constructing a facility similar to the IIFP FEP and DUF_6 deconversion plant in Lea County, New Mexico or the DUF_6 deconversion plants at the Paducah or Portsmouth sites, as the construction footprint is anticipated to be less than the footprint for those facilities. However, site-specific analysis would need to be conducted to make a final determination of impacts.

Operation

Minority and low-income populations could be directly or indirectly affected by the operation of a new deconversion facility. Existing NEPA documentation from a site with an existing deconversion plant or with processes similar to deconversion describe impacts associated with operations of these facilities. Impacts from the HALEU deconversion would be anticipated to be less than the facility operations described in these NEPA documents. However, detailed site-specific analyses would still need to occur to determine impacts for environmental justice communities in the vicinity of the final deconversion location.

The Fluorine/DU EIS for the IIFP FEP and DU deconversion plant in Lea County, New Mexico (NRC, 2012a, pp. 4-34), notes the following impacts related to operation:

- The NRC staff finds that the impacts of IIFP operation would be SMALL for most resources and SMALL to MODERATE for air quality and in some cases, beneficial. Furthermore, the nearest minority or low-income population is 14 miles from the proposed facility. Therefore, because all resource area impacts are SMALL or SMALL to MODERATE, and the identified minority and low-income populations are not close to the proposed site, the NRC staff finds that impacts would not be considered disproportionately high and adverse to any population, including low-income or minority populations.

The Paducah DU EIS (DOE, 2004c, pp. 5-72 to 5-73) notes the following impacts related to operations:

- Despite the presence of disproportionately high percentages of both minority and low-income populations within 50 miles (80 km) of the Paducah site, no environmental justice impacts are anticipated at any of the three alternative locations because of the lack of high and adverse impacts. Similarly, no evidence exists indicating that minority or low-income populations would experience high and adverse impacts from operating the proposed facility in the absence of such impacts in the population as a whole.

The Portsmouth DU EIS (DOE, 2004b, pp. 5-90) notes the following impacts related to operations:

- Despite the presence of disproportionately high percentages of both minority and low-income populations within 50 miles (80 km) of the Portsmouth site, no environmental justice impacts are anticipated at any of the three alternative locations because of the lack of high and adverse impacts. Similarly, no evidence exists indicating that minority or low-income populations would experience high and adverse impacts from operating the proposed facility in the absence of such impacts in the population as a whole.

In summary, although minority and low-income populations are present within 50 miles of the Lea County, New Mexico; Paducah, Kentucky; and Portsmouth, Ohio, sites, construction and operation of the proposed DUF_6 deconversion facilities at these locations were not expected to result in disproportionately high and adverse effects to minority and low-income populations. Impacts for construction and operations would be SMALL to MODERATE (MODERATE impacts relate to associated impacts on air quality) for existing facilities. Based on this, construction and operations of a HALEU deconversion facility at the HALEU enrichment and fuel fabrication facility sites would be expected to have no disproportionate and adverse effects to minority and low-income populations. However, site-specific analysis would need to be conducted to make a final determination of impacts. If the proposed deconversion facility is constructed and operated on a brownfield or greenfield site, site-specific environmental justice analysis would be required to determine the potential effect.

4.4 Summary of Impacts for Deconversion

For each of the resource areas discussed above, impact indicators have been identified. Table 4-7 summarizes the impacts associated with each indicator for the identified facilities and the overall impact for a HALEU deconversion facility.

Table 4-7. Summary of Impacts for Uranium Hexafluoride Deconversion Facilities

Resource Area	***Impact Indicator***	***Existing NEPA***			***New HALEU UF_6 Deconversion Facility***
		IIFP DUF_6 Deconversion Facility Lea County, NM (NRC, 2012a)	***Paducah DUF_6 Deconversion Facility Paducah, KY (DOE, 2004c)***	***Portsmouth DUF_6 Deconversion Facility Portsmouth, OH (DOE, 2004b)***	
General	***Annual Production***	***3,400 MT DUF_6***	***13,500 MT DUF_6***	***18,000 MT DUF_6***	***38 MT HALEU UF_6***
Land Use	Developed/Disturbed Area	40 acres developed	45 acres (p. S-19, 2-8)	65 acres (p. S-21, p. 2-9)	SMALL – Land disturbance would alter the physical layout of the site and exclude previous land uses, such as agriculture, grazing, or other industrial uses. Future land use on or near the facility may be restricted due to potential radiological and chemical contamination. Potential impacts on land use can be mitigated through careful planning, site selection, construction practices, and operation procedures, including strict adherence to safety and environmental regulations.
	Site Size	640 acres	Not addressed	3,714 acres (p. 3-15)	
	Compatible with land use plans and zoning	Construction restricted grazing on existing land but was moved to nearby developed land.	Yes; Consistent with heavily industrialized land use (p. 5-57).	Yes; Consistent with heavily industrialized land use (p. 5-40).	
	Impact	SMALL	SMALL	SMALL	
Visual & Scenic Resources	Tallest Substantial Structure	21.3 m (70 feet) (p. 3-7)	Not considered	Not considered	SMALL – Facility construction would introduce new structures along with security fencing and lighting along the perimeter and a parking lot. The facility could alter the landscape
	Distance to Nearest Full-Time Residence	1.6 miles (2.6 km)	0.8 miles (1.3 km)	0.6 miles (0.9 km)	
	BLM VRM Rating	Class IV – Lowest	Not considered	Not considered	
	Impact	SMALL	Not assessed	Not assessed	

Table 4-7. Summary of Impacts for Uranium Hexafluoride Deconversion Facilities

Resource Area	*Impact Indicator*	*Existing NEPA*			*New HALEU UF_6 Deconversion Facility*
		IIFP DUF_6 Deconversion Facility Lea County, NM (NRC, 2012a)	*Paducah DUF_6 Deconversion Facility Paducah, KY (DOE, 2004c)*	*Portsmouth DUF_6 Deconversion Facility Portsmouth, OH (DOE, 2004b)*	
					especially if the area is currently undeveloped or predominantly natural. It is assumed construction would occur in an area with low scenic quality, so there would not be a high contrast with the surrounding landscape.
Geology and Soils	Disturbed Area	40 acres (p. 4-9)	45 acres (p. 2-11)	65 acres (p. 5-42)	SMALL – Potential impacts include disturbance of up to 65 acres of previously disturbed soils, soil erosion due to ground disturbance, and the potential for spills due to construction and operations. Implementation of BMPs for erosion control and spill prevention would limit impacts.
	Rock and Soil Excavated	42,400 yd^3 (p. 2-11)	No significant changes to topography. Small amounts of contaminated soil excavated. (pp. 5-28, 5-29)	No significant changes to topography. Small amounts of contaminated soil excavated. (p. 5-49)	
	Backfill Needed	200 yd^3 (p. 2-11)	Not provided	Not provided	
	Impact	SMALL	Not provided	Not provided	
Water Resources	Effluent Discharge	No permanent surface waters occur on-site. The facility would not discharge industrial effluents to surface waters. Stormwater	Effluent discharges are regulated and monitored under KPDES permits. Approximately 4,000 gpd (15,140 L/day) of wastewater would be	Effluent discharges are regulated and monitored under NPDES permits. Approximately 4,000 gpd (15,140 L/day) of sanitary wastewater	Discharges would be regulated and monitored in accordance with all necessary permits. BMPs would limit impacts on waters resulting from effluent discharges, but

Table 4-7. Summary of Impacts for Uranium Hexafluoride Deconversion Facilities

Resource Area	Impact Indicator	Existing NEPA			New HALEU UF_6 Deconversion Facility
		IIFP DUF_6 Deconversion Facility Lea County, NM (NRC, 2012a)	Paducah DUF_6 Deconversion Facility Paducah, KY (DOE, 2004c)	Portsmouth DUF_6 Deconversion Facility Portsmouth, OH (DOE, 2004b)	
		discharges would be permitted (p. 4-12).	produced during construction (p. 5-28). Approximately 35,000 gpd of wastewater would be produced during operations (p. 5-65).	would be produced during construction. No sanitary wastewater would be discharged to the environment (p. 5-48). Approximately 4,000 to 8,000 gpd (15,140 to 30,280 L/day) of sanitary wastewater would be produced during operations, as well as about 26,000 gpd (98,500 L/day) of process wastewater. An additional 36,000 gpd (136,300 L/day) of wastewater would be produced if HF neutralization was required (p. 5-82).	decreases in water quality resulting from erosion, sedimentation, and spills or leaks may occur.
	Water Use	Groundwater. Water use during construction was projected to average 3,600 L/day (960 gpd), up to 12,500 L/day (3,300 gpd) maximum (p. 4-10).	Surface water. Peak water use during construction was estimated at 5,500 gpd (20,800 L/day) (p. 5-27). Operational water use was estimated at 40	Water is supplied by off-site water-supply well fields (p. 5-48). Operation water needs would be satisfied by groundwater (p. 5-83). Peak water consumption during	Increased water use may tax local water sources and impact other nearby users. Anticipated water usage during construction and operation would be calculated and weighed against the existing

Table 4-7. Summary of Impacts for Uranium Hexafluoride Deconversion Facilities

Resource Area	***Impact Indicator***	***Existing NEPA***			***New HALEU UF_6 Deconversion Facility***
		IIFP DUF_6 Deconversion Facility Lea County, NM (NRC, 2012a)	***Paducah DUF_6 Deconversion Facility Paducah, KY (DOE, 2004c)***	***Portsmouth DUF_6 Deconversion Facility Portsmouth, OH (DOE, 2004b)***	
		Average operational water use was estimated at 7.9 L/min (2.1 gpm) to 11.8 L/min (3.1 gpm) up to 26.3 L/min (6.95 gpm) maximum (p. 4-31).	million gallons/year (151.4 million L/year) (p. 5-65).	construction was estimated at 5,500 gpd (20,800 L/day) (p. 5-48). Peak operational water consumption was estimated at 34.1 million gallons per year (167 million L/year) (p. 5-83).	capacity of the region's water supplies.
	Floodplains	No FEMA floodplains on-site (p. 3-44).	No 100-year floodplain on-site (p. 3-15).	100-year floodplains exist in the vicinity of the site, but outside the area surrounded by Perimeter Road, in which development occurs (p. 3-19).	Possibility of floodplain impacts would be site specific.
	Impact	SMALL	SMALL (negligible impacts on surface waters and no direct impacts on groundwater)	SMALL (negligible impacts on surface waters and no direct impacts on groundwater)	SMALL
Air Quality	NAAQS Attainment Status	Attainment of all NAAQS	Attainment of all NAAQS	Attainment of all NAAQS	SMALL with effective implementation of fugitive dust control measures during construction and adherence to applicable
	Construction Emissions	MODERATE for NO_2, PM_{10}, and $PM_{2.5}$ emissions and SMALL for all other emissions	Exceedances of PM_{10} and $PM_{2.5}$ NAAQS	Exceedances of PM_{10} and $PM_{2.5}$ NAAQS	

Table 4-7. Summary of Impacts for Uranium Hexafluoride Deconversion Facilities

Resource Area	***Impact Indicator***	***Existing NEPA***			***New HALEU UF_6 Deconversion Facility***
		IIFP DUF_6 Deconversion Facility Lea County, NM (NRC, 2012a)	***Paducah DUF_6 Deconversion Facility Paducah, KY (DOE, 2004c)***	***Portsmouth DUF_6 Deconversion Facility Portsmouth, OH (DOE, 2004b)***	
	Operations Emissions	Complies with NAAQS	Complies with NAAQS	Exceedances of $PM_{2.5}$ NAAQS	permit conditions during operations.
	Emergency Generator Emissions	Yes	Yes	Yes	
	GHG Emissions	1,303 MT	Not considered	Not considered	
	Impact	SMALL to MODERATE	No determination	No determination	
Ecological Resources	Native Vegetation Disturbed	Yes	Yes	Yes	SMALL to MODERATE – impacts on ecological resources would be dependent on the resources disturbed and mitigation and the minimization measures employed. NEPA analysis will be required to determine the site-specific impacts.
	Aquatic Habitat Disturbed	No	Yes	Yes	
	Wildlife Habitat Disturbed	No	No	No	
	Protected Species Present	No	Yes	Yes	
	Impact	SMALL	SMALL (DOE, 2020)	SMALL (DOE, 2020)	
Historic and Cultural Resources	NRHP Property Disturbed	None known	101 historic properties identified inside the security fencing, contributing to an NRHP-eligible historic district.	Three prehistoric and two historic era archaeological sites are NRHP eligible. Thirty-three Portsmouth buildings are NRHP eligible.	Impacts could occur if known NRHP-eligible cultural resources are in the area of potential effects.
	TCP Present	None known	None known	None known	None known
	Other Known Resources Disturbed	None known	Existing disturbance greatly reduces the likelihood of finding	Impacts could occur if ground disturbance resulted in the discovery of previously	Impacts could occur if ground disturbance resulted in the discovery of previously unrecorded

Table 4-7. Summary of Impacts for Uranium Hexafluoride Deconversion Facilities

Resource Area	Impact Indicator	Existing NEPA			New HALEU UF_6 Deconversion Facility
		IIFP DUF_6 Deconversion Facility Lea County, NM (NRC, 2012a)	Paducah DUF_6 Deconversion Facility Paducah, KY (DOE, 2004c)	Portsmouth DUF_6 Deconversion Facility Portsmouth, OH (DOE, 2004b)	
			any cultural resources with intact integrity.	unrecorded NRHP-eligible cultural resources.	NRHP-eligible cultural resources.
	Impact	SMALL	SMALL	SMALL	SMALL to MODERATE
Infrastructure	Electrical Use	Not assessed	1,500 MWh (construction) 37,269 MWh per year (operations)	Not assessed	Construction of a new HALEU deconversion facility would require extension of existing utility service to accommodate new structures and to support operations of the proposed deconversion facilities. However, any needed infrastructure improvements or installation of additional utilities would comply with all applicable permits, service agreements, and regulatory requirements. For siting in an industrial site, impacts would be SMALL; for siting at an undeveloped site, impacts would likely range from SMALL to MODERATE due to potentially greater construction needs, risk
	Water Use	10,000 gpd (operations)	3.7×10^7 gal per year process water (operations) 3×10^6 gal per year potable water (operations) (p. 5-65)	1.1×10^6 gal per year process water (operations) 3.3×10^7 gal per year potable and nonpotable water (operations) (p. 5-83)	
	Fuel Use	Not assessed	73,000 gal (construction) (p. 5-40) 4,000 gal per year (operations) (p. 5-72) 4,000 gal per year liquid fuel and 44 M ft^3 of natural gas (p. 5-72)	73,000 gal (construction) (p. 5-57) 3,000 gal per year (operations) (p. 5-89) 3,000 gal per year liquid fuel and 40 M ft^3 of natural gas (p. 5-89)	

Table 4-7. Summary of Impacts for Uranium Hexafluoride Deconversion Facilities

Resource Area	***Impact Indicator***	***Existing NEPA***			***New HALEU UF_6 Deconversion Facility***
		IIFP DUF_6 Deconversion Facility Lea County, NM (NRC, 2012a)	***Paducah DUF_6 Deconversion Facility Paducah, KY (DOE, 2004c)***	***Portsmouth DUF_6 Deconversion Facility Portsmouth, OH (DOE, 2004b)***	
					of service disruption to users, and decreasing existing utility capacity for future needs.
	Impact	NA	SMALL	SMALL	SMALL to MODERATE
Noise	Distance to Nearest Residence	1.6 miles (2.6 km)	0.8 miles (1.3 km)	0.6 miles (0.9 km)	Unknown
	Noise Above Ambient Levels	No	No	No	Not likely
	Impact	SMALL	SMALL	SMALL	SMALL
Waste Management	Disposal pathways and relative volume	SMALL	SMALL	SMALL	SMALL
	Impact	SMALL	SMALL	SMALL	SMALL
Public and Operational Health – Normal Operations	Construction Radiological Impacts	None	35 to 40 mrem/yr to construction workers.	Up to 88 mrem/yr to construction workers.	< 100 mrem/yr
	Operations Worker Dose – Average & Total	75 mrem/yr operational workers 430 to 690 mrem/yr for cylinder yard workers.	75 mrem/yr for deconversion facility workers. 430 to 690 mrem/yr for cylinder yard workers.	75 mrem/yr for deconversion facility workers. 510 to 600 mrem/yr for cylinder yard workers.	< 100 mrem/yr for deconversion facility workers. 430 to 690 mrem/yr for cylinder yard workers.
	Operations Public Dose – MEI & Total	MEI dose (infant) of 0.014 mrem/yr, nearest resident (infant) dose of 0.009 mrem/yr. Population dose of 0.04 person-rem per year	MEI dose of much less than 1 mrem/yr. Populations dose of much less than1 person-rem per year.	MEI dose of much less than 1 mrem/yr. Populations dose of much less than1 person-rem per year.	MEI 0.001 mrem/yr (but site-specific characteristics could impact). Population dose 4×10^{-5} to 0.04 person-rem per year.

Table 4-7. Summary of Impacts for Uranium Hexafluoride Deconversion Facilities

Resource Area	***Impact Indicator***	***Existing NEPA***			***New HALEU UF_6 Deconversion Facility***
		IIFP DUF_6 Deconversion Facility Lea County, NM (NRC, 2012a)	***Paducah DUF_6 Deconversion Facility Paducah, KY (DOE, 2004c)***	***Portsmouth DUF_6 Deconversion Facility Portsmouth, OH (DOE, 2004b)***	
		Transportation and storage impacts could be higher (21 mrem/yr to MEI, 1 mrem/yr to nearest resident).			
	Chemical Risk	Chemical releases are below regulatory limits.	No impacts on workers or the public.	No impacts on workers or the public.	No impacts on workers or the public.
	Impact	SMALL	SMALL	SMALL	SMALL
Public and Occupational Health – Facility Accidents	Radiological Accidents	Involved worker 686 rem Noninvolved worker 8.07 rem MEI 11.7 rem Public 16.1 person-rem	Storage building failure – 40 rem to noninvolved worker and MEI	Cylinder fire – 13 mrem to MEI 34 person-rem to general public	Criticality – worker fatality Nearest site boundary 0.57 rem Public – 451 person-rem Worst-case UF_6 release - 686 rem to worker inside room. Cylinder fire – 11.7 rem to MEI and 34 person-rem to general public.
	Chemical Accidents	UF_6 release – HF concentration at boundary 7,800 mg/m^3 uranium concentration at boundary 2.72×10^{-7} µCi/mL	Corroded cylinder spill – 33 workers adverse effect	Cylinder fire – 680 members of the general public and 1,000 noninvolved workers might experience adverse effects from HF	680 members of the general public and 1,000 noninvolved workers might experience adverse effects from HF
	Impact	SMALL with controls	SMALL with controls	SMALL with controls	SMALL with controls
Traffic	Construction –	280 daily vehicle trips 40 daily truck trips	Not addressed	Not addressed	Within the impact levels estimated for the IIFP

Table 4-7. Summary of Impacts for Uranium Hexafluoride Deconversion Facilities

Resource Area	***Impact Indicator***	***Existing NEPA***			***New HALEU UF_6 Deconversion Facility***
		IIFP DUF_6 Deconversion Facility Lea County, NM (NRC, 2012a)	***Paducah DUF_6 Deconversion Facility Paducah, KY (DOE, 2004c)***	***Portsmouth DUF_6 Deconversion Facility Portsmouth, OH (DOE, 2004b)***	
	Daily Traffic Volumes from Additional Worker Vehicles and Truck Shipments				facility in Lea County, New Mexico. New AADT volumes would be within daily design capacity of roadways.
	Operations – Daily Traffic Volumes from Additional Worker Vehicles and Truck Shipments	280 daily vehicle trips 22 daily truck trips	Not addressed	Not addressed	Within the impact levels estimated for the IIFP facility in Lea County, New Mexico. New AADT volumes would be within daily design capacity of roadways.
	Impact	SMALL	NA	NA	SMALL
Socioeconomics	Peak Construction Employment	140 workers, 28 of whom would in-migrate	190 direct jobs	190 direct jobs	140 construction workers and 140 operations workers; 20% of each (28 construction and 28 operations workers) would in-migrate to the region. Impacts would be SMALL in the ROI; and would include small, beneficial economic impacts (e.g., increased jobs, income, and tax revenues). Potential SMALL to MODERATE impacts on local
	Operations Employment	140 workers, 28 of whom would in-migrate	160 direct jobs	160 direct jobs	
	ROI Employment	12 indirect construction jobs and 51 indirect operations jobs resulting from in-migrating workforce	100 indirect jobs for construction and 170 indirect jobs for operations	90 indirect jobs for construction; 160 indirect jobs for operations	
	Impact	SMALL increase in employment and income and small increase in local and regional population; impacts on the local	SMALL. Only minor impacts on regional growth and housing, local finances, and public service	SMALL. No significant impacts on regional growth and housing, local finances, and public service	

Table 4-7. Summary of Impacts for Uranium Hexafluoride Deconversion Facilities

Resource Area	***Impact Indicator***	***Existing NEPA***			***New HALEU UF_6 Deconversion Facility***
		IIFP DUF_6 Deconversion Facility Lea County, NM (NRC, 2012a)	***Paducah DUF_6 Deconversion Facility Paducah, KY (DOE, 2004c)***	***Portsmouth DUF_6 Deconversion Facility Portsmouth, OH (DOE, 2004b)***	
		unemployment rate, housing vacancies, schools, and public services and utilities would be minimal during operations and construction.	employment in the ROI are expected. Beneficial impacts: creation of 290 construction jobs and generate almost $10 million in personal income in the peak construction year. Operation of the conversion facility would create 330 jobs and generate $13 million in personal income each year	employment in the ROI are expected. Beneficial impacts: creation of 280 jobs (direct and indirect) and generate $9 million in personal income in the peak construction year. Operation of the conversion facility would create 320 jobs and generate $13 million in personal income each year.	community/host county that is more rural/less populated, and majority of workers choose to live there (higher numbers could adversely affect housing and social services, although increased revenue generated by project could help address deficiencies).
Environmental Justice	Minority or low-income population in ROI. Determine if impacts would be disproportionate and adverse.	Minority and low-income populations present within 50 miles (80 km).	Minority and low-income populations present within 50 miles (80 km).	Minority and low-income populations present within 50 miles (80 km).	Site-specific analysis is required.
	Impact	SMALL Impacts are considered SMALL for other resource areas. Air was determined to be SMALL to MODERATE. No disproportionately high and adverse effects	SMALL Minimal impacts on the general public related to air quality, climate, noise, and water resources. No disproportionately high and adverse effects on minority or	SMALL Minimal impacts on the general public related to air quality, climate, noise, and water resources. No disproportionately high and adverse effects on	Site-specific analysis is required.

Table 4-7. Summary of Impacts for Uranium Hexafluoride Deconversion Facilities

Resource Area	***Impact Indicator***	***Existing NEPA***			***New HALEU UF_6 Deconversion Facility***
		IIFP DUF_6 Deconversion Facility Lea County, NM (NRC, 2012a)	***Paducah DUF_6 Deconversion Facility Paducah, KY (DOE, 2004c)***	***Portsmouth DUF_6 Deconversion Facility Portsmouth, OH (DOE, 2004b)***	
		on minority or low-income populations.	low-income populations.	minority or low-income populations.	

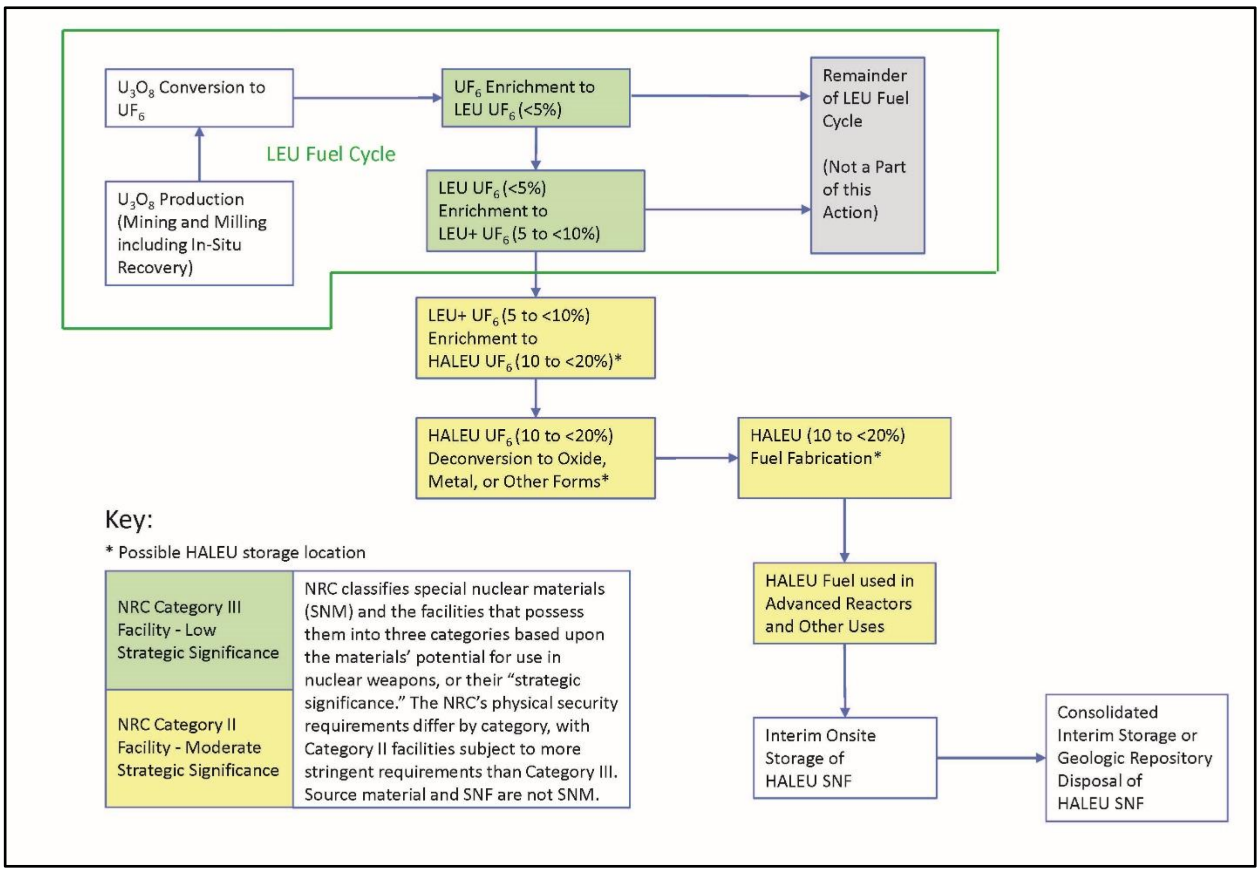
Key: AADT = annual average daily traffic; BLM = Bureau of Land Management; DUF_6 = depleted uranium hexafluoride; UF_6 = uranium hexafluoride; ft^3 = cubic feet; FEMA = Federal Emergency Management Agency; gal = gallons; GHG = greenhouse gas; gpd = gallons per day; gpm = gallons per minute; HALEU = high-assay low-enriched uranium; HF = hydrogen fluoride; IIFP = International Isotopes Fluorine Products, Inc.; km = kilometers; KPDES = Kentucky Pollutant Discharge Elimination System; KY = Kentucky; L/day = liters per day; L/min = liters per minute; L/year = liters per year; LLW = low-level waste; MEI = maximally exposed individual; MLLW = mixed low-level waste; mrem/yr = millirem per year; MT = metric tons; MWh = megawatt-hours; NA = not applicable; NAAQS = National Ambient Air Quality Standards; NEPA = National Environmental Policy Act; NM = New Mexico; NRHP = National Register of Historic Places; OH = Ohio; $PM_{2.5}$ = particulate matter less than or equal to 2.5 microns; PM_{10} = particulate matter less than or equal to 10 microns; ROI = region of influence; SNF = spent nuclear fuel; µCi/mL = microcuries per milliliter; UF_6 = uranium hexafluoride; VRM = versatile remediation module; yd^3 = cubic yards

5 HALEU Storage

5.1 Description of the Activity

5.1.1 General Description

The high-assay low-enriched uranium (HALEU) Proposed Action includes the requirement for a facility to store HALEU as uranium hexafluoride (UF_6), HALEU oxide (UO_2), or HALEU metal. The HALEU storage facility could be located at a commercial HALEU enrichment, deconversion, or fuel fabrication facility or facilities (as noted by an asterisk [*] in Figure 5-1), or another industrial (brownfield) facility or facilities, or an undeveloped (greenfield) site or sites. The storage facility could reside within an existing building at one of these locations. However, as a conservative approach, the Leidos Team evaluates construction and operation of a new HALEU storage facility in the Technical Report.



Key: % = percent; HALEU = high-assay low-enriched uranium; LEU = low-enriched uranium; MT = metric ton; NRC = U.S. Nuclear Regulatory Commission; SNF = spent nuclear fuel; U = uranium; U-235 = uranium-235; U_3O_8 = triuranium octoxide; UF_6 = uranium hexafluoride; UO_2 = uranium oxide

Figure 5-1. Potential HALEU Fuel Cycle

5.1.2 Description of the Process

Activity data developed for use in the analysis of new storage facilities is conservatively based on the assumption that the facilities would store the material that requires the most space, which is HALEU in the form of uranium dioxide (UO_2). The project total storage demands for HALEU are 290 metric tons

(MT), metal or 330 MT oxide, respectively. (For analysis purposes, the facility is assumed to handle 25 MT of metal or 28 MT of UO_2 per year.) The Leidos Team has assumed at least two storage facilities would be utilized at separation locations. Therefore, based on the number of containers needed to house one half of the total storage demand, or 165 MT of UO_2, the preliminary size of a storage facility is about 12,000 square feet (ft^2) with a height of 25 feet (see below for further details). The design would meet the U.S. Nuclear Regulatory Commission (NRC) criteria for the storage of HALEU (such as seismic capability, tornado protection, etc.) and would include the necessary environmental controls to protect staff and the environment. The storage facility would be an NRC Category II facility, with security features meeting NRC requirements for the possession of uranium enriched to between 10% and 20% uranium-235.

Construction

The following presents design and activity data estimated for construction of a new HALEU storage facility at a generic industrial site (DOE, 2023d). Construction of the project facility at a greenfield site could require substantially more effort to clear and to grade the site.

The ES-3100 package was chosen as a surrogate package design for storing UO_2 as it satisfies the safety standards needed for HALEU (NRC, 2021d). Use of the ES-3100 package would require the largest HALEU storage facility and therefore represents the most conservative scenario to evaluate potential construction impacts. The ES-3100 package is a cylindrical container that is about 43 inches in height and 19 inches in diameter and is composed of an outer drum assembly and an inner containment vessel. The purpose of the ES-3100 is to transport bulk high-enriched uranium in various forms. It is assumed that each package would include a containment vessel that would hold about 28 kilograms (kg) (62 pounds [lbs]) of UO_2 (INL, 2019). Based on the total storage demand of 165 MT of UO_2, the facility would house 5,893 containers. Assuming there are four containers per pallet (4 feet × 4 feet), stacked three pallets high, this design would result in a footprint of about 7,900 ft^2. Considering about 50% additional floor space is assumed to be needed for the operation of container handling equipment, the final building footprint would be about 12,000 ft^2 with a height of 25 feet.

The building walls would have pre-cast concrete panels topped with metal exterior siding and roof. The floor would be made of solid reinforced concrete 7 inches thick to handle the expected weight of the stacked storage packages. The facility also would include an associated approach pad constructed of reinforced concrete with a dimension of 40 feet × 30 feet and 12 inches thick to handle the expected weight of the delivery trucks.

Additional construction metrics include the following:

- It is assumed construction would occur in previously disturbed areas of a site.
- The site is level, but excavation would be required for the building slab and approach pad. Construction would disturb 1 acre of land.
- Foundation excavation would require the removal of 295 cubic yards (yd^3) of earth. Excavated soils would be stockpiled on-site and reused for grading post-concrete slab construction.
- Subbase gravel installation would require 363 tons of material at 6 inches thick and would be delivered in 17 truckloads, based on 22 tons per truck.
- The total concrete volume for the building slab and approach pad would amount to 334 yd^3, which would be delivered by 31 concrete trucks with capacities of 11 yd^3.
- The building slab and approach pad would require the installation of 520 feet of form material and 4, 990 kg (11,000 pounds [lbs]) of reinforcement steel bar (rebar), which would be delivered in a total of two truckloads.

- Building construction would require 4,600 ft^2 of 8-inch precast wall panels, 12,000 ft^2 of 26-gauge galvanized steel panels, and structural steel members, which would be delivered in a total of eight truckloads.
- Cement and gravel would originate from local sources at a distance of 16 kilometers (km) (10 miles).
- Concrete forms would be rented and would be returned to the supplier (no waste).
- The concrete pour would generate up to 10 yd^3 of municipal waste. Two truck loads of construction waste would be delivered to a nearby landfill.

Construction of the storage facility would take approximately 55 days with a duration-weighted average of 15 personnel and a peak workforce of 30 personnel.

A summary of the construction metrics is shown in Table 5-1.

Table 5-1. Summary of Estimates for Construction of the HALEU Storage Facility

Subtask	***Duration (day)***	***Personnel***	***Equipment***	***Materials***	***Material Truck Round Trips***
Earthwork and subbase	6	9	Excavation – CAT D3 Small Dozer, CAT D3 tracked skid steer, CAT 308 Excavator, CAT 60-inch compactor, 2 dump trucks Subbase – CAT D3 Small Dozer, 2 dump trucks	363 tons #57 stone	17
Concrete pad formwork and rebar install	8	13	2 support trucks, 1 long-reach forklift	520 feet of form material and 11,000 lbs #4 rebar	2
Concrete pad pour	1	17	1 concrete pumper, 2 ride-on trowels, 5 concrete trucks (11 yd^3), 2 support trucks	334 yd^3 5,000 psi concrete	31
Building construction – install pre-cast concrete panel walls/metal structure	20/10	7/7	3 support trucks, 1 boom crane	4,600 ft^2 of 8-inch precast wall panels (46,000 lbs). 12,000 ft^2 of 26-gauge galvanized steel wall panels (12,000 lbs) and structural steel members (220,000 lbs).	8

Source: www.cat.com

Key: CAT = Caterpillar Inc.; ft^2 = square feet; HALEU = high-assay low-enriched uranium; lbs = pounds; psi = pounds per square inch; yd^3 = cubic yards

Operation

Operations at a storage facility would include (1) receipt and shipment of HALEU containers by truck, (2) handling of HALEU containers with industrial equipment such as forklifts, and (3) monitoring and inspection of stored HALEU containers. Security could be provided for the facility itself or by existing security of the site location. The following are activity data for the operation of each new storage facility.

- The annual and total storage demands for UO_2 are 28 and 165 MT, respectively. The annual and total round trips associated with receipt and shipment of this material, assuming trucks would be fully loaded with material, would be 8 and 47, respectively[24]. Annual round trip mileages generated by receipt and shipment trips are 38,288 one-way km, or 47,600 miles, as shown in Table 6-4 in Section 6, *Human Health – Transportation Impacts*.
- HALEU containers would be handled by an electric forklift with a rated lift capacity of at least 2,268 kg (5,000 lbs) to handle a loaded pallet weighing about 907 kg (2,000 lbs).
- The facility is assumed to house one diesel-powered electric generator (about 200 horsepower) for use in the event of power outages. Otherwise, the generator would operate 1 hour per month for routine maintenance testing.
- Two personnel are assumed to staff the facility 24 hours per day and 365 days per year. Assume 2,190 worker commuter round trips per year (2 employees times 3 shifts/day times 365 days/year) for 6 years.

5.1.3 Potential Facilities

The storage facilities would be located at a commercial enrichment, deconversion, or fuel fabrication facility or facilities (see Figure 5-1), or another industrial (brownfield) facility or facilities, or an undeveloped (greenfield) site or sites. A principal driver for the facility location would be to minimize transportation of the materials and to provide the appropriate level of security. However, DOE has not designated a location for these facilities.

5.1.4 Existing NEPA Documentation

National Environmental Policy Act (NEPA) coverage does not exist for construction and operation of a new HALEU storage facility. The following five NEPA documents evaluate building construction at potential locations for a HALEU storage facility and include example affected environment and impact analyses information used in developing the Technical Report:

- ***Environmental Impact Statement for the Proposed American Centrifuge Plant in Piketon, Ohio***

  The NRC issued an EIS (NUREG-1834) for the American Centrifuge Plant (ACP) in 2006 (NRC, 2006b) (referred to as the "2006 ACP EIS"). In April 2007, a 30-year license (license SNM-2011) was issued to USEC (now Centrus) to construct, operate, and decommission the Centrus ACP, a commercial-scale gas centrifuge uranium enrichment facility. The license is held by American Centrifuge Operating, a subsidiary of Centrus. In 2011, DOE adopted the 2006 ACP EIS (NRC, 2006b) and issued DOE/EIS-0468 (DOE, 2011). The NRC's 2006 ACP EIS, adopted in 2011 by DOE, includes dimensions of buildings proposed for construction and analyses of construction and operation impacts.

- ***Environmental Impact Statement for the Proposed GE-Hitachi Global Laser Enrichment, LLC Facility in Wilmington, North Carolina*** (NRC, 2012b) (the "GLE EIS")

  The GLE EIS does not disclose dimensions of buildings proposed for construction, as it states they are

24 While the storage facility could be co-located with either an enrichment, deconversion, or fuel fabrication facility; for the receipt and shipping analysis it has been assumed that the storage facility has been independently sited.

considered proprietary and contain security-related information. However, it provides analyses of construction and operation impacts.

- ***Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico*** (NRC, 2005a) (the "2005 NEF EIS")

The 2005 NEF EIS proposes many construction activities and discloses metrics for site areas and earth moving, but no building dimensions. However, it provides analyses of construction and operation impacts.

- ***Environmental Impact Statement for the Proposed Fluorine Extraction Process and Depleted Uranium Deconversion Plant in Lea County, New Mexico*** (NRC, 2012a) (the "Fluorine/DU EIS")

The Fluorine/DU EIS proposes many construction activities but does not disclose metrics for building dimensions. However, it provides analyses of construction and operation impacts.

- ***Environmental Assessment Related to the Renewal of NRC License No. SNM-42 for BWX Technologies, Inc. (BWXT)*** (NRC, 2005b) (the "BWXT EA")

For BWX Technologies, Inc. (BWXT), the NRC completed an Environmental Assessment (EA) and Finding of No Significant Impact for renewing Materials License Special Nuclear Material (SNM)-42 for the BWXT facility in Lynchburg, Virginia.

5.2 Approach to NEPA Analyses

This section describes the impacts of construction and operation of a HALEU storage facility based on the metrics provided in Section 5.1.2, *Description of the Process*. Affected environment and construction impacts information for the potential enrichment, deconversion, and fuel fabrication facility locations were obtained from (1) the applicable NEPA documents cited in Section 5.1.4, *Existing NEPA Documentation*, and (2) Section 3, *Uranium Enrichment*, Section 4, *HALEU Deconversion*, and Section 7, *HALEU Fuel Fabrication*. As described in this section, it is expected that operations would minimally impact all resources. The analyses consider project and environmental controls, and if needed, mitigations that would minimize impacts.

As described in this section, placing a HALEU storage facility in an existing uranium fuel cycle facility would represent the lower end of potential project construction impacts. Locating a HALEU storage facility at an undeveloped (greenfield) site would likely result in the highest construction impacts for some resources. Siting a HALEU storage facility at an unknown location would have to take into consideration site-specific environmental conditions and comply with the applicable regulatory requirements at that location.

As described in Section 5.1.2, *Description of the Process*, this section evaluates the construction and operation of one storage facility that is sized to store half of the total amount of HALEU produced by the Proposed Action. Therefore, at least two storage facilities would be required to store the entire amount of HALEU produced. HALEU storage facilities could also be constructed and operated that store less than half the total amount. The impacts of construction and operation of these smaller storage facilities would be bounded by the impacts presented in this section.

Each storage facility would continue to operate in some capacity or would be repurposed for other uses after completion of the Proposed Action. Therefore, decommissioning of a storage facility does not require analysis in the Technical Report but would be evaluated in a future NEPA document.

5.3 Affected Environment and Environmental Consequences

The following sections describe affected environments and environmental consequences from construction and operation of a HALEU storage facility at one or more of the potential facility locations.

5.3.1 Land Use

Construction and operation of a HALEU storage facility have not been previously evaluated. Impacts on land use from construction of a storage facility would be similar to construction of an enrichment, deconversion, or fuel fabrication facility, though impacts would be much smaller in magnitude due to the size and scope of the storage facility. For example, the International Isotopes Fluorine Products, Inc. (IIFP) depleted uranium hexafluoride (DUF_6) deconversion facility disturbs around 16 hectares (ha) (40 acres) and includes the construction of cylinder storage facilities, as well as large chemical process equipment; whereas a HALEU storage facility would only disturb about 0.40 ha (1 acre) and would not require large processing equipment. Impacts on land use from construction of the IIFP facility were considered to be SMALL (NRC, 2012a, pp. 4-71); impacts on land use from the construction of a HALEU storage facility are expected to be similar and likely much smaller in magnitude.

Potential impacts on land use from construction of a HALEU storage facility would consider existing land development, zoning restrictions, land use plans, land regulation, and disturbances due to construction, excavation, and grading activities. However, these impacts are considered to be minimal, as the facility would likely be constructed in an area with other industrial uses and effects would be limited to within the facility boundary. Construction of a HALEU storage facility also would need to consider site-specific characteristics. Sites in proximity to residential areas or grazing or agricultural land could require additional review or consideration for siting. Potential sites and their associated land use impacts for HALEU enrichment, deconversion, and fuel fabrication are described in Section 3, *Uranium Enrichment,* Section 4, *HALEU Deconversion*, and Section 7, *HALEU Fuel Fabrication*.

Impact Summary

As construction and operation of a HALEU storage facility on existing industrial and developed areas would conform to existing land use associated with those facilities, impacts on land use are expected to be SMALL. Construction and operation of a HALEU storage facility at a greenfield site also would result in SMALL impacts on land use, as the facility would only disturb 0.40 ha (1 acre).

5.3.2 Visual and Scenic Resources

Impacts on visual and scenic resources from construction of a HALEU storage facility would be expected to be similar to construction of an enrichment, deconversion, or fuel fabrication facility. Impacts would be much smaller in magnitude due to the size and scope of the storage facility. Impacts on visual and scenic resources from construction of the IIFP facility were considered to be SMALL (NRC, 2012a, pp. 4-25, 4-71). Impacts on visual and scenic resources from the construction of a HALEU storage facility are expected to be similar and likely much smaller in magnitude.

Potential impacts on visual and scenic resources from construction of a HALEU storage facility would consider the visual setting and scenic quality on and near the proposed site, and disturbances due to construction, excavation, and grading activities. Impacts could include the introduction of tall structures in a landscape and potential for air or vapor plumes visible from a distance. However, these impacts are considered to be minimal, as the storage facility would likely be a 12,000 ft^2 single-story building with a height of 25 feet located in a rural area with an existing low-quality viewshed. Any visibility of additional lighting from the surrounding area would be mitigated with down-shielding to minimize light pollution (NRC, 2012a, pp. 4-25).

Construction of a HALEU storage facility also would need to consider site-specific characteristics. Sites in proximity to recreational or historic facilities, or residential areas, could require additional review or consideration for siting. Potential sites and their associated visual and scenic resource impacts for HALEU enrichment, deconversion, and fuel fabrication are described in Section 3, *Uranium Enrichment*, Section 4, *HALEU Deconversion*, and Section 7, *HALEU Fuel Fabrication*.

Impact Summary

As construction and operation of a HALEU storage facility on existing industrial and developed areas would conform to existing industrial aesthetics, impacts on visual and scenic resources are expected to be SMALL. Construction and operation of a HALEU storage facility at a greenfield site also would result in SMALL impacts on visual and scenic resources, as the facility would likely be a relatively small low building constructed in a rural area.

5.3.3 Geology and Soils

Impacts on soils and geology from construction of a HALEU storage facility would be similar to new construction of an enrichment, deconversion, or fuel fabrication facility, although impacts would be much smaller in magnitude due to the smaller size and scope of the storage facility. For example, the IIFP UF_6 deconversion facility disturbs around 16 ha (40 acres) and includes the construction of uranium storage facilities as well as installation of large chemical processing equipment, whereas a HALEU storage facility would only disturb about 0.40 ha (1 acre) and would not require large processing equipment. Impacts on soils and geology from construction of the IIFP facility were considered to be SMALL (NRC, 2012a); impacts on soils and geology from the construction of a HALEU storage facility are expected to be similar and likely much smaller in magnitude.

Potential impacts on soils and geology from construction of a HALEU storage facility would include soil erosion, compaction, soil contamination and disturbances due to construction, excavation, and grading activities. However, these impacts are considered to be minimal, as they would be limited to the facility boundary and mitigated by implementation of best management practices (BMPs). A list of example BMPs to mitigate these impacts are provided in Section 4.1.1.5 of the Fluorine/DU EIS (NRC, 2012a). Potential for soil contamination from spills also would be mitigated through appropriate soil monitoring, site decontamination, and decommissioning procedures. Impacts on geological features are considered minimal due to most activities occurring in shallow soils.

Construction of a HALEU storage facility also would need to consider site-specific characteristics. Sites with higher erosion potential, sensitive geology, existence of prime farmlands, and valuable mineral deposits could require additional review or other BMPs to limit impacts. Potential sites and their associated soils and geology impacts for HALEU enrichment, deconversion, and fuel fabrication are described in Section 3, *Uranium Enrichment*, Section 4, *HALEU Deconversion*, and Section 7, *HALEU Fuel Fabrication*.

Impact Summary

Since construction of a HALEU storage facility on existing industrial and developed areas would disturb only 0.40 ha (1 acre), impacts on soils and geology are expected to be SMALL. With the implementations of BMPs, construction of a HALEU storage facility at a greenfield site also would result in SMALL impacts on soils and geology. Because there would be no additional land disturbance, no additional impacts on soils and geology are expected during operation.

5.3.4 Water Resources

The affected environment for siting the HALEU storage facility at proposed enrichment, deconversion, and fuel fabrication facilities, as well as site-specific impacts where available, are presented in Section 3, *Uranium Enrichment*, Section 4, *HALEU Deconversion*, and Section 7, *HALEU Fuel Fabrication*, respectively.

The above NEPA documents described in Section 5.1.4, *Existing NEPA Documentation*, as well as previous NEPA documents discussed in Section 3, *Uranium Enrichment*, Section 4, *HALEU Deconversion*, and Section 7, *HALEU Fuel Fabrication*, were used to support the environmental impacts analysis for a HALEU storage facility. This approach was chosen because while potential impacts of a HALEU storage facility have not been previously analyzed, it is anticipated that impacts associated with the construction and operation of such a facility would be similar to but likely less than those associated with existing enrichment, deconversion, and fuel fabrication facilities, as the proposed HALEU storage facility would occupy less land and would involve minimal use of equipment and personnel, once fully operational. Site-specific NEPA analysis would be required for construction occurring in any location not previously analyzed, as impacts on water resources would vary based on the presence of surface water features and floodplains, and the availability, quality, and existing local uses of groundwater resources.

Impacts on water resources associated with the construction of a HALEU storage facility would likely be less than those presented in Section 3, *Uranium Enrichment*, Section 4, *HALEU Deconversion*, and Section 7, *HALEU Fuel Fabrication,* for construction of new enrichment, deconversion, and fuel fabrication facilities, as the proposed storage facility would only require disturbance of approximately 0.40 ha (1 acre) and would not require large processing equipment. Construction impacts on water resources analyzed in previous NEPA documents for enrichment, deconversion, and fuel fabrication facilities were expected to be SMALL. Briefly, ground-disturbing activities associated with construction could result in temporary increases in runoff leaving the site, causing increased sedimentation and turbidity in nearby surface waters. Additionally, an increase in activity and construction equipment on-site could lead to leaks or spills of fuel, oil, and lubricants, potentially contaminating nearby surface waters and groundwater resources. Construction would require the use of water for potable and nonpotable uses, which could tax the local water supply, depending on site-specific factors such as aquifer productivity and local water uses.

During the construction phase, adherence to required Federal and state permits and implementation of BMPs would minimize the potential for impacts on local water resources, by trapping and treating runoff before it leaves the site and following a plan to mitigate leaks and spills (potential BMPs are discussed in more detail in Section 3.3.4, *Water Resources*). As a result, impacts on water resources associated with the construction of a HALEU storage facility would be expected to be SMALL.

Due to limited activity and staffing needs at the proposed HALEU storage facility, operational water needs would be minimal. Expected liquid effluents would likewise be limited. The greatest potential impact on water resources would occur in the unlikely event of a failure of a HALEU container, resulting in a spill or leak. This potential impact would be prevented by routine inspections and immediate repairs of HALEU containers showing signs of disrepair. As a result, it is expected that impacts on water resources associated with the operation of a HALEU storage facility would be SMALL.

Impact Summary

Since construction of a HALEU storage facility on existing industrial and developed areas would disturb only 0.40 ha (1 acre), impacts on water resources are expected to be SMALL. With the implementation of BMPs, construction of a HALEU storage facility at a greenfield site also would result in SMALL impacts on water resources. Operation of the HALEU storage facility would have a minimal water demand and resulting impacts on water resources would be SMALL.

5.3.5 Air Quality

The following section discusses potential air quality impacts from construction and operation of a facility to store UF_6, UO_2, or HALEU metal at site locations described in Section 5.1.3, *Potential Facilities*. The analysis of impacts relies on analyses from a previous NEPA document that assessed the impacts of construction and operation of uranium fuel cycle facilities.

Construction and operation of a HALEU storage facility would result in air emissions of criteria pollutants, hazardous air pollutants, and greenhouse gases. The following evaluates projected emissions relative to air quality conditions within a potential project region and applicable air pollution standards and regulations. Section 5.3.11, *Public and Occupational Health – Normal Operations* presents estimates of health effects due to radiological air emissions that would occur from the facility.

Under the Clean Air Act (CAA), the U.S. Environmental Protection Agency (EPA) establishes National Ambient Air Quality Standards (NAAQS) for common air pollutants known as criteria pollutants. The NAAQS represent the maximum allowable atmospheric concentrations that may occur and still protect public health and welfare. The CAA establishes air quality planning processes and requires states to develop a State Implementation Plan that details how they will maintain the NAAQS or attain a standard in nonattainment within mandated time frames. Under the CAA, states are allowed to develop their own ambient air quality standards so long as they are at least as stringent as the NAAQS.

In addition to criteria pollutants, EPA also regulates hazardous air pollutants that are known, or are suspected, to cause serious health or adverse environmental effects. EPA sets Federal regulations to reduce hazardous air pollutant emissions from stationary sources in the *National Emission Standards for Hazardous Air Pollutants* (EPA, 2023a).

Construction

The air quality analysis for construction of a HALEU storage facility relies on analyses presented in the 2006 ACP EIS (NRC, 2006b). The 2006 ACP EIS evaluated impacts from refurbishing existing buildings and constructing new facilities for purposes of enriching uranium. It is expected that air quality impacts from construction activities presented in the 2006 ACP EIS would substantially bound impacts from construction of a HALEU storage facility, as it proposes substantially larger building construction activities. Construction of a HALEU storage facility at any other location would have to take into consideration current air quality conditions and to comply with the applicable regulatory requirements at that location.

EPA designates all areas of the United States as having air quality better than (attainment) or worse than (nonattainment) the NAAQS. Former nonattainment areas that have attained the NAAQS are designated as maintenance areas. Presently, EPA categorizes Pike County, which surrounds the American Centrifuge Plant site, as in attainment of all NAAQS (EPA, 2023b). The Ohio Environmental Protection Agency regulates sources of air pollution in Ohio. Additional descriptions of the air quality resource within the American Centrifuge Plant site region of influence (ROI) are presented in the 2006 ACP EIS Section 3.5.3 (NRC, 2006b).

Construction of a HALEU storage facility would include site clearing and grading as well as building construction. Air quality impacts from these activities would occur from (1) combustive emissions due to the use of fossil-fuel-powered equipment, trucks, and worker commuter vehicles and (2) fugitive dust emissions due to the operation of equipment and vehicles on exposed soil. Impacts would occur primarily during initial clearing, grading, and construction of the concrete building pad.

The analysis of emissions associated with construction of the enrichment capabilities at the American Centrifuge Plant site determined that criteria air pollutant concentrations at the property boundary would be below the NAAQS except for annual levels of particulate matter less than or equal to 2.5 microns

($PM_{2.5}$). With the implementation of mitigation measures for equipment to operate with newer nonroad emission standards (Tier 2) and to use ultra-lower sulfur diesel (see 2006 ACP EIS, Table 5-3), the resulting annual $PM_{2.5}$ concentrations would not exceed the $PM_{2.5}$ NAAQS. Therefore, the potential air quality impacts from construction of this facility would be reduced to SMALL (2006 ACP EIS, Section 4.2.4.1). Since the effort needed to construct a HALEU storage facility would be much smaller than the construction activities and resulting emissions evaluated in the 2006 ACP EIS, air quality impacts from construction of the project facility also would be SMALL. Implementation of BMPs identified in 2006 ACP EIS Table 5-1 would minimize potential fugitive dust impacts.

Operation

Air quality impacts from operation of a HALEU storage facility would occur from (1) diesel-powered trucks the deliver and ship HALEU containers, (2) the handling of HALEU containers with industrial equipment such as forklifts (if not electric powered), (3) one diesel-powered electric generator (about 200 horsepower) for use in the event of power outages (otherwise, the generator would operate 1 hour per month for routine testing and maintenance), and (4) personnel commuter vehicles. All operational sources would operate intermittently and would generate minor amounts of emissions. Mobile sources that operate off-site (e.g., trucks and personnel commuter vehicles) would produce dispersed air quality impacts. Therefore, operation of a HALEU storage facility would result in minor air quality impacts.

Impact Summary

Construction of a HALEU storage facility on existing industrial and developed areas or a greenfield site, with the implementations of BMPs to minimize fugitive dust, would result in SMALL impacts on air quality. Operation of a HALEU storage facility would produce minimal air emissions and resulting impacts on air quality would be SMALL.

5.3.6 Ecological Resources

The following NEPA documents evaluate construction and operation of uranium fuel cycle facilities and include example affected environment and impact analyses information used in the Technical Report to determine the likely impacts of construction and operation of a new HALEU storage facility.

- ***Environmental Impact Statement for the Proposed American Centrifuge Plant in Piketon, Ohio***

  Descriptions of ecological resources at the Piketon, Ohio, site are presented in Section 3.8 of the 2006 ACP EIS (NRC, 2006b). As indicated in that EIS, wetlands, Federal, and state rare, threatened, and endangered species are known to occur at or near the facility. Results of the analysis determined that impacts on ecological resources from the action would be SMALL through implementation of mitigation measures on-site.

- ***Environmental Impact Statement for the Proposed GE-Hitachi Global Laser Enrichment, LLC Facility in Wilmington, North Carolina*** (NRC, 2012b) (the "GLE EIS")

  Descriptions of ecological resources at the Wilmington site are presented in Section 3.8 of the GLE EIS (NRC, 2012b). As indicated in the GLE EIS, environmentally sensitive areas, wetlands, Federal, and state rare, threatened, and endangered species are known to occur at or near the Wilmington site. Results of the analysis determined that impacts on ecological resources from the action would be SMALL to MODERATE.

- ***Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico*** (NRC, 2005a) (the "2005 NEF EIS")

Descriptions of ecological resources at the site are presented in Section 3.9 of the 2005 NEF EIS (NRC, 2005a). Results of the analysis concluded that due to the lack of rare or unique communities, habitats, or wildlife on the proposed National Enrichment Facility site in Lea County, New Mexico, and the short duration of the site preparation and construction phase, the impacts on ecological resources on-site were determined to be SMALL.

- ***Environmental Impact Statement for the Proposed Fluorine Extraction Process and Depleted Uranium Deconversion Plant in Lea County, New Mexico*** (NRC, 2012a) (the "Fluorine/DU EIS")

Descriptions of ecological resources at the site are presented in Section 3.8 of the Fluorine/DU EIS (NRC, 2012a). There are no wetlands or unique habitats, and no threatened or endangered species on the proposed site. Results of the analysis determined that impacts on ecological resources from the action would be SMALL.

New HALEU Storage Facility (Generic Site)

Impacts on ecological resources from the construction of a new HALEU storage facility could occur from removal or degradation of vegetation, wildlife habitats, wetlands, and Federal- and state-listed species. Contamination impacts from radioactive or hazardous materials via air- or water-borne pathway, while unlikely, could also potentially occur in the event of an accidental release. If new construction were to occur entirely within previously developed and disturbed lands, impacts on ecological resources would be SMALL, as these areas are subject to frequent disturbance from human activity, grounds maintenance, and disruptions from ongoing facility operations, and native habitats are no longer present or have likely degraded over time. Previously developed and disturbed areas are not likely to support habitat for wildlife, other than for those species adapted to human disturbance (such as transient small mammals, insects, and birds).

Any new construction occurring within undeveloped lands could have SMALL to MODERATE impacts on ecological resources depending on the resources disturbed, mitigation, and the minimization measures employed. Land-clearing activities as part of new construction would likely result in increased erosion, stormwater runoff, and loss of vegetation. Additionally, impacts on wildlife could include habitat fragmentation, disturbance, and injury or mortality, as habitats within the footprint disturbed by construction would be reduced or altered, and construction activities would result in habitat fragmentation. Loss of habitat could result in a long-term reduction in wildlife abundance and richness. Habitat disturbance could facilitate the spread and introduction of invasive plant species. Wildlife habitat could be adversely affected if invasive vegetation became established in the disturbed areas and adjacent off-site habitats. Construction activities could cause wildlife disturbance, including interference with behavioral activities. Wildlife could respond in various ways, including attraction, habituation, and avoidance. Principal sources of noise would include vehicle traffic and operation of machinery. Regular or periodic noise could cause adjacent areas to be less attractive to wildlife and result in a reduction in use. Construction activities could result in the direct injury or death of certain wildlife species. Wildlife could also be exposed to accidental fuel spills or releases of other hazardous materials. To avoid these impacts on wildlife, any new construction associated with a new HALEU storage facility should be placed in other previously developed areas of the site, if possible.

Pending site selection, an official U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation data request would need to be submitted for the project under Section 7 of the Endangered Species Act (ESA) (16 United States Code [U.S.C.] 1531–1544) to generate an *Official Species List* and identify if federally designated critical habitats are present. Additional analysis would be required to determine the severity and nature of impacts on the federally protected species as part of the final design and description of the project storage facility. Removal of native habitats would impact vegetation, wildlife, and possibly special status species. Special status species are defined as those protected under the ESA, the Migratory Bird Treaty Act (U.S.C. 703–712), the Bald and Golden Eagle Protection Act (16 U.S.C. 668–668d), and state-listed species.

Migratory birds are protected under the Migratory Bird Treaty Act. Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668–668d). Numerous migratory birds, including some birds of conservation concern and eagles, likely occur or have the potential to occur as transients throughout the vicinity of the proposed facility sites. The USFWS recommends conducting tree-clearing activities outside of the bird nesting season to avoid the need for active nest relocation or destruction, when appropriate. To avoid impacts on migratory birds, tree clearing within undeveloped lands would need to occur outside of the nesting season (late February through early August). Tree-clearing work during the nesting season would require a migratory bird nest survey 72 hours prior to the start of clearing activities. A permit would be required for the purposeful take of an active migratory bird nest. A permit is not required to destroy migratory bird inactive nests.

Wetlands could be impacted by alteration of surface water runoff patterns, soil compaction, or groundwater flow. Pending facility site selection, the USFWS's National Wetlands Inventory dataset would need to be accessed to identify the presence of wetlands and/or water features subject to protection under Section 404 of the Clean Water Act (33 U.S.C. 1251 et seq.) that could occur within the project area. If USFWS National Wetlands Inventory resources were identified to occur within the project area, formal wetland delineation surveys would be required. Wetlands, streams, lakes, ponds, and other waters are regulated by state and Federal law, and permits are required to impact these water bodies. Impacts on federally protected wetlands would require consultation with the U.S. Army Corps of Engineers to obtain a permit. Additionally, subsequent NEPA analysis under these actions may also be required.

A summary of this site-specific NEPA analysis process is provided below.

Site-Specific NEPA Analysis Considerations Summary

Once a final HALEU storage site has been selected, a subsequent analysis would be required to complete the following**:**

- Define and assess the affected area/area of impact for ecological resources under implementation of the Proposed Action.
- Identify and describe the ecological resources (including terrestrial and aquatic vegetation, wildlife, special status species, and wetlands) within the affected area/area of impact that would be affected or have potential to be affected (directly or indirectly) under implementation of the Proposed Action. Special status species reviews can be completed through the USFWS's Information for Planning and Consultation and state game and fish department databases. Wetlands, streams, lakes, ponds, and other waters that may be impacted (regulated by state and Federal law) may be identified through the USFWS's National Wetlands Inventory dataset.
- Conduct targeted species surveys to identify the presence/absence of special status species within the affected area/area of impact and conduct interagency coordination with the USFWS and applicable state agency/agencies, if warranted.
- Assess the effects of the Proposed Action on significant ecological resources and include a determination of effects for special status species—in accordance with the ESA, Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, and applicable state threatened and endangered species laws.

- Identify any necessary mitigations required to avoid or minimize any identified adverse effects to special status species or wetlands.

Impacts on ecological resources are analyzed on a project-specific basis. The NRC will perform the requisite NEPA analysis for impacts on special status species and wetlands, in accordance with the ESA, Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, Clean Water Act, and applicable state threatened and endangered species laws in its site selection process, and prior to construction of a new HALEU storage facility. The ESA Section 7 consultation, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act analysis includes formal and or/informal consultations with the USFWS, while wetland impacts shall be coordinated with the U.S. Army Corps of Engineers. Local state action agencies shall be contacted for adverse impacts on state threatened and endangered species. Impacts on ecological resources could be expected to be lower (SMALL or none) if construction of a new facility were to occur in an already developed or disturbed site versus an undeveloped or undisturbed site.

Impact Summary

Construction and operation of a HALEU storage facility within previously developed and disturbed lands would result in SMALL impacts on ecological resources, as these areas are subject to frequent disturbances from human activity and native habitats are no longer present or have likely degraded over time. Locating a HALEU storage facility within undeveloped lands could have SMALL to MODERATE impacts on ecological resources, depending on the resources disturbed and the effort to mitigate and minimize potential impacts. An inventory of threatened or endangered species would be developed during site-specific reviews to identify unique or special habitats, and ESA consultations conducted with the U.S. Fish and Wildlife Service would assist in reducing/avoiding adverse impacts.

5.3.7 Historic and Cultural Resources

The analysis in the Technical Report for historic and cultural resources impacts of constructing and operating a HALEU storage facility at any of the potential locations relies upon the previously prepared NEPA documents described in Section 5.1.4, *Existing NEPA Documentation*.

American Centrifuge Plant Uranium Enrichment Facility, Piketon, Ohio

Construction

DOE analyzed the potential impacts on historic and cultural resources of constructing and operating a uranium enrichment facility at the Centrus ACP site in Piketon, Ohio (NRC, 2006b; DOE, 2011; NRC, 2021c). The NRC identified 15 historic properties within the area of proposed facility construction, which included the Gaseous Diffusion Plant historic district, 13 farmsteads, and 1 prehistoric lithic scatter (NRC, 2006b, p. Executive Summary). In addition, the NRC included three properties located around the perimeter in its consideration of potential effects. As previously determined by the NRC (2006b), there would be no adverse indirect or direct effect on these historic properties from the proposed construction or operations of the proposed uranium enrichment facility. In addition, construction of new buildings and refurbishment of existing buildings would result in buildings of design, size, and function similar to the existing buildings, and therefore would not alter the historic setting of the existing Historic District. Potential impacts from construction of a new HALEU storage facility in a previously disturbed area of a site, as assumed in Section 5.1.2, *Description of the Process*, would be the same as determined by the NRC for the uranium enrichment facility (NRC, 2006b).

Operation

Operations and maintenance activities at a proposed HALEU storage facility would have the potential to affect historic and cultural resources. Because there would be no additional land disturbance, no impacts on undiscovered cultural resources would be expected during operation. Proposed operational impacts would be expected to range from SMALL to MODERATE, depending on the proximity of a storage facility to significant historic and cultural resources.

Impact Summary

Any disturbance of a previously disturbed site for construction and operation of a HALEU storage facility is not anticipated to result in impacts on historic and cultural resources that exceed those associated with construction and operation of the proposed Centrus ACP uranium enrichment facility. Any proposed changes to or demolition of existing buildings or structures would be evaluated for historic and cultural resources impacts and subject to the National Historic Preservation Act (NHPA) Section 106 consultation process with the Ohio State Historic Preservation Officer (SHPO), federally recognized Tribes, and other interested parties prior to implementation. Therefore, construction and operation of a HALEU storage facility at the Centrus ACP site would be expected to have SMALL impacts on historic and cultural resources.

Global Laser Enrichment (GLE) Uranium Enrichment Facility, Wilmington, North Carolina

Construction

The NRC previously analyzed the potential impacts on historic and cultural resources of constructing and operating a uranium enrichment facility at the GE-Hitachi Global Laser Enrichment, LLC (GLE) site in Wilmington, North Carolina (NRC, 2012b). The NRC identified one historic property within the area of proposed facility construction that would be avoided during preconstruction and construction activities (NRC, 2012b, p. § 4.2.2.1). Although no construction activities were proposed where historic and cultural resources are known to exist, the Wilmington site is located within a region containing high concentrations of historic and cultural resources. Due to potential impacts on undiscovered historic and cultural resources, the NRC determined potential impacts at the proposed National Enrichment Facility site were expected to be SMALL to MODERATE, with license conditions that would require GLE to consider the potential effects on historic and cultural resources from any ground-disturbing activities in unsurveyed areas of the GLE facility site and development of Common Procedure CP-24-201 to address the unanticipated discovery of human remains or artifacts.

As previously determined by the NRC (NRC, 2012b), there would be no adverse indirect or direct effects on known historic properties from construction or operations of the proposed uranium enrichment facilities that were proposed under the GLE EIS that have not yet occurred (see Section 2.1 of the GLE EIS). Any changes to or demolition of buildings or structures proposed to be conducted during implementation of the proposed action would be evaluated for historic and cultural resources impacts and subject to the NHPA Section 106 consultation process prior to implementation. Therefore, construction and operation of a HALEU storage facility at the GLE site would be expected to have SMALL to MODERATE impacts on historic and cultural resources.

Operation

Operations and maintenance activities at a proposed HALEU storage facility would have the potential to affect historic and cultural resources. Because there would be no additional land disturbance, no impacts on undiscovered cultural resources would be expected during operation. Proposed operational impacts would be expected to range from SMALL to MODERATE, depending on the proximity of a storage facility to significant historic and cultural resources.

Impact Summary

Any disturbance of the previously disturbed site for construction and operation of a HALEU storage facility is not anticipated to result in impacts on historic and cultural resources that exceed those associated with construction and operation of the proposed uranium enrichment facility at the GLE site in Wilmington, North Carolina (NRC, 2012b). Any proposed changes to or demolition of buildings or structures would be evaluated for historic and cultural resources impacts and subject to the NHPA Section 106 consultation process with the North Carolina SHPO, federally recognized Tribes, and other interested parties prior to implementation. Therefore, construction and operation of a HALEU storage facility at the GLE site would be expected to have SMALL impacts on historic and cultural resources.

Urenco USA (UUSA) National Enrichment Facility, Lea County, New Mexico

Construction

The NRC analyzed the potential impacts on historic and cultural resources of constructing and operating a uranium enrichment facility at the Urenco USA (UUSA) site in Eunice, New Mexico (NRC, 2005a). The NRC previously identified seven historic properties within the area of proposed facility construction, all of which were prehistoric archaeological sites (campsites) of indeterminate age (NRC, 2005a, p. § 3.3). The NRC determined that potential impacts on historical and cultural resources at the proposed UUSA site were expected to be SMALL, with execution of a Memorandum of Agreement among the NRC, the New Mexico SHPO, the New Mexico State Land Office, Lea County, and Louisiana Energy Services (now UUSA) stipulating that all seven of the sites would be excavated and data recovery would be conducted before construction began to mitigate the adverse effects (NRC, 2005a, p. § 4.2.2). The Memorandum of Agreement stipulations were satisfied in 2007 when the New Mexico SHPO concurred with the findings of the data-recovery activities. In 2014, the NRC determined that no historic properties would be affected by the proposed facility expansion because no historic properties remain on the UUSA property, and the New Mexico SHPO concurred (NRC, 2015, p. § 1.5.4.2).

UUSA has indicated that only previously disturbed areas on the site of its existing facility would be used during construction and operation of an expanded uranium enrichment facility. As previously determined by the NRC (NRC, 2015), no historic properties would be affected by the proposed facility expansion because no historic properties remain on the UUSA property.

Operation

As previously determined by the NRC (NRC, 2015), no historic properties would be affected by the proposed facility expansion or operations because no historic properties remain on the UUSA property. Proposed operational impacts would be expected to be SMALL.

Impact Summary

Any disturbance of the previously disturbed site for construction and operation of a HALEU storage facility is not anticipated to result in impacts on historic and cultural resources that exceed those associated with constructing and operating a uranium enrichment facility at the UUSA site in Eunice, New Mexico (NRC, 2005a). As previously described, no historic properties remain on the UUSA property. Therefore, proposed construction and operation of a HALEU storage facility at the UUSA site would be expected to have SMALL impacts on historic and cultural resources.

BWX Technologies, Inc. Fuel Fabrication Facility, Lynchburg, Virginia

The NRC analyzed the potential impacts on historic and cultural resources of continuing radiological operations at the BWXT fuel fabrication facility in Lynchburg, Virginia (NRC, 2005b, p. § 3.7). As described in the BWXT EA, no known historic properties are within the BWXT boundaries, and the closest NRHP-listed sites are within 4.8 km (3 miles) of the facility. The BWXT EA (NRC, 2005b, p. § 4.1) determined that the continuing radiological operations at the BWXT fuel fabrication facility would not result in impacts on the regional historic and cultural resources.

Construction

Preconstruction and construction activities for the proposed HALEU storage facility at the BWXT facility have the potential to affect historic and cultural resources if siting of the facility is proposed in an area that contains historic and archaeological resources. The proposed HALEU storage facility construction would be evaluated for historic and cultural resources impacts and subject to the NHPA Section 106 consultation process prior to implementation, including survey and identification of cultural resources within the area of potential effects of the proposed site, determination of any adverse effects, and consultation with the Virginia SHPO, federally recognized Tribes, and other interested parties to resolve (mitigate) adverse effects. Proposed construction impacts would then be expected to range from SMALL to MODERATE, depending on the proposed HALEU storage facility's proximity to significant historic and cultural resources.

Operation

Operations and maintenance activities at the proposed HALEU storage facility have the potential to affect historic and cultural resources. Because there would be no additional land disturbance, no impacts on undiscovered cultural resources would be expected during operation. Proposed operational impacts would be expected to range from SMALL to MODERATE, depending on the proximity of a storage facility to significant historic and cultural resources.

Impact Summary

Potential impacts on historic and cultural resources could be mitigated if the NRC proposed a license condition that would require the facility to consider the potential effects on historic and cultural resources from any ground-disturbing activities in unsurveyed areas of the proposed new HALEU storage facility site. Proposed construction or operational impacts would then be expected to range from SMALL to MODERATE, depending on the proposed HALEU storage facility's proximity to significant historic and cultural resources.

New HALEU Storage Facility (Generic Site)

While it is possible that a HALEU storage facility could reside within an existing building located at a HALEU enrichment, deconversion, or fuel fabrication facility or facilities, the Technical Report conservatively evaluates construction and operation of a new HALEU storage facility.

Construction, Operation, and Impact Summary

Construction of a HALEU storage facility at an enrichment, deconversion, or fuel fabrication facility or facilities would likely occur on previously surveyed and disturbed areas and has the potential to impact approximately 1 acre of land. Therefore, impacts of construction at an existing uranium fuel cycle facility or industrial site would likely be SMALL. Construction of a HALEU storage facility at an undeveloped location has the potential to impact historic and cultural resources. The degree of impact, while limited due to the relatively small size of the facility and the implementation of BMPs, would be dependent upon the historical and cultural characteristics of the selected site. Because of this, construction impacts are expected to be SMALL to MODERATE.

Operations and maintenance activities at a proposed HALEU storage facility have the potential to affect historic and cultural resources. Because there would be no additional land disturbance, no impacts on undiscovered cultural resources would be expected during operation. Therefore, the impacts from operations would likely be SMALL.

5.3.8 Infrastructure

The affected environment and impacts of construction and operation of proposed HALEU enrichment, deconversion, and fuel fabrication facilities, are described in Section 3, *Uranium Enrichment*, Section 4, *HALEU Deconversion*, and Section 7, *HALEU Fuel Fabrication*, respectively. The HALEU storage facility could be co-located with these facilities.

Construction and Operation

Construction involve portable generators, fuel and water brought in from off-site, and portable toilets. Since construction of a HALEU storage facility on existing industrial and developed areas or a greenfield site would disturb only 0.40 ha (1 acre), would employ a peak daily workforce of 30, and would use mostly off-site resources, impacts on site infrastructure would likely be SMALL.

Impacts on infrastructure associated with the construction and operation of a HALEU storage facility would likely be less than those presented in Section 3, *Uranium Enrichment*, Section 4, *HALEU Deconversion*, and Section 7, *HALEU Fuel Fabrication,* for construction and operation of new enrichment, deconversion, and fuel fabrication facilities, as the proposed storage facility would only require disturbance of approximately 1 acre, would employ a peak day workforce of 30 during construction and 6 during operations, and would not require large processing equipment. While additional utility infrastructure could be required to support the proposed facility and to connect the structure to existing local providers, the utility demands of the storage facility would be minor. Any increase in demand would be accommodated by existing providers, and service to other customers would not be affected. Any expansion of local utility service would comply with all applicable usage agreements, permits, and regulatory requirements. As such, only SMALL infrastructure impacts would be expected during construction and operation of a proposed HALEU storage facility.

Impact Summary

Since construction of a HALEU storage facility on existing industrial and developed areas or a greenfield site would disturb only 0.40 ha (1 acre) and would employ a peak day workforce of 30, and would use mostly offsite resources, impacts on infrastructure would be SMALL. Operation of a HALEU storage facility would have minor utility demands and resulting impacts on infrastructure would be SMALL.

5.3.9 Noise

Any pressure variation that the human ear can detect is considered “sound,” and “noise” is defined as unwanted sound. Sound is described in terms of amplitude (perceived as loudness) and frequency (perceived as pitch). Sound pressure levels are typically measured with a logarithmic decibels (dB) scale. To account for human sensitivity to frequencies of sound (i.e., less sensitive to lower and higher frequencies, and most sensitive to sounds between 1,000 and 5,000 hertz), an A-weighted decibels (denoted by dBA) (Acoustical Society of America, 1983; 1985) is widely used. This scale has a good correlation to a human’s subjective reaction to sound. Most noise standards, guidelines, and ordinances use the A-weighted scale.

The day-night average sound level (L_{dn}) is the average over a 24-hour period, with the addition of 10 dB to sound levels from 10 p.m. to 7 a.m. to account for the greater sensitivity of most people to nighttime noise. The L_{dn} scale is widely used for community noise assessment and has been adopted by several government agencies (e.g., Federal Aviation Administration, Department of Housing and Urban

Development, and the NRC). In general, a 3-dB change over an existing noise level is considered a barely discernible difference, and a 10-dB increase is subjectively perceived as a doubling in loudness and almost always causes an adverse community response (NWCC, 2002).

Background noise is defined as the noise from all sources other than the source of interest. The background noise level can vary considerably, depending on the location, season, and time of day. Background noise levels in a busy urban setting can be as high as 80 dBA during the day. In isolated outdoor locations with no wind, vegetation, animals, or running water, background noise may be under 10 dBA. Typical noise levels in rural settings are about 40 dBA during the day and 30 dBA during the night, which correspond to an L_{dn} of 40 dBA; in wilderness areas, typical noise levels can be below 35 dBA (Harris, 1991).

At the Federal level, the Noise Control Act of 1972 and subsequent amendments (Quiet 4 Communities Act of 1978, 42 U.S.C. 4901–4918) delegate the authority to regulate noise to the states and direct government agencies to comply with local noise regulations. EPA guidelines recommend L_{dn} of 55 dBA as sufficient to protect the public from the effect of broadband environmental noise in typically quiet outdoor and residential areas and farms (EPA, 1974a). For protection against hearing loss in the general population from nonimpulsive noise, EPA recommends an equivalent noise level of 70 dBA or less over a 40-year period. The HALEU storage facility activities would have to follow applicable Federal, state, or local guidelines and regulations on noise.

Noise-sensitive areas are created to represent common noise environments within the same activity category, and are represented by receptors, which represent a discrete or representative location within the noise-sensitive area. Activity categories include land uses such as residences, hotels, motels, active sport areas, schools, places of worship, hospitals, parks, and others.

The distance from the Piketon, Ohio, American Centrifuge Plant to the nearest residence is approximately 6,000 feet (1,829 meters [m]) (NRC, 2011c). At the GLE facility in an unincorporated part of northwestern New Hanover County approximately 6 miles (10 kilometers [km]) north of the city of Wilmington, North Carolina, the nearest sensitive receptors, areas of human habitation or use where the intrusion of noise has the potential to adversely impact the occupancy, use, or enjoyment of the environment, are located just next to the northeast site boundary and about 0.8 miles (1.2 km) directly to the east of the proposed facility. Other land uses adjacent to the site include a hunting or recreational area to the north, the Northeast Cape Fear River to the southwest, Interstate 140 to the south, and North Carolina Highway 133 (Castle Hayne Road) to the east. Interstate 140, which is elevated relative to the site, acts as a natural sound barrier and blocks noises from current site operations to the residences to the south. Industrial land uses are dominant on the west side of the Cape Fear River. No other residences and sensitive receptors (e.g., schools, hospitals, and nursing homes) are located in the immediate vicinity (within about 1 mile [1.6 km]) of the Wilmington site (NRC, 2012b). The nearest residence would be 2.6 miles (4.3 km) away from the gas centrifuge uranium enrichment facility near Eunice in Lea County, New Mexico (NRC, 2005a). No noise-sensitive areas are within 6 miles (10 km) of the proposed Fluorine Extraction Process and Depleted Uranium Deconversion Plant west of Hobbs, New Mexico, based on a review of aerial photographs. The nearest residence is approximately 1.6 miles (2.6 km) northwest of the site. No recreational facilities are within 6 miles (10 km) of the proposed site (NRC, 2012a). The land around the BWXT facility is used for a variety of purposes. The area hosts other industrial facilities. Forestry and agriculture, however, dominate the activities in the predominately rural area. Because of the rolling terrain adjacent to the river, most of the population is located more than 3 miles (4.8 km) from the BWXT facility.

Construction

The HALEU storage facility could reside within an existing building at one of the existing locations. However, as a conservative approach, construction and operation of a new HALEU storage facility at the proposed enrichment, deconversion, and fuel fabrication facility locations and other sites was evaluated.

Noise would come predominantly from construction equipment and traffic. Construction activities would be temporary and limited to daytime working hours. The HALEU storage facility could be co-located with an enrichment, deconversion, fuel fabrication, or another facility. Therefore, a HALEU storage facility would be in an existing industrial area or another relatively remote area, away from existing residences and other sensitive noise receptors like schools, churches, and hospitals.

Because the construction equipment noise would attenuate within a short distance of a proposed HALEU storage site, the nearest residences and other land uses would not be adversely affected by construction noise. Construction of a HALEU storage facility would take approximately 55 days, so the duration of the construction noise would be temporary. Therefore, impacts due to noise would be SMALL, based on the likely distances to surrounding residences and recreational areas and the rate at which noise is attenuated with distance.

Operation

Noise from the operation of a proposed HALEU storage facility would be minimal, occur mostly inside the buildings, and be attenuated by distance. The proposed facility would be in a location surrounded by other industrial facilities, and/or far from land uses that could be adversely affected by increases in noise levels. Noise at the nearest residences and recreational areas would not increase due to operation of a proposed HALEU storage facility. Therefore, impacts from noise due to facility operations would be SMALL.

The following BMPs would reduce noise-related impacts from construction and operation of a HALEU storage facility:

- Maintain equipment in good working order in accordance with manufacturer's specifications.
- Limit noisy activities to the least noise-sensitive times of the day (daytime between 7:00 a.m. and 7:00 p.m.) and weekdays; limit idle time for vehicles and motorized equipment.
- Employ noise-reduction devices (e.g., mufflers) as appropriate.
- Provide a noise complaint process for surrounding communities.

Impact Summary

Construction of a HALEU storage facility within an existing industrial or developed area would occur at a location that would be at least nominally distant from sensitive noise receptors, such as residents. Because construction equipment noise would attenuate within a short distance from the construction site, the nearest receptors and other land uses would not be adversely affected by construction noise. Therefore, noise impacts from construction of a HALEU storage facility would be SMALL. Construction of a HALEU storage facility at a greenfield site also would result in SMALL noise impacts, as the facility likely would be constructed over a short period of time in a rural area away from sensitive receptors. Noise impacts from operation of a HALEU storage facility at any location would be SMALL, as the facility would generate minor amounts of noise.

5.3.10 Waste Management

The following section discusses potential impacts on waste management from HALEU storage activities that would support the Proposed Action described in Section 5.1, *Description of the Activity*.

Construction and Operation

Industrial (i.e., construction debris), hazardous, and radioactive wastes could be generated although there is no plan to open storage containers, and therefore, radioactive wastes are unlikely to be generated. All wastes generated have a disposal path forward. The generated wastes do not have any unique or problematic characteristics that would preclude use of the existing disposition paths. All wastes would be managed in accordance with applicable regulatory requirements. The waste quantities generated are a small portion of the total quantities of waste generated annually by all generators.

Impact Summary

Available commercial facilities' capacities can accommodate the lifecycle disposition requirements for all the waste categories. Impacts would be SMALL since all wastes generated have a disposal path and represent a fraction of the available capacities of the commercial waste management facilities.

5.3.11 Public and Occupational Health – Normal Operations

This section discusses the human health impacts on workers from the construction and operation of a HALEU storage facility designed to hold the total inventory of HALEU produced under one enrichment agreement (145 MT of HALEU metal, about 170 MT of UO_2, or about 220 MT of HALEU in the form of UF_6). Potential radiological effects from locating a HALEU storage facility at the site of another uranium fuel cycle facility are considered in addition to the impacts of construction and operation of the facility.

Operations at a storage facility would include (1) receipt and shipment of HALEU containers by truck, (2) handling of HALEU containers with industrial equipment such as forklifts, and (3) storage of the containers, which would include monitoring and inspection of stored HALEU containers. None of these activities involve the opening of HALEU containers. Because the containers remained sealed, there are no liquid or airborne effluents (radiological or nonradiological) associated with the storage facility operation. (Monitoring and inspection of the stored containers would ensure early detection of container degradation and leaks, limiting the potential and quantity of material potentially released.)

Therefore, during construction, human health impacts would only result from existing radiological conditions at the selected site. The existing NEPA documentation identified in Section 5.1.4, *Existing NEPA Documentation*, provides information on worker dose from construction activities at active fuel cycle facilities. These include:

- At the GLE facility, the potential for an individual external dose of 10.5 millirem (mrem) per year from direct exposure to existing site sources (GLE EIS, pp 4-74 to 4-76).
- At the proposed American Centrifuge Plant in Piketon, Ohio, the potential for a dose of 89 mrem per year to construction workers from direct radiation (i.e., a full-time worker in the cylinder yard at the point of the highest dosimeter readings). A most likely construction worker dose was estimated at 22 mrem per year (2006 ACP EIS, pp. 4-60).
- At the proposed National Enrichment Facility near Eunice, New Mexico, the potential for a dose of 5 mrem per year to construction workers working near completed operational cascades (2005 NEF EIS, pp. 4-46).

Construction

No impacts on the public would be expected during construction. Any impacts from contaminated fugitive dust would affect personnel on-site but have little chance of impacting public health. Since there are no radiological materials used during construction, direct radiation impacts on the public would not occur as a result of construction.

The worker exposure to radiological material during construction has been assessed in each of the three EISs referenced (the GLE EIS, the 2006 ACP EIS, and the 2005 NEF EIS). The construction activity impacts were assessed for both enrichment facilities and fuel fabrication facilities. Based on the information provided, construction worker exposures for construction of a storage facility at any of these sites should be limited to less than 5 mrem for the approximately 2 months of construction activities. With a total workforce of 15, the total worker dose would be less than 0.1 person-rem.

The proposed facility would be a relatively small structure, but nonetheless construction activities would expose workers to normal workplace-related events (occupational accidents) that could result in injury or fatality. The U.S. Department of Labor, Bureau of Labor Statistics information on workplace accidents during construction predict that there would be no injuries (less than 0.1) or fatalities (much less than 1) during facility construction. This is due to both the short construction period (about 2 months) and a relatively limited workforce (15 full-time equivalent workers) (Bureau of Labor Statistics, 2021; 2022).

Operation

Health impacts on the public are not anticipated during operation of a HALEU storage facility. Since no operations would involve the transfer of materials from one container to another, the airborne releases associated with such actions (a typical part of uranium enrichment, conversion, and fuel fabrication operations) would not happen.

Occupational doses to the storage facility workers would result from direct radiation associated with the containers used to store the HALEU. Like potential exposures to the public, no airborne or liquid effluent releases would be expected during normal operations.

Data collected by the NRC for fuel cycle facilities includes worker dose data for workers at enrichment facilities, conversion facilities, and fuel fabrication facilities. Data for the year 2020 show these workers received an average dose of less than 100 mrem per year and only one worker received a dose in excess of 1 rem (less than 2 rem) (NRC, 2022a). Estimates of workplace exposures from cylinder yard operation associated with operations at the deconversion facilities at Paducah, Kentucky, and Piketon, Ohio, ranged from 430 to 690 mrem per year (DOE, 2004b; DOE, 2004c). (In 2001, the annual doses to the cylinder yard workers at Portsmouth, Virginia, was 64 mrem (DOE, 2004b, pp. 5-7).) Operational activities at a HALEU storage facility should be similar to those at the cylinder yards for those two facilities: inspection and movement of cylinders. If located at the site of an existing fuel cycle facility, operations at the facility should come under the site's radiological protection program. Under such a program, a proposed HALEU facility would adhere to the principles of as low as reasonably achievable for the protection of workers. Under these conditions, the worker doses would be well below the regulatory limit of 5 rem per year in Title 10 Code of Federal Regulations (CFR) Section 20.1201 and lower than many administrative limits used in fuel cycle facilities (often 4 rem per year).

A proposed HALEU facility would have a small operational staff (estimated at 8 full-time equivalents), but with an increased staff during receipt or shipment of materials. Nonetheless, operational activities could expose workers to normal workplace-related events (i.e., occupational accidents) that could result in injury or fatality. The U.S. Department of Labor, Bureau of Labor Statistics information on workplace accidents during construction predict that there would be no injuries (much less than

1 annually) or fatalities (much less than 1) during facility operation (Bureau of Labor Statistics, 2021; 2022).

Impact Summary

There would be no human health impacts on the public from the construction and operation of a HALEU storage facility.

Impacts on workers during construction would consist of occupational hazards and the potential for radiological exposure resulting from existing facility operations if the storage facility were to be located at a site, such as the sites for the enrichment facilities, with ongoing operations using radiological material. Given the small size of the storage facility, no occupational injuries or fatalities would be expected. Radiological exposure to workers would be minimal, again due to the small size of the facility and the relatively small construction workforce and short duration of construction, with estimates for the total workforce dose of less than a rem.

Operational hazards for workers would be limited to occupational hazards and exposure to direct radiation from the stored material. With the limited staff needed for storage operations, no occupational injuries or fatalities would be expected. Based on historical exposure data for fuel cycle facilities and especially for cylinder yard workers, the worker dose would be expected to be less than 100 mrem per year, although estimates from prior NEPA documents are as high as 690 mrem per year.

5.3.12 Public and Occupational Health – Facility Accidents

As part of the Proposed Action, HALEU would be stored for future fabrication into fuel for advanced nuclear reactors. HALEU is likely to be stored in the form of an oxide (UO_2) but another form such as UF_6 or uranium metal could be stored. The operation of a HALEU storage facility would involve risks to workers, the public, and the environment from potential accidents. The facility would be licensed under 10 CFR 40, "Domestic Licensing of Source Material," and would also be subject to 10 CFR 70, Subpart H, "Additional Requirements for Certain Licensees Authorized to Possess a Critical Mass of Special Nuclear Material."

Companies holding licenses under 10 CFR 70, "Domestic Licensing of Special Nuclear Material," must perform an integrated safety analysis (ISA) and submit a summary to the NRC for approval. An ISA (1) identifies potential accident sequences during operations of a storage facility, (2) designates items relied on for safety (IROFS) to either prevent such accidents or mitigate their consequences to an acceptable level, and (3) describes management measures to provide reasonable assurance of the availability and reliability of IROFS.

The performance requirements in 10 CFR 70, Subpart H, define acceptable levels of risk from accidents at nuclear fuel cycle facilities such as a HALEU storage facility. The regulations in Subpart H require reduction of the risks of credible high- and intermediate-consequence events and assure that under credible abnormal conditions all nuclear processes are subcritical. Table 5-2 defines the accident consequence categories used for the accident analysis. Table 5-3 defines exposure thresholds, by receptor and intermediate- and high-consequence accidents, for each chemical species analyzed.

Table 5-2. Accident Consequence Categories

Category	Workers	Off-Site Public	Environment
Category 3: High Consequences	Individual Radiation Dose ≥ 100 rem Individual Chemical Dose = endanger life (> than AEGL-3, 10-min exposure) 75 mg soluble uranium intake	Individual Radiation Dose ≥ 25 rem Chemical Dose = long-lasting health effects (> AEGL-2, 30-min exposure) 30 mg soluble uranium intake	
Category 2: Intermediate Consequences	Individual Radiation Dose ≥ 25 rem Individual Chemical Dose = long-lasting health effects (> AEGL-2 but < AEGL-3, 10-min exposure)	Individual Radiation Dose ≥ 5 rem Chemical Dose = mild transient health effects (> AEGL-1 but < AEGL-2, 30-min exposure)	Radiological release > 5,000 times values in Table 2 of 10 CFR 20
Category 1: Low Consequences	Accidents of lower radiological and chemical exposures than Category 2	Accidents of lower radiological and chemical exposures than Category 2	Radiological releases lower than Category 2

Source: (NRC, 2012a, pp. 4-59)

Key: > = greater than; ≥ - greater than or equal to; < = less than; AEGL = acute exposure guideline level; CFR = Code of Federal Regulations; mg = milligrams; min = minute; rem = roentgen equivalent man

Table 5-3. Chemical Consequence Exposure Thresholds

Chemical	Intermediate Consequences				High Consequences			
	Worker Exposure		Public Exposure		Worker Exposure		Public Exposure	
	Level of Concern	Concentration (mg/m^3)	Level of Concern	Concentration (mg/m^3)	Level of Concern	Concentration (mg/m^3)	Level of Concern	Concentration (mg/m^3)
HF	AEGL-2 10 min	77.8	AEGL-1 30 min	0.82	AEGL-3 10 min	139	AEGL-2 30 min	28
UF_6	AEGL-2 10 min	28	AEGL-1 30 min	3.6	AEGL-3 10 min	216	AEGL-2 30 min	19
UO_2F_2	AEGL-2 10 min	28	AEGL-1 30 min	3.6	AEGL-3 10 min	216	AEGL-2 30 min	19
UO_2	ERPG-210 min	201	ERPG-130 min	0.68	ERPG-310 min	180	ERPG-230 min	32

Source: (NRC, 2012a, pp. 4-59)

Key: AEGL = acute exposure guideline levels; ERPG = Emergency Response Planning Guideline; mg/m^3 = milligrams per cubic meter; min = minute; UF_6 = uranium hexafluoride; UO_2F_2 = uranyl fluoride; UO_2 = uranium oxide

Note: ERPGs are concentration values established by the American Industrial Hygiene Association that meet certain human response criteria similar to those for AEGLs.

The hazards identification process results in identification of radiological or chemical characteristics that have the potential for causing harm to workers, the public, or the environment. The hazards of concern for the storage facility relate to an inadvertent nuclear criticality and either a release (loss of confinement) of UO_2, UF_6, or reactions that may generate uranyl fluoride (UO_2F_2), hydrogen, or hydrogen fluoride (HF). Hydrogen can be generated at a slow rate by UO_2 or uranium metal reactions with moist air. Hydrogen is a gas that is flammable and could create an explosion hazard. However, hydrogen generation is not expected to be a significant hazard. Releases from a byproduct reaction involving UF_6 could pose accident risks. UO_2F_2 and HF are toxic chemicals with the potential to cause harm to the workers or the public. UO_2F_2 and HF can be released as the byproduct of UF_6 reaction with moist air. HF is a clear, colorless, corrosive, fuming liquid. In high concentrations, a release could form dense white vapor clouds. The HF, which is in a gaseous form, could be transported throughout the storage facility and ultimately beyond the site boundary.

The ISA may include probabilities or likelihood categories (i.e., highly unlikely, unlikely, or not unlikely) for each accident scenario. The analysis described in this section does not include an estimate of the probability of occurrence of accidents, which, in combination with consequences, would reflect the overall risk from an accident. Instead, analyzed accidents are assumed to occur and consequences of each accident reported. The accidents evaluated are a representative selection of the types of accidents that are possible at a HALEU storage facility. The accident sequences selected vary in severity from high- to low-consequence events and include accidents initiated by natural phenomena (or seismic event), operator error, and equipment failure. Possible initiators for accidents at the storage facility include process upsets, seismic events, and extreme weather events such as tornadoes. Potential accident scenarios include the following:

- Generic inadvertent nuclear criticality
- Seismic event causing multiple process containment failures: This scenario would occur across multiple processes; the evaluation of collective effects utilized an estimate of the total facility source term.
- Liquid depleted uranium tetrafluoride (DUF_6) cylinder drop: This scenario would include a breach and release of liquid DUF_6.

The results of the ISA are intended to give assurance that the potential failures, hazards, accident sequences, and scenarios, as well as facility features and procedures have been investigated in an integrated fashion, so as to adequately consider common-mode and common-cause situations. For credible events with a potential for high consequences, the ISA provides a detailed evaluation of plant features and procedures that would mitigate those consequences. The impacts of accidents with the potential to release radioactive materials or chemicals and affect public health and the environment would be mitigated by the protective measures identified in the ISA.

Accident Consequences

Operating procedures for a HALEU storage facility would be designed to ensure that the high and intermediate accident scenarios would be highly unlikely and unlikely, respectively. The combination of responses by IROFS, which mitigate or prevent emergency conditions, and the implementation of emergency procedures and protective actions in accordance with the facility emergency plan would limit the consequences and reduce the likelihood of accidents that could otherwise extend beyond the proposed facility site and property boundaries. Consequences of selected accidents may be evaluated against the threshold values for a facility worker, a site worker 328 feet (100 m) from the release point, an individual at the site boundary, the environment at the site boundary, and the exposed population.

Accident consequences have not been calculated for a HALEU storage facility, but the consequences would be considered from both a radioactive material and chemical hazards perspective if calculations were performed. To provide perspective for the storage facility, impacts from applicable accidents at the proposed IIFP facility (NRC, 2012a) and at an enrichment facility (NRC, 2011c) are presented. The IIFP facility is proposed to deconvert depleted uranium and recover fluorine products. As such, impacts from the IIFP facility are primarily related to the chemical hazards of a storage facility. To gain perspective of the radiological impacts of a storage facility, the consequences of applicable accidents at an enrichment facility are presented. The consequences of accidents at the IIFP facility and an enrichment facility are considered to be very conservative with respect to the consequences of accidents at a HALEU storage facility.

Accidents at the Deconversion Facility

Table 5-4 summarizes the consequences for accidents at the IIFP depleted uranium deconversion and fluorine recovery facility (NRC, 2012a, pp. 4-60 to 4-61) that are applicable to a HALEU storage facility. The most significant accident consequences are those associated with the release of UO_2 or UF_6 caused by rupturing a storage container.

Table 5-4. Summary of Accident Analysis Results

Receptor	***Parameter***	***Worst Case DUF_6 Release***	***Seismic Event Causing Multiple Process Containment Failures***	***Fluorine Compounds Release***
Worker (inside room, 10-min exposure)	HF concentration (mg/m^3)	1.34×10^6	--	56.5
	UO_2F_2 concentration (mg/m^3)	5.14×10^6	--	--
	Soluble U intake (mg)	7.94×10^5	--	--
	Dose (rem)	686	--	--
Worker (outside building, 10-min exposure)	HF concentration (mg/m^3)	1.64×10^4	47.3	0.452
	UO_2F_2 concentration (mg/m^3)	6.05×10^4	179	---
	Soluble U intake (mg)	9,340	27.6	--
	Dose (rem)	8.07	0.02	--
Public (MEI) (at site boundary, 30-min exposure)	HF concentration (mg/m^3)	7,800	15.7	0.367
	UO_2F_2 concentration (mg/m^3)	2.93×10^4	59.4	--
	Soluble U intake (mg)	1.36×10^4	27.4	--
	Dose (rem)	11.7	0.02	--
Environment (at site boundary, 24-hr avg)	Activity Concentration (µCi/mL)	2.72×10^{-7}	4.96×10^{-10}	--
Public Collective Exposure	Dose (person-rem)	16.1	135	--
	LCF	0.00351	0.0297	--

Source: (NRC, 2012a, pp. 4-60 to 4-61)

Key: µCi/mL = microcuries per milliliter; avg = average; DUF_6 = depleted uranium tetrafluoride; HF = hydrogen fluoride; hr = hour; LCF = latent cancer fatality; MEI = maximally exposed individual; mg = milligram; mg/m^3 = milligrams per cubic meter; min = minute; U = uranium; UF_6 = uranium hexafluoride; UO_2F_2 = uranyl fluoride

Accidents at the Enrichment Facility

The most significant accident consequences are those from an inadvertent nuclear criticality and those associated with the release of UO_2 or UF_6 caused by rupturing a storage container. For the criticality accident, a worker within a few feet of the event would likely be killed. A maximally exposed individual at the controlled area boundary (CAB) would receive a radiation dose of 0.57 rem total effective dose equivalent, which represents a low consequence to an individual (less than [<] 5 rem). The collective dose to the off-site population is estimated to be 451 person-rem. This population dose would cause an estimated 0.3 lifetime cancer fatalities, or less than one fatality.

The consequences of accident scenarios involving a release of uranium and HF from the enrichment facility vary widely. For the individual at the CAB, consequences are intermediate for the earthquake and facility-wide fire scenarios on the basis of HF exposure (between 0.8 and 28 milligrams per cubic meter), but low for uranium exposure (< 2.4 milligrams per cubic meter). All the accident scenarios predict less than one lifetime cancer fatality in the off-site population. The consequences of enrichment facility accidents (NRC, 2011c, pp. 4-119) applicable to a HALEU storage facility are summarized in Table 5-5.

Table 5-5. Summary of Radiological and Nonradiological Health Effects Resulting from Accidents [(a)]

Accident	Worker [(b)]		Environment at Restricted Area Boundary [(c)]	Individual at CAB [(c)]		Collective Dose to Off-Site Population [(d)]	
	U [(e)] mg/m^3 (rem)	HF mg/m^3	µCi/mL	U [(e)] mg/m^3 (rem)	HF mg/m^3	Person-rem [(e)]	LCFs
Inadvertent nuclear criticality	(High) [(f)]	NA	18.4 [(g)] (ratio > 1)	(0.57) [(h)]	NA	451	0.3
Earthquake	9.59 (0.136)	32.2	1.28×10^{-9}	0.274 (0.001)	2.08	0.47	3×10^{-4}
Facility-wide fire	13 (0.805)	4.36	2.57×10^{-9}	0.549 (0.002)	2.08	0.94	6×10^{-4}

Source: (NRC, 2011c, pp. 4-119)

Key: > = greater than; µCi/mL = microcuries per milliliter; CAB = controlled area boundary; CFR = Code of Federal Regulations; ESE = east-southeast; HF = hydrogen fluoride; LCFs = latent cancer fatalities; mg/m^3 = milligrams per cubic meter; NA = not applicable; U = uranium

Notes:

[a] A safety evaluation is conducted as part of the facility licensing process to identify items relied on for safety (IROFS). Health effect impact estimates are based on calculations assuming the current design prior to any IROFS determinations. These results are used to identify which IROFS are to be incorporated into facility designs or procedures to reduce the risks to workers, the public, and the environment to acceptably low levels.

[b] Worker exits after 5 minutes in all cases but the earthquake. The exit is assumed to occur in 2.5 minutes for the earthquake.

[c] Distance to restricted area boundary is 0.47 miles and the distance to the CAB is 0.7 miles.

[d] The off-site population includes 0 people within 5 miles and 267,256 people within 50 miles.

[e] Radiation dose from HALEU would be somewhat greater than the radiation dose from LEU due to the greater concentration of uranium-234 except for the inadvertent nuclear criticality dose. The criticality impacts and number of fissions are largely independent of material, enrichment, and configuration.

[f] High consequence could lead to a fatality.

[g] Pursuant to 10 CFR 70.61I(3), this value is the sum of the fractions of individual fission product radionuclide concentrations over 5,000 times the concentration limits that appear in 10 CFR 20, Appendix B, Table 2.

[h] The dose to the individual at the CAB is the sum of internal and external doses from fission products released from the criticality.

Accident Impact Summary for a HALEU Storage Facility

Storage of HALEU could occur at either an existing facility or at a new facility. In either case, facility design would reduce the likelihood of a rupture event by a robust storage container design that maintains the container integrity during credible drops, shocks, collisions, and thermal events. The form of the uranium in storage would also limit dispersion of the uranium. The use of safe-by-design components would prevent an inadvertent nuclear criticality. In addition, the proposed facility emergency plan would address all lower-risk, high-, and intermediate-consequence events. Through the combination of facility design, passive and active engineered controls (i.e., IROFS), administrative controls, and management of these controls, accidents at a storage facility would pose an acceptably low risk to workers, the environment, and the public.

Construction

Accidents during construction of a new HALEU storage facility are standard industrial hazards. Accidents from standard industrial hazards are evaluated above in Section 5.3.11, *Public and Occupational Health – Normal Operations*.

Operation

The consequences shown in Table 5-4 and Table 5-5 are representative of the accident consequences at a HALEU storage facility. The accident scenarios for a HALEU storage facility include an inadvertent nuclear criticality, releases of uranium, and releases of hazardous chemicals. The differences in accident consequences would primarily be due to differences in assumed worker exposure times and in site-specific parameters such as distances to receptors and population distribution. Because the IIFP deconversion facility and the enrichment facility would be handling much larger quantities of material than a HALEU storage facility, the consequences of accidents in the HALEU storage facility would be expected to be similar to or less than the consequences reported in Table 5-4 and Table 5-5. The criticality impacts and number of fissions are largely independent of material, enrichment, and configuration. Thus, low-enriched uranium and HALEU would produce similar criticality impacts. An inadvertent nuclear criticality could be fatal to an involved worker but the use of critically safe components would make a fatality highly unlikely. Accident doses could be greater than the 25-rem total effective dose equivalent established by DOE as a guideline for assessing the adequacy of protection of public health and safety from potential accidents. The probability of a latent cancer fatality within the general public is less than one. The impacts from the release of hazardous chemicals could be high with persons experiencing both adverse effects and irreversible adverse effects. Fatalities among workers and the general public could occur as a result of an accidental hazardous material release. However, the risk to the operational staff and to the public from exposure to radioactive material and hazardous chemicals would be negligible with IROFS. Therefore, after consideration of accident consequence and frequency, accidents from operation of a HALEU storage facility would be considered to have SMALL impacts.

5.3.13 Traffic

This section discusses potential traffic impacts on nearby roadways resulting from vehicles during construction and operation of a proposed HALEU storage facility. The project would generate new vehicle trips during each phase of the project from trucks (transporting equipment, materials, supplies, and wastes) and from personal vehicles of commuting workers. A vehicle trip is defined as a one-way trip movement; a round trip is defined as two vehicle trips. For purposes of the Technical Report, the focus of traffic impacts from a proposed HALEU storage facility is limited to the principal roadways leading up to the project site.

Annual average daily traffic (AADT) is a measure of the average daily number of vehicles that pass through a given segment of roadway and is indicative of traffic conditions (i.e., higher AADT volumes lead to increases in traffic congestion and delays). To evaluate potential traffic impacts, baseline AADT data (i.e., most recent available AADT data, ranging from years 2019 through 2022) for nearby roadway segments at each of the candidate sites (i.e., proposed enrichment, deconversion, fuel fabrication, or other facility) was obtained from the respective site's state transportation agency. The baseline AADT data was then combined with project-related traffic volumes and compared against the operating capacities of the roadway segments to provide estimates on level of traffic impacts.

Based on the estimates presented in Table 5-1 (Section 5.1.2, *Description of the Process*), it is conservatively estimated that during construction 30 workers would generate 30 daily vehicle round trips (or 60 vehicle trips per day) from commuting to or from the project site, and truck transport would generate approximately 1 to 3 daily truck round trips (or 6 vehicle trips per day). The truck transport estimate does not take into account the 31 trucks for the concrete pad pour, which would only occur over a single day. Therefore, a typical construction day could experience approximately 66 total vehicle trips a day, with a majority of vehicle trips occurring from commuting workers during the peak traffic hours.

During operation, it is expected that only two personnel per shift (with three shifts per day), resulting in six round trips could occur on any given day. In addition, the facility would generate 20 truck round trips per year due to the receipt and shipment of HALEU materials.

Table 5-6 summarizes the baseline traffic volumes and new traffic volumes for the principal roadway segments serving each of the candidate sites during construction. The table also includes design capacities for the roadway segments and estimates on the change in operating capacities of the roadways.

The "Daily Design Capacity" values presented in the table are based on estimates provided in the U.S. Department of Transportation's "Simplified Highway Capacity Calculation Method for the Highway Performance Monitoring System" and represent the maximum daily traffic volumes that can be maintained and still be within an acceptable level of service (LOS).

Table 5-6. Roadway Traffic and Design Capacity Volumes During Construction of a Proposed HALEU Storage Facility [(a)]

Roadway (location of segment)	*# of Lanes*	*Daily Design Capacity [(b)] (vehicle trips per day)*	*Baseline AADT (vehicle trips per day)*	*New AADT [(c)] (vehicle trips per day)*	*Percent Increase in AADT*	*Percent of Design Capacity*
Urenco USA (Eunice, New Mexico) [(d)]						
SR-176 (between Main St and SR-18)	2	10,200	5,203	5,269	1%	52%
SR-176 (near project site)	2	19,000	4,801	4,867	1%	26%
SR-18 (between SR-207 and SR-176)	4	42,900	2,892	2,958	2%	7%
SR-18 (between SR-176 and SR-207)	4	42,900	7,104	7,170	1%	17%
Centrus (Piketon, Ohio) [(e)]						
US-23 (between SR-32 and project site)	4	42,900	15,425	15,491	< 1%	36%
US-23 (south of project site)	4	42,900	14,783	14,849	< 1%	35%
SR-32 (east of US-23)	4	42,900	9,348	9,414	1%	22%
SR-32 (west of US-23)	4	42,900	15,007	15,073	< 1%	35%
GNF-A (Wilmington, North Carolina) [(f)]						
Castle Hayne Road (north of I-140)	4	33,400	12,000	12,066	1%	37%
Castle Hayne Road (south of I-140)	4	33,400	14,000	14,066	< 1%	43%
I-140 (west of Castle Hayne Road)	4	52,200	23,500	23,566	< 1%	45%

Table 5-6. Roadway Traffic and Design Capacity Volumes During Construction of a Proposed HALEU Storage Facility [(a)]

Roadway (location of segment)	# of Lanes	Daily Design Capacity [(b)] (vehicle trips per day)	Baseline AADT (vehicle trips per day)	New AADT [(c)] (vehicle trips per day)	Percent Increase in AADT	Percent of Design Capacity
I-140 (east of Castle Hayne Road)	4	52,200	26,500	26,566	< 1%	51%
Framatome, Inc. (Richland, Washington) [(g)]						
Horn Rapids Road (west of Stevens Dr)	2	13,900	2,471	2,537	3%	18%
Stevens Drive (south of Battelle Blvd)	6	44,600	13,910	13,976	< 1%	31%
SR-240 (Jadwin Ave intersection, southwest alignment)	6	56,100	30,570	30,636	< 1%	55%
SR-240 (Jadwin Ave intersection, northwest alignment)	2	22,100	16,334	16,400	< 1%	74%
Kingsgate Way (north of SR-240)	2	8,600	3,930	3,996	2%	46%
Westinghouse Electric (Columbia, South Carolina) [(h)]						
SR-48 (north of project site)	2	13,900	7,500	7,566	1%	54%
SR-48 (south of project site)	2	13,900	4,900	4,966	1%	36%
Nuclear Fuel Services (Erwin, Tennessee) [(i)]						
Carolina Ave (north of Jones Rd)	2	9,300	2,310	2,376	3%	46%
Jackson Love Highway (north of Washington St)	2	10,200	4,851	4,917	1%	58%
Jackson Love Highway (west of Carolina Ave)	2	10,200	6,909	6,975	1%	82%
BWX Technologies, Inc. (Lynchburg, Virginia) [(j)]						
SR-726 (near project site)	2	13,900	5,600	5,666	1%	66%
US-460 (east of SR-726)	4	53,300	23,000	23,066	< 1%	54%
US-460 (west of SR-726)	4	53,300	27,000	27,066	< 1%	63%
X-energy / TRISO-X and Ultra Safe Nuclear Corporation (Oak Ridge, Tennessee) [(k)]						
SR-95 (near New Bedford Ln)	4	53,300	19,485	19,551	< 1%	46%
SR-95 (near project site)	4	53,300	11,593	11,659	1%	27%
SR-95 (Whipp Rd, near Bear Creek crossing)	2	13,900	6,234	6,300	1%	73%
SR-58 (near the project site)	4	53,300	12,560	12,626	1%	29%

Key: % = percent; AADT = average annual daily traffic; Ave = Avenue; Blvd = Boulevard; con = construction phase; Dr = Drive; GNF-A = Global Nuclear Fuel – Americas; HALEU = high-assay low-enriched uranium; I = Interstate; Ln = Lane; ops = operation phase; Rd = Road; SR = State Route; St = Street; US = U.S. Highway

Notes:

[a] Candidate site locations for a proposed HALEU storage facility include candidate sites for a proposed HALEU enrichment facility, deconversion facility, and/or fuel fabrication facility.

[b] These values are taken from the U.S. Department of Transportation's "Simplified Highway Capacity Calculation Method for the Highway Performance Monitoring System" (USDOT, 2017) and represent the maximum daily traffic volumes that can be maintained and still be within the level of service "C."

[c] For construction, New AADT = Baseline AADT + 66 vehicle trips per day.

[d] Source of Baseline AADT for Eunice, New Mexico: (NMDOT, 2023)

[e] Source of Baseline AADT for Piketon, Ohio: (ODOT, 2023)

[f] Source of Baseline AADT for Wilmington, North Carolina: (NCDOT, 2023a)

[g] Source of Baseline AADT for Richland, Washington: (City of Richland, 2023; WSDOT, 2023)

Table 5-6. Roadway Traffic and Design Capacity Volumes During Construction of a Proposed HALEU Storage Facility [(a)]

Roadway (location of segment)	*# of Lanes*	*Daily Design Capacity [(b)] (vehicle trips per day)*	*Baseline AADT (vehicle trips per day)*	*New AADT [(c)] (vehicle trips per day)*	*Percent Increase in AADT*	*Percent of Design Capacity*

[h] Source of Baseline AADT for Columbia, South Carolina: (SCDOT, 2023)
[i] Source of Baseline AADT for Erwin, Tennessee: (TDOT, 2023)
[j] Source of Baseline AADT for Lynchburg, Virginia: (VDOT, 2019)
[k] Source of Baseline AADT for Oak Ridge, Tennessee: (TDOT, 2023)

LOS is a qualitative measure of a roadway and is designated with a letter A to F, with A representing the best operating conditions and F the worst. Most engineering or planning efforts usually base design capacities at an LOS of C or D to ensure an acceptable operating service for users. For a more conservative analysis, the "Daily Design Capacity" values in Table 5-6 are based on an LOS of C. An LOS of C typically means that a roadway is operating under stable conditions and is at or near free flow (Transportation Research Board, 1994).

The "New AADT" estimates presented in Table 5-6 represent baseline AADT volumes combined with additional traffic volumes from project-related vehicles occurring during construction. Incremental increases in traffic volumes during operation would be much lower than those estimated for construction.

Table 5-6 shows that most of the roadways would experience relatively low increases in daily traffic volumes (typically less than 5%). The additional traffic volumes from project construction would result in minimal increases in roadway congestion, delays, and safety hazards, and new AADT volumes would be within the "Daily Design Capacity" volumes of these roadways. As such, it is expected that the level of traffic impacts at all of the candidate sites for a proposed HALEU storage facility would be SMALL during construction and operation.

Construction and operation of a HALEU storage facility at another industrial (brownfield) facility or at an undisturbed (greenfield) site would also generate similar increases in traffic volumes from commuting workers and truck shipments of equipment, supplies, materials and waste. Although the intensity of impacts would depend on the baseline traffic conditions of the roadways leading up to the proposed site (e.g., existing AADT volumes), it is expected that potential traffic impacts at a brownfield facility or greenfield site would be SMALL if traffic data are similar to those shown in Table 5-6.

As the schedule progresses closer to final site selection, siting for a new HALEU storage facility would have to take into greater consideration additional activities that provide a more accurate representation of existing and future traffic conditions, especially if it would be co-located with a new HALEU enrichment facility, deconversion facility, or fuel fabrication facility as these facilities could result in substantial increases in new traffic volumes. As shown in Table 5-6, a few of the roadway segments would be operating at 70% or greater of their daily handling capacity and would require detailed traffic analyses and mitigation measures. If co-location would occur with a proposed HALEU enrichment facility or fuel fabrication facility, a traffic analysis would be required to evaluate combined traffic volumes that take into account changes to baseline AADT. Traffic impacts under a co-location scenario could result in MODERATE to LARGE impacts and would need to develop mitigation measures to reduce the level of traffic impacts.

In addition to the combined traffic volumes from co-locating proposed HALEU facilities, other activities and factors that would need consideration in a traffic analysis include, but are not limited to, expanding the ROI to include additional roadways that encompass primary truck and commuter routes; reviewing the weight and size restrictions along potential truck routes; projecting traffic volumes to the years of construction and operation; and reviewing local and regional land development and transportation projects that could directly impact relevant roadways. Additionally, any project-related traffic study and findings should be coordinated with local, county, and state transportation departments.

Impact Summary

Traffic generated from construction of a HALEU storage facility would result in minimal increases in roadway congestion, delays, and safety hazards, and new AADT volumes would be within the "Daily Design Capacity" volumes of these roadways. As such, it is expected that the level of traffic impacts at any candidate site for a proposed HALEU storage facility would be SMALL during construction. Operation of a storage facility would generate minimal amounts of traffic from personnel vehicles and HALEU material trucks; therefore, impacts on traffic would be SMALL during operations. Similar types of traffic impacts would occur from constrution and operation of a HALEU storage facility at an industrial (brownfield) facility or an undeveloped (greenfield) site.

5.3.14 Socioeconomics

A HALEU storage facility could be located at a HALEU enrichment, deconversion, or fuel fabrication facility; another industrial (brownfield) facility or facilities; or an undeveloped (greenfield) site or sites. The affected socioeconomics environment for the ROIs associated with the enrichment, deconversion, and fuel fabrication facilities has already been described in Section 3, *Uranium Enrichment,* Section 4, *HALEU Deconversion*, and Section 7, *HALEU Fuel Fabrication*, respectively; these sections also identify relevant existing NEPA documentation related to these sites.

While it is possible that a HALEU storage facility could reside within an existing building located at a HALEU enrichment, deconversion, or fuel fabrication facility or facilities, the Technical Report evaluates construction and operation of a new HALEU storage facility at the existing uranium fuel cycle facility sites discussed in Section 5.1.2, *Description of the Process*. None of the past NEPA documents related to these five industrial sites included an analysis of impacts specific to construction and operation of a HALEU storage facility; however, they did analyze impacts from construction and operation of a new uranium fuel cycle facility of some type based on estimated workforce requirements specific to the type of facility. As described in Section 5.1.2, construction of a proposed HALEU storage facility would require an average of 15 workers and a peak workforce average of 30 personnel; and that two personnel would staff the facility 24 hours per day during project operation (2 × 3 shifts per day = 6 workers). Given such small numbers, it is not necessary to rely on a specific existing NEPA document, but rather a general comparison can be made to the larger workforce estimates and demographic data evaluated in the other NEPA documents to support the evaluation of impacts from construction and operation of a proposed HALEU storage facility.

Construction

With respect to construction, because the construction workforce estimates for a HALEU storage facility are significantly smaller than for other facility types analyzed in the Technical Report, and based on the assumption that any specialty workforce skills would be minimal, it is assumed that the majority, or likely all, of the construction workers would be found within the ROI, based on the updated employment data for each of the sites being considered (and their respective ROIs). No population influx, consisting of new workers and their families outside the ROI, would be expected for construction of the proposed storage facility. Even if there were some migration, as part of a bounding analysis, the expected population influx would be fewer than 100 persons—between 45 and 90 persons at peak—if every worker in-migrated with their family (similar to other socioeconomic analyses performed in the Technical Report, this assumes that each worker would bring a spouse and one child). Given the resulting small percentage increase (less than 0.1%) in employment and population levels identified within each site's ROI, an in-migrating construction workforce would be expected to have no adverse impacts on the existing population, employment, housing, and community service levels within the ROI at any of the enrichment, fuel fabrication, deconversion sites or other facilities. Therefore, potential socioeconomic impacts from construction of the HALEU storage facility would be considered SMALL. The increase in income and tax revenues generated from Federal, state and local taxes on the proposed storage facility also would be SMALL, given the small workforce; however, it would be considered a SMALL beneficial impacts on the local and regional economy.

Operation

Because the workforce for operation of a HALEU storage facility would be considerably smaller than for construction—estimated at only six personnel—impacts from the operations workforce on existing employment, housing and community services, also would be expected to be SMALL. It is assumed that the six operations workers could be transitioned over from the existing workforce at some of the proposed sites or originated from within a site's ROI.

Once a location for a HALEU storage facility has been selected, the NRC will provide an updated and site-specific analysis on any socioeconomic impacts on the ROI with respect to population, employment, income, housing, and community services.

Impact Summary

Based on the low workforce numbers, as compared to the existing population and employment data in the ROIs for all the sites where a HALEU storage facility could be located, it is determined that potential impacts on socioeconomics from construction and operation of a HALEU storage facility at any site under consideration would be SMALL. In addition, the SMALL increase in income and tax revenues generated by the small workforce would be considered a beneficial impacts on the local economy.

5.3.15 Environmental Justice

At this stage in project development, the location of a HALEU storage facility is not known. The storage facility could be located at a HALEU enrichment, deconversion, or fuel fabrication facility or facilities, or other locations. DOE information on Justice40 and site-specific analysis of minority and low-income populations for potential enrichment facility locations are provided in Section 3, *Uranium Enrichment*. Justice40 and minority and low-income population data by city and state for representative fuel fabrication facility locations are provided in Section 7, *HALEU Fuel Fabrication*. Once a storage location has been selected, the NRC will provide site-specific analysis on any disproportionate and adverse impacts on minority or low-income populations as part of NEPA documentation for construction and operation of the facility.

Since final storage locations are not known, a preliminary analysis on the types of construction and operations impacts that might be anticipated to occur to environmental justice populations in the vicinity of a HALEU storage facility are described below. Four NEPA documents discussed in Section 5.1.4, *Existing NEPA Documentation*, were used to estimate the types of impacts expected at locations where a HALEU storage site could be located. Environmental consequences that are dependent on final locations and site-specific designs are only mentioned in general terms. For facilities that have environmental justice populations within 6.4 km (4 miles), detailed site-specific analyses would be required in NRC NEPA documents prepared once facility design plans are developed.

Construction

Minority and low-income populations could be directly or indirectly affected by the construction of a HALEU storage facility. For example, construction of a storage facility in an urban area with minority or low-income populations proximate to the construction site could increase exposure to dust and other particulates related to land disturbance and construction. Increased demand for rental housing during construction could disproportionately affect low-income populations. However, demand for rental housing could be mitigated if the plant is constructed near a metropolitan area. Construction would also create employment opportunities for minority and low-income individuals. Construction could disproportionately affect minority and low-income populations residing in the vicinity of the site by air emissions and by noise from construction and increased truck and commuter traffic. Air emissions, noise, and worker traffic and equipment during construction would only occur for the duration of construction.

Existing NEPA documentation from sites where a potential HALEU storage facility could be located describe impacts from similar to much larger construction projects. The EISs selected and described represent impacts that would bound impacts from construction of the storage facility. The 2006 ACP EIS for the proposed American Centrifuge Plant in Piketon, Ohio (DOE, 2011), notes the following impacts related to construction activities: site preparation and construction are projected to result in a temporary increase in the concentrations of particulate matter with a mean diameter of 10 microns or less in the ambient air that slightly exceed the air quality standard up to a distance of 1,000 m (3,280 feet) beyond the fenceline. However, the 2006 ACP EIS indicated that there are no populations that qualify as minority or low income that are close to the site. Impacts on regional employment for site preparation and construction are considered MODERATE, which are generally considered positive impacts.

The GLE EIS for the proposed GLE facility in Wilmington, North Carolina (NRC, 2012b), noted that preconstruction activities would result in impacts on minority and low-income populations, mostly consisting of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts would be short term and limited to on-site activities. However, due to the short duration of preconstruction activities and the availability of rental housing, impacts on minority and low-income populations would be short term and limited. The majority of environmental impacts associated with the construction of the proposed GLE facility would be SMALL to MODERATE. Impacts associated with the construction of a HALEU storage facility would be anticipated to be less than those associated with constructing the entire GLE facility.

The 2005 NEF EIS for the proposed National Enrichment Facility near Eunice, New Mexico (NRC, 2005a), identified potential impacts on minority and low-income populations would mostly consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts would be short term and limited to on-site activities. Minority and low-income populations residing along site access and the primary commuter roads could experience increased commuter vehicle traffic during shift changes. Increased demand for rental housing during construction could disproportionately affect low-income populations. However, due to the short duration of construction work and the availability of rental housing, impacts on minority and low-income populations would be short term and limited. The results of the 2005 NEF EIS analysis indicated that the construction of the proposed National Enrichment Facility would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations residing in the vicinity of the facility site.

Operation

Minority and low-income populations could be directly or indirectly affected by the operation of a HALEU storage facility. Existing NEPA documentation from sites where a potential storage facility could be located describe operations that are much more extensive compared to the operations associated with a storage facility. Impacts from a HALEU storage facility would be anticipated to be less than the facility operations described in these NEPA documents. However, detailed site-specific analyses would still need to occur to determine impacts for environmental justice communities in the vicinity of the final storage location.

The 2006 ACP EIS (Piketon, Ohio) listed SMALL to MODERATE impacts on the general population and determined that there would be no disproportionately high and adverse impacts on minority or low-income populations associated with the operation of the facility (NRC, 2006b).

The GLE EIS (Wilmington, North Carolina) noted that even where environmental impacts would be SMALL for the general population, some population subgroups, such as individuals participating in outdoor recreation, home gardening, or subsistence hunting and fishing, could be disproportionately affected through the inhalation or ingestion of radionuclides (NRC, 2012b). One census block group, which has a high percentage of low-income and minority residents, is located downstream of the proposed GLE facility on the Northeast Cape Fear River. Residents of this census block group could face increased risk of exposure due to fish consumption; however, releases of total uranium and UF_6 were projected to be extremely low and exposure through fish consumption would be even lower. The GLE EIS concluded that any impacts on the minority and low-income populations from operation of the proposed GLE facility would not be disproportionately high and adverse. The radiological doses to the nearest residents resulting from operation of the proposed GLE facility and current GE operations are projected to be well below the EPA 10 mrem (0.1 millisievert) per year standard (20 CFR 190) and the NRC total effective dose equivalent limit of 100 mrem (1 millisievert) per year (10 CFR 20).

Operation of a HALEU storage facility at a location such as the GLE facility or a similar facility would not be anticipated to have impacts on minority or low-income populations that are disproportionally high or adverse. However, site-specific analysis by the NRC would need to be conducted to make a final determination of impacts.

Summary of Impacts

NEPA documents for existing facilities with construction and operations that are larger in scope than the planned storage activities concluded that any impacts on the minority and low-income populations from construction and operations would not be disproportionately high and adverse. This is likely to be the case for a new HALEU storage facility located at an existing industrial site since most environmental justice-related impacts for the comparable construction and operations were determined to be SMALL or SMALL to MODERATE. This is largely because a HALEU storage facility would disturb only 0.40 ha (1 acre), would employ 6 workers during operations, and would have no radiological releases under normal operations. Therefore, construction and operation of a HALEU storage facility at an existing industrial site would not be anticipated to have impacts on minority or low-income populations that are disproportionate and adverse. However, a site-specific analysis would need to be conducted by the NRC to make a final determination of environmental justice impacts. If the proposed storage facility site is constructed and operated on a brownfield or greenfield site, site-specific environmental justice analysis would be required to determine the potential effects.

6 Human Health – Transportation Impacts

6.1 Description of the Activity

This section presents human health considerations associated with transportation of high-assay low-enriched uranium (HALEU) under the Proposed Action. Both radiological and nonradiological transportation impacts would result from shipment of radioactive material (natural uranium and HALEU products) and wastes. Radiological impacts are those associated with the effects from low levels of radiation emitted during incident-free transportation and from the accidental release of radioactive materials. Nonradiological impacts are independent of the nature of the cargo being transported and are expressed as traffic accident fatalities resulting only from the physical forces that accidents could impart to humans.

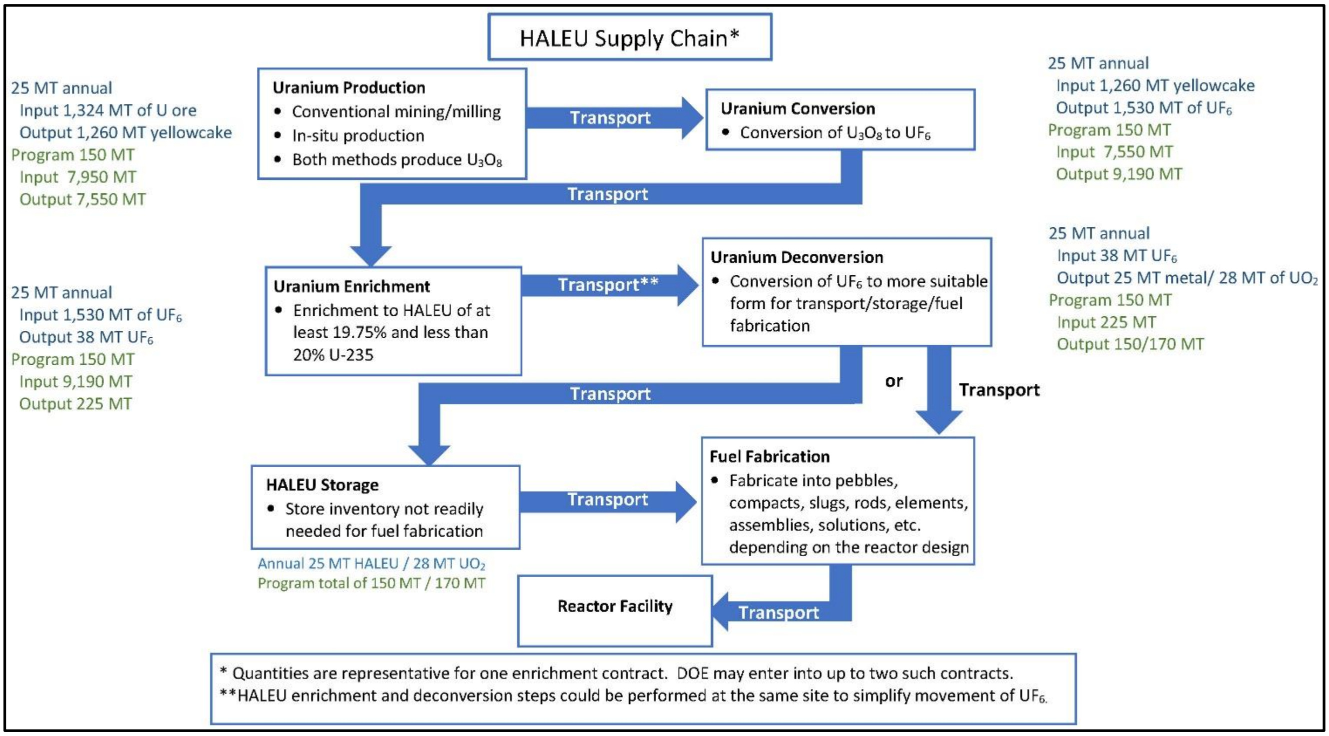
Transportation packaging for radioactive materials is designed, constructed, and maintained to ensure the package contains the package contents and provides radiation shielding. The type of packaging used is determined by the total radioactive hazard presented by the material within the packaging. For example, natural uranium ore is classified as a low specific activity (LSA) material with no activity limit and no specific packaging requirements, as covered under Title 49 Code of Federal Regulations (CFR) Part 173 (49 CFR 173) (Shippers – General Requirements for Shipments and Packaging). Requirements for motor carrier transportation can also be found in 49 CFR 350–399. The refined yellowcake product is generally packed in 55-gallon (gal), 18-gauge drums holding an average of 430 kilograms (kg) (950 pounds [lbs]) and classified by the U.S. Department of Transportation (DOT) as Type A packaging (49 CFR 171–189 and 10 CFR 71). The packaging needs for the other products are identified and discussed in their respective activities' sections. Attachment A to this section provides additional details on the packaging assumed for the transport of uranium in various forms in the Technical Report.

The Technical Report analyzes the environmental consequences of radioactive material transportation activities related to the Proposed Action. Additionally, the U.S. Department of Energy (DOE) would create a HALEU storage capability, until such time as DOE sells or otherwise provides the HALEU it acquires to members of the HALEU consortium.

Activities under the Proposed Action, as shown in Figure 6-1, include:

- **Uranium production/recovery** – both conventional mining and in-situ recovery (ISR) options are considered. The recovered product from this step is yellowcake, which is almost pure (about 0.95%) triuranium octoxide (U_3O_8).
- **Conversion** – processing the yellowcake (primarily U_3O_8) produced during uranium recovery to produce uranium hexafluoride (UF_6)
- **Enrichment** – enriching the natural uranium (uranium-235 [U-235] enrichment of 0.711%) to HALEU (U-235 enrichment of 19.75%)
- **Deconversion** – converting the enriched HALEU to a form suitable for fabrication into reactor fuel, most likely metallic uranium, or uranium dioxide (UO_2)
- **HALEU storage** – a facility to store the HALEU products (i.e., metal, oxide, or both)

The stated goal of the Proposed Action is to create a demand for up a total production of 290 metric tons (MT) (rounded up to 300 MT for analysis purposes) at an assumed production rate of 50 MT per year, all of which could be stored in the HALEU storage facility. To meet the demand of 50 MT of HALEU per year, DOE may exercise two separate contracts (DOE, 2023a). The analyses herein are based on the annual production level of 25 MT of HALEU per contract.



Key: % = percent; HALEU = high-assay low-enriched uranium; MT = metric ton; U = uranium; U-235 = uranium-235; U_3O_8 = triuranium octoxide; UF_6 = uranium hexafluoride; UO_2 = uranium oxide

Figure 6-1. Components of the HALEU Supply Chain and the Required Quantities for the HALEU EIS

The human health transportation risk analysis in the Technical Report incorporates by reference resource conditions and impact considerations of the primary existing National Environmental Policy Act (NEPA) documentation sources, as well as other related online/available sources including site-specific NEPA documentation, and Federal and state databases. The analysis provides a range of potential impacts that could occur for transporting various radioactive materials (e.g., feed, product, and wastes) from each activity/process for the HALEU production.

6.2 Uranium Production/Recovery

Uranium production/recovery is the first step of the HALEU fuel production cycle (see Figure 6-1). Both conventional mining and milling and ISR options are considered. In ISR, the uranium recovery takes place within the naturally situated ore body underground and processing is performed at the recovery site. Whereas the conventional mining requires an additional transport of ore to the milling site, where it is crushed, diluted, and processed to recover uranium. The processing and separation activities are similar in both options.

In determining the transportation impacts during uranium recovery, the analysis incorporates by reference the results presented in the following U.S. Nuclear Regulatory Commission (NRC)-generated generic NEPA documentation:

- For conventional mining and milling, the analysis approach and discussions is based on NUREG-0706, *Final Generic Environmental Impact Statement on Uranium Milling Project M-25* (NRC, 1980) (referred to as the "UM GEIS")
- For ISR, the analysis approach and discussions will be based on NUREG-1910, *Generic Environmental Impact Statement for In-Situ Leach Uranium Mining Facilities* (NRC, 2009a) (referred to as the "ISR GEIS")

6.2.1 Conventional Uranium Milling

The NRC *Final Generic Environmental Impact Statement on Uranium Milling Project* (i.e., the UM GEIS) model was based on the following considerations (NRC, 1980, pp. 5-1). The model mill is to have an ore-processing capacity of 1,800 MT (2,000 short tons [ST]) per day. The grade of the ore to be processed by the model mill was expected to be average 0.10% (U_3O_8). The ore is to be transported from the mine to the mill by trucks with an average load of 23 MT (25 ST) over an average hauling distance of 50 kilometers (km) (30 miles). The model mill is assumed to be operated 310 days per year, with a uranium recovery efficiency of 93%, the average annual production is about 520 MT (570 ST) of U_3O_8. If the product is 90% U_3O_8, the yellowcake production rate is 580 MT (635 ST) per year. The yellowcake is shipped by truck in 55-gal drums; each contains a maximum of 430 kg (950 lbs) of yellowcake, and up to 40 drums are carried on each truck, hence approximately 34 shipments will be required annually. The model assumes that the yellowcake is shipped by truck an average of 2,400 km (1,500 miles) to a conversion plant, which transforms the yellowcake to UF_6 for the enrichment step of the light water-cooled reactor fuel cycle (NRC, 1980, pp. 7-8).

The radioactive materials handled at the model mill typically have LSA, i.e., 10^{-9} curies per gram (Ci/g) for the tailings, 10^{-9} Ci/g for the ore, and 6×10^{-7} Ci/g for the refined yellowcake product (NRC, 1980, pp. 7-1). The quantities of materials handled, for the 580 MT (635 ST) of yellowcake per year, would be about 350 Ci of radioactivity.

Using a probability of truck accident rate of 1.3×10^{-6} per vehicle-km, the likelihood of a truck shipment of yellowcake from the mill being involved in an accident of any type during a one-year period would be approximately 11%.[25]

Two models were used to define the amount of yellowcake that would be released from drums as a result of the accident (NRC, 1980, pp. 7-9). Expected fractional yellowcake release from a truck was calculated as a function of accident severity and probability. The expected fractional release from an accident was 0.45 for the bounding case (Model I) and 0.03 for the more realistic case (Model II). These fractional releases were used to calculate 50-year dose commitments per accident in a well-populated area with a density of 61 persons per km^2 (160 persons per square miles) of 200 person-rem for Model I and 14 person-rem for Model II (NRC, 1980, pp. 7-10). The consequences of transporting other radioactive materials (e.g., ores, slurries, or uranium-loaded resin) would be smaller than that of the yellowcake, which was assumed to be fine power.

When combined with a health risk conversion factor of 6×10^{-4} per rem, per person-rem (DOE, 2003), an expected 0.1 and 0.007 latent cancer fatalities (LCFs) per accident for Models I and II were estimated, respectively. Using the 0.11 probability of an accident per year per facility leads to an estimated expected 0.01 (Model I) or 0.0008 (Model II) LCFs per year as a result of yellowcake transport accidents associated with one facility. These impacts are considered to be SMALL.

The Proposed Action would require up to 1,260 MT of yellowcake per year per enrichment contract, which would require about 1.32 million MT of ore with an average ore grade of 0.1%,[26] leading to approximately 74 shipments of yellowcake and 57,400 shipments of ore, annually. Section 1, *Uranium Mining and*

---

25 This probability was obtained by multiplying the probability of an accident per vehicle-km (1.3×10^{-6}/km) by the number of shipments per year (34) and the distance per shipment 2,400 km (1,491 miles).

26 Note, this assumption is conservative, as this grade would require larger amounts of ore. Uranium concentrations in the ore deposit vary depending on system geochemistry and hydrology. For example, in New Mexico, uranium deposits typically contain about 0.2% to 0.3% U_3O_8 by weight, while deposits in Wyoming contain lower concentrations (about 0.1% to 0.25%) (NRC, 2009, pp. 2-4).

Milling, lists three conventional uranium milling locations and one milling processing facility. Table 6-1 summarizes the estimated distances between the ore, milling, and conversion facility for the listed sites.

After yellowcake is produced, it is transported to a conversion facility in Metropolis, Illinois (the only conversion facility in the United States), to produce UF_6. Using the average U.S. truck accident and fatality rates of 5.77×10^{-7} and 2.34×10^{-8} per km (Saricks & Tompkins, 1999; UMTRI, 2003), the likelihood of a truck shipment of yellowcake from the mill (White Mesa, Utah) being involved in an accident of any type, during a 1-year period, would be approximately 10%, or 90% of the likelihood determined in the UM GEIS (NRC, 1980). Hence, the nonradiological consequences of any accidents involving yellowcake would be SMALL, accordingly.

Table 6-1. Estimated Distances Between the Uranium Mines and the Mill, and Between the Mill and the Conversion Facility

Origin (Mines/Mills)	*Destination (Mill/Conversion)*	*Distance in miles (km)*	*Remarks*
Northwest AZ (Mojave County)	White Mesa Mill, UT	372 (599)	Distance from Google Maps
Southwest CO (Montrose and San Miguel Counties)	White Mesa Mill, UT	62–166 (100–266)	Distance range is from Table 4.3-12 of the ULP EIS (DOE/EIS-0472) (DOE, 2014)
Southeast UT (San Juan County)	White Mesa Mill, UT	74 (119)	Distance from Denison site in White Canyon, UT
White Mesa Mill, UT	Conversion, Metropolis, IL	1,422 (2,288)	Distance from Google Maps

Key: AZ = Arizona; CO = Colorado; DOE/EIS = Department of Energy Environmental Impact Statement; IL = Illinois; km = kilometers; ULP EIS = Uranium Leasing Program Environmental Impact Statement; UT = Utah

The *Final Uranium Leasing Program Programmatic Environmental Impact Statement (DOE/EIS-0472)* (DOE, 2014) (referred to as the "ULP EIS") evaluated the population and truck drivers' doses for a production rate of 2,000 ST (1,800 MT) per day. The average collective dose to the public from transporting uranium ore in the region was estimated to be approximately 1.54×10^{-7} person-rem/km. The average dose to a truck driver was estimated to be approximately 8.08×10^{-7} rem/km (DOE, 2014, pp. D-3 in Appendix D). Given that this analysis used the White Mesa milling site and the production rate would be similar to that being used in the Technical Report, the incident-free radiological impacts of transporting ores to the milling station is also SMALL.

6.2.2 In-Situ Leaching/Recovery

In the ISR GEIS, the NRC assessed the potential environmental impacts associated with the construction, operation, aquifer restoration, and decommissioning of ISR uranium recovery facilities (NRC, 2009a). The ISR GEIS considered four regions: Wyoming West, Wyoming East, Nebraska-South Dakota-Wyoming, and Northwestern New Mexico.

Table 2.8-1 of the ISR GEIS (NRC, 2009a, pp. 2-39) lists the estimated annual transports of various materials. Table 2.8-1 of the ISR GEIS estimated annual yellowcake transports between 21 and 143 and a frequency of remote ion-exchange truck shipments of 365 (1 per day) to support ISR facility operation.

The ISR GEIS (NRC, 2009a) indicated that an in-situ leaching facility could use a variety of routes for actual yellowcake shipments, but the shipment distances for alternate routes are not expected to differ significantly from those estimated for the representative routes. The ISR GEIS indicates that the NRC has previously analyzed the hazards associated with yellowcake transport for both the generic and site specific (NRC, 2009a, pp. 4.2-6). It added that these analyses were conservative and tended to overestimate the impacts (e.g., release model, accident rates, dosimetry, and exposed population density). The ISR GEIS refers to the analysis of accidents involving yellowcake transport in the UM GEIS (NRC, 1980). It also states that using the maximum permitted yellowcake production of 145 shipments in an ISR facility would increase the estimated doses in the UM GEIS by a factor of 4.3 (e.g., 145/34). Safety controls and compliance with existing transportation regulations in 10 CFR 71 add confidence that yellowcake can be shipped safely with a low potential of affecting the environment. That is because the transport drums must meet specifications of 49 CFR 173, which is incorporated in NRC regulations at 10 CFR 71, and the delivery trucks must meet safety certifications and that drivers hold appropriate licenses. Therefore, the potential radiological impacts associated with yellowcake transportation are SMALL.

The radiological impacts of ion-exchange resin transports are expected to be lower than estimated risks from the finished yellowcake product because (NRC, 2009a, pp. 4.2-8):

- Ion-exchange resins are less concentrated {about 50 grams per liter [0.009 ounces per gal]} than yellowcake and therefore will contain less uranium per shipment than a yellowcake (about 85% uranium by weight) shipment.
- The uranium in ion-exchange resins is chemically bound to the resins; therefore, it is less likely to spread and easier to remediate in the event of a spill or release of shipped material.
- While the shipment distance for remote ion exchange varies for each ISR site, the total annual distance traveled by ion-exchange shipments is normally less than the same for yellowcake shipments.

The NRC regulations at 10 CFR 71 and the incorporated DOT regulations for shipping ion-exchange resins, which are enforced by NRC on-site inspections, also provide confidence that safety will be maintained and the potential for environmental impacts would be SMALL.

Furthermore, all radioactive waste shipments are shipped in accordance with the applicable NRC requirements in 10 CFR 71 and DOT requirements in 49 CFR 171–189. Risks from transporting yellowcake shipments during operations bound the risks expected from waste shipments, owing to the concentrated nature of shipped yellowcake, the longer distance yellowcake is shipped relative to waste destined for a licensed disposal facility, and the relative number of shipments for each type of material. Therefore, impacts from transporting ISR facility byproduct wastes would be SMALL.

The Proposed Action would require about 74 shipments per year of yellowcake to the conversion facility. Other radioactive wastes (e.g., ion exchange-resin and radioactive wastes) would be similar to those listed in the ISR GEIS. Section 1, *Uranium Mining and Milling*, lists the ISR facility locations, some of which are those listed in the ISR GEIS:

- Northwest Nebraska (Dawes County)
- Northwest New Mexico (McKinley County)
- Southwest South Dakota (Fall River and Custer Counties)
- South Texas (Goliad, Brooks, and Duval Counties)
- Eastern Wyoming (Campbell, Crook, Johnson, and Converse Counties)
- Southwestern Wyoming (Sweetwater County)

Table 6-2 summarizes the estimated distances between the ISR locations and the conversion facility in Metropolis, Illinois.

After yellowcake is produced, it is transported to a conversion facility in Metropolis, Illinois (the only conversion facility in the United States), to produce UF_6 for use in the production of nuclear reactor fuel. Using the average U.S. truck accident and fatality rates of 5.77×10^{-7} and 2.34×10^{-8} per km (Saricks & Tompkins, 1999; UMTRI, 2003), the likelihood of a truck shipment of yellowcake from an ISR location with a maximum distance of 2,285 km (1,420 miles) being involved in an accident of any type during a one-year period would be approximately 9.8%, which is slightly less than the likelihood (e.g., 11%) determined in the UM GEIS (NRC, 1980). Hence, the consequences of any accidents involving yellowcake would be SMALL, accordingly.

Table 6-2. Estimated Distances Between the ISR Locations and the Conversion Facility

Origin (ISR)	*Destination Conversion Facility*	*Distance in Miles (km)*	*Remarks*
Northwest NE (Dawes County)	Metropolis, IL	1,410 (2,253)	Section 3.4 of ISR GEIS [maximum distance]
Northwest NM (McKinley County)	Metropolis, IL	1,350 (2,172)	Section 3.5 of ISR GEIS [maximum distance]
Southwest SD (Fall River and Custer Counties)	Metropolis, IL	1,410 (2,253)	Section 3.4 of ISR GEIS [maximum distance]
South TX (Goliad, Brooks, and Duval Counties)	Metropolis, IL	1,090 (1,754)	Distance from Google Maps [maximum distance]
Eastern WY (Campbell, Crook, Johnson, and Converse Counties)	Metropolis, IL	1,420 (2,285)	Section 3.3 of ISR GEIS [maximum distance]
Southwestern WY (Sweetwater County)	Metropolis, IL	1,400 (2,253)	Section 3.2 of ISR GEIS [maximum distance]

Key: IL = Illinois; ISR GEIS = *Generic Environmental Impact Statement for In-Situ Leach Uranium Mining Facilities* (NRC, 2009a); km = kilometers; NE = Nebraska; NM = New Mexico; SD = South Dakota; TX = Texas; WY = Wyoming

6.3 Uranium Conversion

Uranium conversion is the second step of the HALEU fuel production cycle (see Figure 6-1). In the conversion process, yellowcake (primarily U_3O_8) produced during uranium production (either conventional or ISR option, or both) is converted in a series of steps to UF_6. The proposed conversion activity for the Proposed Action includes operation of a conversion facility, as evaluated in Section 2, *Uranium Conversion*. The conversion activities could occur either at a new facility (to be constructed) or at the existing Metropolis Works facility in Metropolis, Illinois (the "Metropolis facility"), with sufficient excess capacity to accommodate the HALEU fuel cycle needs. Here, the Metropolis facility is used as a surrogate for the purposes of analysis in the Technical Report.

Only one facility in the United States performs commercial-scale uranium conversion—the Metropolis facility, along the Ohio River, which ConverDyn (formerly Honeywell International) owns and operates. The NRC completed an Environmental Assessment (EA) in 2019 that evaluated the impacts of renewing the operating license for 40 years (NRC, 2019a). In 2020, the NRC approved an extension of the facility license to March 2060 (NRC, 2020c). This facility is licensed to convert up to 15,000 MT of uranium per year from ore concentrates into UF_6.

The annual demand of 25 MT of HALEU fuel per enrichment contract would require the conversion of 1,260 MT of yellowcake to 1,530 MT of UF_6. The 1,260 MT of yellowcake, as discussed in Section 6.2, *Uranium Production/Recovery*, would be transported in 55-gal drums in about 74 shipments to this conversion facility, which then would produce 1,530 MT of UF_6 (with a 98% purity) that would be transported to an enrichment facility in 48-Y cylinders with a maximum net capacity of 12.5 MT of UF_6 and an average of 12 MT of UF_6. These assumptions would lead to 123 to 128 cylinders; considering a maximum of 128 48-Y cylinders, or 128 truck shipments (one cylinder per shipment), to an enrichment facility.

In determining the transportation impacts during uranium conversion, the analysis incorporates the results presented in the following NRC-generated NEPA documentation:

- *Environmental Assessment for the Proposed Renewal of Source Material License SUB-526 Metropolis Works Uranium Conversion Facility* (Massac County, Illinois) (NRC, 2019a)[27] (referred to as the "Metropolis EA")

The Metropolis EA indicates that the analysis in NUREG-0170 (NRC, 1977b) concludes that "the average radiation dose to the population at risk from normal transportation is a small fraction of the limits recommended for members of the public from all sources of radiation other than natural and medical sources and is a small fraction of natural background dose," (NRC, 2019a, pp. 4-3). It emphasized that the earlier environmental analysis (NRC, 1977b) considered the types of activities conducted at the Metropolis facility, including the receipt of yellowcake and shipment of UF_6.

For the accident analysis, the EA uses the radiological impacts from accidents involving yellowcake transport from the ISR GEIS (NRC, 2009a) for the maximum shipments to indicate that the potential risk is SMALL (NRC, 2019a, pp. 4-3). For the nonradiological impacts, the Metropolis EA presents potential traffic fatality risks for all transport types with a conclusion of no fatalities for truck and rail shipments transport mileage of about 3.86 million km (2.4 million miles). The annual shipment estimates of yellowcake and UF_6 shipments were 700 and 660, respectively.

The Proposed Action would require 74 shipments of yellowcake into the facility and 128 shipments of UF_6 transported to an enrichment facility, annually. These shipments represent about 10% to 20% of the yellowcake and UF_6 shipments analyzed in the Metropolis EA. Hence, the impacts of additional transports for the Proposed Action are a small fraction of the analyzed impacts in the Metropolis EA, which was concluded to be SMALL.

6.4 Uranium Enrichment

Uranium enrichment is the third step of the HALEU fuel production cycle (see Figure 6-1). In the enrichment process, the natural UF_6 would be enriched in U-235 from 0.711% to a maximum of 19.75%. Three different enrichment facilities are considered:[28]

- Gas centrifuge enrichment plant at Urenco USA (UUSA) (previously Louisiana Energy Services) in New Mexico
- Gas centrifuge enrichment plant at Centrus Energy Corp (previously American Centrifuge Plant [ACP]) (currently "Centrus") in Ohio
- Laser enrichment plant at Global Laser Enrichment, LLC (GLE) in Wilmington, North Carolina[29]

Currently, UUSA in Eunice, New Mexico, is the only operating gas centrifuge commercial production plant in the United States, initially licensed to Louisiana Energy Services (under license SNM-2010). The NRC granted licenses for two other commercial gas centrifuge facilities including the ACP in Piketon, Ohio, and Eagle Rock Enrichment Facility near the city of Idaho Falls, Idaho, which is currently terminated, and no further activities have occurred for this location; therefore, the Eagle Rock Enrichment Facility is not considered in the Technical Report. The construction of the ACP facility as initially proposed was not

27 DOE/National Nuclear Security Administration has independently reviewed NRC's Final EA to assess the potential environmental impacts of the proposed license renewal and of reasonable alternatives while reflecting regulatory changes and operational and environmental experience obtained during the most recent 10 years of facility operation, and the Final EA was adopted, as DOE/EA-2184 (available at https://www.energy.gov/nepa/doeea-2184-renewal-source-material-license-sub-526-metropolis-works-uranium-conversion).

28 These facilities would be analyzed as representative of two types of technologies and facilities that could produce HALEU in the timeframe required.

29 Even though the license for this facility was terminated on January 5, 2021, the facility was selected to represent a new enrichment process and provide a reasonable alternative to gaseous centrifuge (NRC, 2023d).

completed. However, the ACP site has been used for demonstration of enrichment technologies including ongoing demonstration efforts to enrich uranium and produce HALEU using centrifuges.

A license for the full-scale General Electric (GE)-Hitachi uranium enrichment facility (license SNM-2019) was issued in 2012, but the license was terminated in 2021. However, GLE was licensed for a test loop in 2008 and continues to conduct demonstrations at the Wilmington, North Carolina, site. The Wilmington site is also the proposed location for the Natrium™ Fuel Facility, to produce HALEU metallic fuel that will be jointly funded by TerraPower and DOE through the Advanced Reactor Demonstration Program.

6.4.1 Uranium Enrichment at UUSA Plant

The UUSA received NRC authorization and began enrichment activities in June 2010 for a nominal capacity of 3 million separative work units (SWUs) per year (SWUs/yr), which was amended to 10 million SWUs/yr in 2015. The NRC issued an EIS for the original license in 2005 (NRC, 2005a) for the National Enrichment Facility (NEF) (referred to as the "2005 NEF EIS") and an EA for capacity expansion in 2015 (NRC, 2015) (referred to as the "2015 UUSA EA").

In this section, the transportation analyses incorporate the results and insights from the 2015 UUSA EA, which evaluated the transport of various radioactive material shipments to and from the facility during the operation of the proposed expanded UUSA facility, including the following:

- Natural UF_6 (i.e., not enriched) feed to the facility
- Enriched UF_6 product from the facility to a fuel fabrication facility
- Depleted UF_6 (DUF_6) to a conversion facility
- Return of empty feed cylinders with residual contamination
- Low-level radioactive wastes (LLW) for disposal

All shipments are anticipated to occur via tractor-trailer combination trucks.

The transportation of radiological materials is subject to NRC regulations (10 CFR 71) and DOT regulations (49 CFR 171–180). All the materials shipped to or from the proposed UUSA facility would be shipped in Type A containers. The product material is regulated by the NRC as fissile material and would require additional fissile packaging considerations such as using an overpack surrounding the shipping container. All feed and product cylinders shipped to and from the enrichment facility would be transported by truck. These cylinders are designed, fabricated, and shipped in accordance with the American National Standards Institute (ANSI) standard for packaging and transporting UF_6 cylinders (ANSI N14.1) (ANSI, 2001).

The assessment of potential radiological transportation impacts from expanded operations was based on the transportation assessment presented in the 2005 NEF EIS (NRC, 2005a), which included an estimate of the transportation risks associated with an annual production capacity of 3 million SWUs (i.e., the original licensed capacity of the UUSA facility). The proposed capacity expansion to 10 million SWUs/yr would result in additional radioactive material shipments of the same types, using the same shipment origins and destinations, which were estimated by scaling the previously reported risks (NRC, 2005a) by the number of shipments for each type of shipment (NRC, 2015, p. 98).

The NRC indicated that it is anticipated UF_6 feed may be obtained from a U.S. facility (the Metropolis facility owned by ConverDyn [formerly, Honeywell International], Metropolis, Illinois) or from a Canadian source (Cameco, Port Hope, Ontario, Canada). UF_6 product may be shipped to and used at fuel fabrication facilities in Wilmington, North Carolina (Global Nuclear Fuel – Americas, or GNF-A); Columbia, South Carolina (Westinghouse Electric [WE]); and Richland, Washington (AREVA NP Inc. [now called Framatome Inc.]). The depleted UF_6 tails could be sent to the DOE facilities in Paducah, Kentucky, or Portsmouth, Ohio, or to a new facility to be constructed at another location, for conversion to uranium oxide for disposal.

In the case of LLW generated at the UUSA facility, only the transport to Energy*Solutions* disposal facility in Clive, Utah, is evaluated. Should an agreement be made between UUSA and the Waste Control Specialists (WCS) facility in Andrews, Texas, for waste shipments, the risk would be bounded by the impacts for shipments to Energy*Solutions*, since the WCS facility is adjacent to the UUSA facility.

The maximum impacts would occur if the number of peak annual shipments occurred in the same year (3,213 shipments total)[30] for all shipment types for the origin or destination that incurs the highest impact for that shipment type (all feed cylinders from Port Hope, Canada, product cylinders to Wilmington, North Carolina, depleted UF_6 cylinders to Portsmouth, Ohio, empty cylinders to Port Hope, Canada, and LLW to Clive, Utah). This situation would be considered an upper bound on the potential impacts. No LCFs would be expected for either crew members (4×10^{-3} LCF) or the general public (0.01 LCF) along the route. The exposure would be spread out among all transportation crew members and people along the transportation routes. Thus, radiological transportation impacts on the transportation crews and collective population during expanded operations would be SMALL for the entire 10 million SWU facility. In addition, the incremental routine transportation impacts due to facility expansion would be SMALL (NRC, 2015, p. 100).

The total annual radiological collective population LCF risk from transportation accidents for all shipments from a 10-million-SWU/yr facility, for the most conservative case (all shipments to their most distant locations), was estimated to be 0.7, a value 0.3 higher than the fatality risk estimated for the 3-million-SWU/yr facility. Since the additional 0.3 LCF risk would be spread out among all people along the transportation routes, the annual radiological transportation accident impacts from the facility expansion to the collective population during operations would be SMALL (NRC, 2015, p. 103). In terms of incident-free and accident risks, higher risks are associated with the assumption that all feed materials would come from Canada; product cylinders would be sent to Wilmington, North Carolina; depleted cylinders to Portsmouth, Ohio; empty cylinders to Port Hope, Canada, and LLW to Clive, Utah (NRC, 2015, pp. Tables 4-1 and 4-2).

For the purposes of the Technical Report, the natural UF_6 feed material would come from the Metropolis facility owned by ConverDyn in Metropolis, Illinois, or from a Canadian source (Cameco, Port Hope, Ontario, Canada) in up to 128 48-Y cylinders, or 128 truck shipments (1 cylinder per truck), similar to the assumption used in the 2015 UUSA EA. The HALEU product would then be 38 MT of enriched UF_6 (to be stored or transported to a deconversion facility), and about 124 48-Y cylinders of DUF_6, to be stored or transported to a deconversion facility. Therefore, about 4 cylinders (e.g., 128 − 124) per year is considered to be returned to the Metropolis facility or Canada. Using the information provided in Table 4-1 of the 2015 UUSA EA (NRC, 2015, p. 101), and using the radioactive material shipments of the same types and the same shipment origins and destinations, the risks were estimated by scaling the previously reported risks (NRC, 2015) by the number of shipments for each type of shipment in the Technical Report. Hence, the estimated annual transportation risks for the feed material and the return of the 48-Y cylinders to the Metropolis facility in terms of the workers (drivers) LCF risk and the excess fatalities among the exposed population would be about 0.00007 and 0.0002, for the feed material and about 0.0000062 and 0.000018 for the return of the cylinders, respectively. The estimated similar annual transportation risks for the feed

[30] This includes: 1,259 shipments of natural UF_6 (from ConverDyn, or Canada), 235 shipments enriched UF_6 (to Richland, Washington; Wilmington, North Carolina; or Columbia, South Carolina), 1,390 shipments of depleted UF_6 (to Portsmouth, Ohio; or Paducah, Kentucky), 225 shipments of empty 48-Y cylinders (to ConverDyn, or Canada), and 104 shipments LLW (to Clive, Utah).

material and the return of the 48-Y cylinders to the Canadian source would be about 0.0002 and 0.0004 for the feed and about 0.000009 and 0.00005 for the return of the cylinders, respectively.

Currently, the only certified fissile material packaging that could be used to transport UF_6 enriched up to 20% U-235 (HALEU in the form of UF_6) is the DN30-X package (NRC, 2023b). The DN30-X transports 30B-X (x = 10 [10% enriched], and × = 20 [20% enriched-HALEU]) UF_6 cylinders in Type B equivalent overpacks (protective structural package [PSP]). The 30B-20 cylinders are similar to the Model 30B cylinders with an additional criticality control system (CCS). The CCS consists of criticality control rods (CCRs) containing neutron poison material in the form of boron carbide. The 30B-20 cylinder can hold up to 1,271 kg (2,802 lbs) of UF_6 enriched up to 20% U-235 (HALEU in the form of UF_6), which is about half of the capacity that could be transported in a 30B cylinder for up to 5% enriched U-235. However, for the analysis purposes, each 30B-20 is considered to contain an average of 1.25 MT of HALEU in the form of UF_6.[31] Using the DN30-20 PSP for transporting HALEU in the form of UF_6 would lead to a maximum of 31 30B-20 packages in eight shipments (assuming four PSPs per truck). If we were to consider that these shipments would have similar external dose rates as that of transporting 30B cylinders shipment used in the 2015 UUSA EA, then the incident-free risk to the workers and general population LCFs from transporting the HALEU in the form of UF_6 to a fuel fabrication facility would be 0.000003 and 0.00001.[32]

Similarly, the accident risks can be estimated using the data in Table 4-1 of the 2015 UUSA EA. These impacts would also be SMALL. Therefore, the overall risks of the radioactive material transports during enrichment activities at UUSA associated with the Proposed Action is SMALL.

6.4.2 Uranium Enrichment at Centrus Plant

The Centrus ACP in Piketon, Ohio, initially involved the proposed construction and operation of a plant to enrich uranium up to 10%, with an initial production capacity of 3.5 million SWUs potentially expandable to 7 million SWUs. The Centrus ACP would be located at the same site as DOE Portsmouth Gaseous Diffusion Plant (now called the Portsmouth site), which has been shut down since May 2001. The ACP would consist of refurbished existing buildings, newly constructed facilities, and adjacent grounds owned by DOE and leased by Centrus (formerly United States Enrichment Corporation [USEC]). The NRC issued an EIS (NUREG-1834) for ACP in 2006 (NRC, 2006b) (referred to as the "2006 ACP EIS"). In April 2007, a 30-year license (license SNM-2011) was issued to USEC (now Centrus) to construct, operate, and decommission the ACP, a commercial-scale gas centrifuge uranium enrichment facility. The license is held by American Centrifuge Operating (ACO), a subsidiary of Centrus. In 2011, DOE adopted the 2006 ACP EIS (NRC, 2006b) and issued DOE/EIS-0468 (DOE, 2011).

In 2021, ACO (Centrus) applied to amend the facility possession licensed material to support the contract with DOE to produce HALEU. ACO entered into a contract agreement with DOE to enrich uranium and produce HALEU for nuclear reactor fuel development. This amendment was evaluated by NRC in the 2021 ACP Amendment EA (NRC, 2021c) and approved in 2021. The HALEU license amendment authorizes ACO to enrich U-235 up to 25%.

In the Technical Report, the transportation analyses incorporate the results and insights from the DOE/EIS-0468 (DOE, 2011), which is essentially the NRC's 2006 ACP EIS (NRC, 2006b). The 2006 ACP EIS evaluated the transport of various radioactive material shipments to and from the facility during the proposed ACP operation, which include essentially similar activities as those listed under the enrichment at UUSA, in Section 6.4.1, *Uranium Enrichment at UUSA Plant*. The only difference is that the depleted uranium

[31] In its presentation to the NRC, Daher indicated that goal is to transport up to 1,250 kg (2,756 lbs) of UF_6 enriched to 20% (Daher, 2020).

[32] Fuel fabrication at Richland, Washington, was used; comparatively it is the highest dose risk.

conversion will occur at the Portsmouth site, which is near the ACP facility, and hence, very limited transportation of the DUF_6 would occur.

The transportation analyses in the 2006 NRC/2011 DOE EISs are based on the following considerations:

- It is anticipated that approximately 1,100 shipments of feed cylinders per year will arrive at the ACP from a U.S. facility (i.e., the Metropolis facility owned by ConverDyn in Metropolis, Illinois) or from a Canadian source (Cameco, Port Hope, Ontario, Canada).[33]
- The enriched uranium product, up to 10 weight percent (U-235), is transported in 30-inch 2.5-ton cylinders (30B-10)[34] to fuel fabrication facilities in in Wilmington, North Carolina (GNF-A); Columbia, South Carolina (WE); and Richland, Washington (AREVA NP [now called Framatome Inc.]).[35]
- LLW would be shipped off-site to Clive, Utah; and/or the Nevada National Security Site (formerly the Nevada Test Site).

The 2006 ACP EIS (NRC, 2006b) evaluated impacts for the transportation of feed material, product, heel cylinders, radioactive waste, and the converted depleted uranium showing some increased risk of cancer to both the occupational workers transporting and handling the material and to members of the public driving on the roads or living along the transportation routes. Considering an upper enrichment of 5%, the transport of all materials is estimated to result in approximately 0.014 LCFs per year of operation from exposure to direct radiation during incident-free transport, and an additional 0.008 LCFs per year from accidents that result in the release of radioactive material into the environment. The total LCFs are estimated to be 0.02 per year of operation, or less than one LCF over 30 years of operation. If the 10% enrichment product were to be used, the NRC determined that the risks would be slightly larger; nevertheless, it is concluded the public and occupational health impacts associated with the proposed transport of radioactive materials are expected to be SMALL.

As indicated in Section 6.4.1, *Uranium Enrichment at UUSA Plant*, the natural UF_6 feed material would come from the Metropolis facility (Illinois) or a Canadian source (Cameco, Port Hope, Ontario, Canada) in up to 128 48-Y cylinders, or 128 truck shipments (one cylinder per truck), similar to the assumption used in the NRC's 2006 ACP EIS. The HALEU product produced would be 38 MT of enriched UF_6, and about 124 48-Y cylinders of DUF_6. Using the information provided in Table D-12 of DOE/EIS-0468 (DOE, 2011, pp. D-14), the estimated annual transportation risks for the feed material in terms of the workers' (drivers) LCF risk and the excess fatalities among the exposed population would be about 0.00028 and 0.00093 (for feeds from the Metropolis facility) and about 0.0003 and 0.001 (from a Canadian source), respectively. The risks for other related activities (i.e., products, wastes, would also be comparatively small).

Again, considering that the HALEU shipments in 30B-20 (8 shipments), and assuming that these shipments would have similar external dose rates as that of the 30B shipments used in the NRC's 2006 ACP EIS, then the incident-free risk to the workers and general population LCFs from transporting the HALEU in the form of UF_6 to a fuel fabrication facility would be 0.000007 and 0.00002, respectively.[36]

---

[33] The ACP Environmental Report Table 4.2.3.2-1 indicates 550 shipments of feed materials from either a U.S. facility or a Canadian source (ML20139A097) (USEC, 2006).

[34] The assumption has been made in this analysis that regulatory approval has been granted to ship up to 10 weight percent product in the 30B cylinders.

[35] The ACP ER anticipates 300 shipments to Richland, Washington; 350 shipments to Columbia, South Carolina; and 400 shipments to Wilmington, North Carolina. Domestic shipments contain up to six cylinders of 30B-10 in PSPs (also referred to as overpacks) per flatbed trailer.

[36] Fuel fabrication at Richland, Washington, was used; it is the farthest distance.

Similarly, the accident risks can be estimated using the data in Table D-13 of NRC's 2006 ACP EIS. These impacts would also be SMALL. Hence, the overall risks of the radioactive material transports during enrichment activities at the Centrus facility associated with the Proposed Action is SMALL.

6.4.3 Uranium Enrichment at GLE Plant

The proposed GLE facility would employ a laser-based process to enrich uranium up to 8% U-235 by weight (although nuclear power reactors normally require 3% to 5% U-235 by weight), with an initial planned maximum target production of 6 million SWUs/yr. In 2012, the NRC issued an EIS (NUREG-1938) for the GLE construction and operation at the Wilmington fuel fabrication facility in North Carolina (NRC, 2012b) (referred to as the "GLE EIS").

The GLE EIS indicates that feed cylinders are expected to be transported to the site by truck (NRC, 2012b, pp. 2-18). It is anticipated that approximately 900 shipments of feed cylinders (48-Y cylinders) per year would arrive at the proposed GLE facility. Expected feed suppliers include the Cameco Corporation (Port Hope, Ontario, Canada), ConverDyn (the Metropolis facility in Illinois), and other possible foreign sources. Empty feed cylinders would be returned to the customers for refilling.

Enrichment would normally be 3% to 5% by weight of U-235, although GLE's license application indicates GLE seeks authorization to produce enriched uranium up to 8% by weight of U-235. The enriched products will use 30-inch cylinders (Type 30B) to be transported to customers (e.g., nuclear fuel fabrication facilities). An average product shipment frequency of six cylinders per day is anticipated at full production capacity, for an annual total of approximately 2,100 shipments.

All cylinders would be prepared for shipment and shipped in accordance with the applicable NRC and DOT regulations. All product cylinders shipped from the proposed GLE Facility would be transported by truck. These cylinders would be designed, fabricated, and shipped in accordance with the ANSI (2001) standard for packaging and transporting UF_6 cylinders (ANSI N14.1).

Approximately 900 Type 48-Y cylinders of DUF_6 tails are expected to be generated by the GLE facility per year during full operation. There are no plans for on-site processing or disposal of DUF_6, so the cylinders would be stored on the Tails Storage Pad and monitored until they are ready to be shipped off-site (NRC, 2012b, pp. 2-19).

The GLE EIS evaluated the transport of various radioactive material shipments to and from the facility during the operation of the proposed GLE, which include similar activities as those listed for the UUSA facility, in Section 6.4.1, *Uranium Enrichment at UUSA Plant*.

The NRC indicated that a number of these shipments may have multiple origins or destinations (NRC, 2012b, pp. 4-66). UF_6 feed may be obtained from a U.S. facility (i.e., the Metropolis facility owned by ConverDyn in Metropolis, Illinois), a Canadian source (Cameco, Port Hope, Ontario, Canada), or from overseas sources arriving at U.S. seaports (Portsmouth Marine Terminal, Portsmouth, Virginia; or Dundalk Marine Terminal, Baltimore, Maryland). UF_6 product may be used at the Wilmington site or sent to other fuel fabrication facilities in Columbia, South Carolina (WE), and Richland, Washington (Framatome). The DUF_6 tails could be sent to facilities in either Paducah, Kentucky, or Portsmouth, Ohio. In the case of the LLW generated at the proposed GLE facility, only one destination is planned, the Energy*Solutions* disposal facility in Clive, Utah. Single-shipment and annual impacts are evaluated for all potential shipment routes. Annual impacts are assumed based on all shipments of one material type over the same route (e.g., all DUF_6 tails going to Paducah, Kentucky, or all going to Portsmouth, Ohio).

Both the per-shipment and collective annual risks of various radioactive material transports were presented in the GLE EIS (NRC, 2012b, pp. 4-67). The most conservative annual impacts can be estimated if the shipment option for each type of shipment with the greatest impacts are selected (i.e., UF_6 feed material from Cameco in Port Hope, Ontario, enriched uranium sent to Framatome in Richland, Washington, DUF_6 tails sent to the Paducah conversion facility in Kentucky, empty cylinders sent to Honeywell in Illinois, and LLW sent to Energy*Solutions* in Utah). In the most conservative case, combined total doses of 11 person-rem and 6.0 person-rem were estimated for the public and the transportation crews, respectively, from all shipments on an annual basis, with an annual expected LCFs of 0.007 and 0.004, respectively. These impacts on the public would be SMALL because the exposure would be spread out among all people along the transportation routes.

Overall annual transportation accident impacts are considered to be SMALL. The total annual radiological collective population accident dose-risk to the public from all shipments for the most conservative case was estimated to be 0.0162 person-rem, or an excess LCFs of 0.00001 annually among the exposed population. These impacts on the public would be SMALL because the exposure would be spread out among all people along the transportation routes.

In the Technical Report, as indicated in Section 6.4.1, *Uranium Enrichment at UUSA Plant*, the natural UF_6 feed material would come from the Metropolis facility (Illinois) or a Canadian source (Cameco, Port Hope, Ontario, Canada) in up to 128 48-Y cylinders, or 128 truck shipments (one cylinder per truck), similar to the assumption used in the GLE EIS. The HALEU product would be 38 MT of enriched UF_6, and about 124 48-Y cylinders of DUF_6. Using the information provided in Table 4-13 of the GLE EIS (NRC, 2012b, pp. 4-69), the estimated annual transportation risks for the feed material in terms of the workers (drivers) LCF risk and the excess fatalities among the exposed population would be about 0.00018 and 0.00018 (for feed materials from the Metropolis facility), and 0.00019 and 0.0002 (from a Canadian source), respectively. The risks for other related activities (i.e., products and wastes) would also be comparatively small.

Again, considering that the HALEU shipments would be made in 30B-20 PSPs (8 shipments), and assuming that these shipments would have similar external dose rate as that of the 30B shipments used in the GLE EIS, then the incident-free risk to the workers and general population LCFs from transporting the HALEU in the form of UF_6 to a fuel fabrication facility would be 0.0001 and 0.0004, respectively.[37]

Similarly, the accident risks can be estimated using the data in Table 4-13 of the GLE EIS. These impacts would also be SMALL. Hence, the overall risks of the radioactive material transports during enrichment activities at GLE associated with the Proposed Action is SMALL.

6.4.4 Uranium Enrichment at two Separate Locations

DOE has indicated a possibility of using two separate enrichment locations (up to 5% or 10% enrichment at one location and then transported to second location where it is enriched up to 20%) (DOE, 2023a, p. 5). For the purposes of analysis in the Technical Report, it was assumed that the first location for enriching up to 5% would occur at either the UUSA plant in New Mexico, or the GLE plant in Wilmington, North Carolina, and the second location for enriching up to 20% would occur at Centrus plant in Piketon, Ohio.

Enrichment at two locations would lead to the need for a larger uranium mass than that of using a single location enrichment facility as evaluated above. For producing 25 MT of HALEU with a 5% enriched U-235 as a feed and an assumed tail of 1% enriched U-235, we would need 117.2 MT of 5% enriched uranium. This in turn would lead to about 1,163 MT of natural uranium. In comparison, when the HALEU enrichment is carried out at one location, we would need about 1,015 MT of natural uranium to produce 25 MT of HALEU.

[37] Fuel fabrication at Richland, Washington, was used; it is the farthest distance.

Under this option, there is a need for 148 shipments of 48-Y cylinders of UF_6 to the first location (for enrichment up to 5%), for the first year, followed by an annual shipments of 136 48-Y UF_6 cylinders. The product from the first enrichment location would be transported to the second enrichment location using 30B cylinders in their PSPs in about 15 truck load shipments. The depleted uranium tail from the second enrichment location would then be transported back to the first enrichment location in 12 48-Y cylinders (e.g., 12 truck load shipments). Therefore, this option would increase the uranium-related shipments by 35 (i.e., =additional 8 shipments [=148-128-12] for feed to first location after first year of operation, and 27 shipments of products and tails between the two locations) in comparison of using a single enrichment location. In addition, there would be about 133 48-Y cylinders of DUF_6, to be stored at the first enrichment location or transported to a deconversion facility, which is about 9 more 48-Y cylinders of DUF_6 in comparisons to the single enrichment location.

Based on the above, and as indicated in Section 6.4.1, *Uranium Enrichment at UUSA Plant*, the natural UF_6 feed material (natural uranium UF_6) would come from ConverDyn (i.e., the Metropolis facility in Illinois) or a Canadian source (Cameco, Port Hope, Ontario, Canada) in up to 148 48-Y cylinders (first year) and 136 48-Y cylinders (after first year). (There would be one cylinder per truck shipment.) There are two distinct product shipments under this option: 15 shipments of low-enriched uranium (up to 5% enriched uranium), or 178.2 MT of UF_6, between the two enrichment locations, and 8 shipments of HALEU, or 38 MT of HALEU F_6, products from the second enrichment location.

Using the information referenced in the above enrichment facilities NEPA documents, the estimated annual transportation risks for the feed material to the GLE facility, in terms of the workers (drivers), LCF risk, and the excess fatalities among the exposed population, would be about 0.0002 and 0.0002 (for feed materials from ConverDyn's Metropolis facility in Illinois), and 0.0002 and 0.0002 (from a Canadian source), respectively. For the UUSA facility, the same risks would be about 0.00008 and 0.0002 (for feed materials from ConverDyn's Metropolis facility in Illinois), and 0.0002 and 0.0004 (from a Canadian source), respectively. The estimated annual transportation risks for the low-enriched uranium (5% enriched UF_6) material to Centrus (ACP) from GLE or UUSA facilities, in terms of the workers (drivers), LCF risk, and the excess fatalities among the exposed population, would be about 0.00004 and 0.00005 (for transport from GLE), and 0.0001 and 0.0002 (for transports from UUSA), respectively. The risks for other related activities (i.e., products and wastes) would also be comparatively SMALL.

Considering that Centrus will be the second enrichment location, the HALEU shipments would be made from Centrus facility in 30B-20 PSPs (the eight shipments), then the incident-free risks to the workers and general population LCFs from transporting the HALEU in the form of UF_6 to a fuel fabrication facility are the same as those listed in Section 6.4.2, *Uranium Enrichment at Centrus Plant*.[38]

Similarly, the accident risks can be estimated using the data in above-referenced NEPA documents. These impacts would also be SMALL. Hence, the overall risks of the radioactive material transports during enrichment activities at the two locations considered under this option is SMALL.

6.5 Uranium Deconversion

Uranium deconversion is the fourth step of the HALEU fuel production cycle (see Figure 6-1). In a deconversion facility, the HALEU as UF_6 is converted to HALEU oxide, or HALEU metal, as needed. Currently, there is no stand-alone "deconversion facility" in the United States capable of producing HALEU in the quantities required by the Proposed Action. A facility would need to be constructed. A potential deconversion facility could be located at an enrichment facility, a fuel fabrication facility, or elsewhere. The technology for deconversion would be similar to that used at U.S. deconversion facilities such as the

38 Fuel fabrication at Richland, Washington, was used; it is the farthest distance.

DOE Portsmouth, Ohio, DUF_6 conversion and Paducah, Kentucky, DUF_6 conversion facilities with the appropriate application of criticality control, as the existing facilities are for converting DUF_6 to oxide with minimum criticality concerns. Deconversion to other unique fuel forms that may be required for some advanced reactor fuels may require new technology.

The conversion of the UF_6 to uranium oxide is, however, the first processing step in any one of the currently operating U.S. commercial fuel fabrication plants (i.e., Framatome in Richland, Washington; WE in Columbia, South Carolina; and GNF-A in Wilmington, North Carolina). These facilities have sufficient excess capacity to accommodate the required conversion needed for the HALEU production. The facilities may need operational changes, or license amendment, to possess uranium enriched to a higher percentage (e.g., 10% to 19.75%) than the current license allows (up to 5%).

Nevertheless, for the purposes of the Technical Report, and to provide additional flexibility, a need for constructing and operating a new facility is evaluated. For evaluation purposes, the planned International Isotopes Fluorine Products, Inc. (IIFP) facility was used as a source of information for evaluating the environmental impacts of construction and operation of a HALEU deconversion facility.

The Technical Report incorporates by reference information and analysis contained in the *Environmental Impact Statement for the Proposed Fluorine Extraction Process and Depleted Uranium Deconversion Plant in Lea County, New Mexico – Final Report* (NRC, 2012a) (referred to as the "Fluorine/DU EIS") and focuses on information on various radioactive material transports for the sites where the new HALEU deconversion facility could be located.

The Fluorine/DU EIS evaluated the transport of various radioactive material shipments to and from the facility during the operation of the proposed IIFP facility, including the following:

- DUF_6 to the deconversion facility
- Return of empty cylinders with residual contamination
- LLW for disposal

All shipments are anticipated to occur via tractor-trailer combination trucks.

Operation of the proposed IIFP facility would require shipment of full DUF_6 cylinders from enrichment facilities, return of empty DUF_6 cylinders back to the enrichment facilities, and disposal of depleted uranium dioxide (DUO_2) and miscellaneous LLW at waste disposal facilities. The Fluorine/DU EIS selected then current, or proposed, U.S. commercial enrichment facilities as representative origins for shipments of DUF_6. The selected facilities were (1) UUSA, just east of Eunice, New Mexico, (2) the GE-Hitachi GLE facility north of Wilmington, North Carolina, and (3) the Areva Eagle Rock Enrichment Facility west of Idaho Falls, Idaho. (Note, the Eagle Rock Enrichment Facility was canceled.) The analysis considered that there would be 293 shipments per year of full DUF_6 cylinders (e.g., 48-Y cylinders) with an assumed dose rate of 0.28 millirem (mrem) per hour (mrem/hr) at 1 meter (m); the cylinders would be shipped one per 18-wheel truck (NRC, 2012a, pp. 4-40 and 4-41).

For empty DUF_6 cylinders, even though it is possible that some cylinders would not be shipped back to their origin, for purposes of analysis, NRC assumed that all cylinders would be returned. In the event that cylinders are not returned, they could be disposed empty, or filled with DUO_2, and disposed as LLW. The returned cylinders would contain some radioactive material. The cylinders are conservatively assumed to be shipped one per truck; however, two per truck is a likely scenario. Conservatively, there would be 293 shipments per year of empty cylinders with an assumed dose rate of 1 mrem/hr at 1 m (3.3 feet).

The DUO_2 is assumed to be waste and not sold. It would be packaged into 55-gal drums and loaded 40 per truck (subject to weight limitations). Shipment destinations selected for analysis are the Energy*Solutions* in Clive, Utah, and the WCS facility in Andrews, Texas (immediately east of the UUSA facility). Less probable destinations, such as the U.S. Ecology Washington disposal facility on the Hanford site near Richland, Washington, and the Nevada National Security site, are also represented by these analyses. It is estimated that there would be as many as 155 DUO_2 waste shipments per year. The volume of LLW would be small compared to the DUO_2 waste. There would be 31 shipments per year, each with forty 55-gal drums.

The Fluorine/DU EIS concluded that the maximum collective dose for routine incident-free operation would be 18-person-rem, if DUF_6 shipped from the enrichment facility and generated DUO_2 waste shipped to the disposal facility that results in the greatest collective dose for all receptors. This collective dose includes receipt and return of cylinders to the GLE facility in Wilmington, North Carolina, and disposal of LLW at the Energy*Solutions* in Clive, Utah. The collective exposure of 18-person-rem would lead to 0.01 LCF among the exposed population (NRC, 2012a, pp. 4-42). For accident conditions, the maximum dose and risk from accidents involving the DUF_6 and UO_2 materials would be 24-person-rem, and 0.014 excess LCFs among the exposed population, which is considered by the NRC to be a SMALL impact (NRC, 2012a, pp. 4-62 to 4-63).

For the Proposed Action, assuming that the deconversion facility is co-located with the fuel fabrication facility, then dose-risk estimates for the transport of the HALEU in the form of UF_6 to a potential fuel fabrication facility would be bounded by those listed in Section 6.4.1, *Uranium Enrichment at UUSA Plant* through Section 6.4.3, *Uranium Enrichment at GLE Plant*. Note that, in Section 6.4, *Uranium Enrichment*, the HALEU in the form of UF_6 was transported to the facility location farthest from the enrichment facilities considered. For a greenfield site, the location of the new facility could be within an existing private or commercial facility.

Because no specific location for the deconversion facility was identified, and for the purposes of the Technical Report, it was assumed that the location would be at IIFP facility and the transport would be from GLE in Wilmington, North Carolina, for maximizing the impacts. If HALEU is shipped in 30B-20 (8 shipments), and adjusting the truck shipment dose rate from 0.28 mrem/hr at 1 m (3.3 feet) that was used for DUF_6 to about 1 mrem/hr at 1 m that was used for the truck shipments of 5% enriched UF_6 in the 2012 GLE EIS (NRC, 2012b, pp. Table 4.1-2), (a factor of 3.57 increase in dose rate), then the incident-free risk to the workers and general population LCFs from transporting the HALEU in the form of UF_6 to this commercial deconversion facility would be 0.00012 and 0.00016, respectively. These estimates were determined using the per-shipment dose results for transport of DUF_6 to IIFP facility in Table E-4 of the Fluorine/DU EIS for the IIFP facility and adjusting them for the increase in external dose rate in conjunction with the consideration of shipment numbers for the 30B-20 packaging.

Note, in the nominal HALEU deconversion facility there are no UO_2 wastes,[39] and the associated LLW would be smaller than those LLW estimated for the DUF_6 conversion facility. Hence, the impact of transporting the HALEU in the form of UF_6 to this commercial deconversion facility would be SMALL.

Similarly, the accident risks can be estimated using the data in Table E-5 of the Fluorine/DU EIS, which provides the per-shipment accident risks. These impacts would also be SMALL. Hence, the overall risks of the radioactive material transports during deconversion activities at any fuel fabrication facility or a commercial facility associated with the Proposed Action is SMALL.

6.6 HALEU General Storage Facility

HALEU storage is the fifth step of the HALEU fuel production cycle (see Figure 6-1). Currently, there is no stand-alone HALEU storage facility in the United States capable of storing HALEU in the quantities required by the Proposed Action. There is, however, the National Nuclear Security Administration's Y-12 Complex

[39] The converted HALEU UO_2 or metal would be transported to the HALEU storage facility.

in Oak Ridge, Tennessee, that is currently a storage location for U.S. highly enriched uranium. Nevertheless, for the purposes of the Technical Report, a storage facility that could be located at a commercial enrichment, deconversion, or fuel fabrication facility is considered.

The radioactive material (e.g., HALEU product) transports to and from this facility is considered to be either HALEU metal, HALEU oxide, or a mix of two. Note, that the HALEU produced in the enrichment facilities are UF_6 packaged in 30B-20 cylinders. If HALEU product were to be kept in this chemical form (UF_6), there would be no need for the uranium deconversion facility, and the product could be stored at an enrichment facility or at a fuel fabrication facility. Nevertheless, if 30B-20 cylinders were to be used, the Proposed Action would require storage locations for 31 cylinders, annually, and about 186 total cylinders, far less space than was determined in Section 5, *HALEU Storage*.

For the transport of uranium metal, the DOE/NRC certified ES-3100 (NRC, 2021d, p. Table 2) can be used. This package can hold up to 35 kg of uranium metal in exclusive-use transport for enrichment below 60%. For an annual production of 25 MT, about 715 ES-3100 packages would be needed, about 36 shipments (with 20 ES-3100, per shipment).

For the transport of the HALEU oxide, currently, there are no certified packaging that can transport uranium oxide enriched up to 20% in large volume. The ES-3100 package can also hold a maximum mass limit of 15.13 kg (33 lbs) oxide, with a maximum mass of 12.32 kg (27 lbs) U-235 (NRC, 2012a, p. 6), which would require about 1,876 ES-3100 packages, annually. There is, however, NAC International Package certified Model No. OPTIMUS®-L (NRC, 2022b) that can be adapted to relicense for transport HALEU dioxide (HALEU O_2) in reasonable quantities per package. (It is noted that this model can be transported in groups of 10 packages per shipment, provided legal weight truck limits are not exceeded.) A recent analysis for the HALEU O_2 transportation (INL, 2019) has determined that about 3.937 MT of HALEU O_2 could be transported in five OPTIMUS®-L packages per shipment (INL, 2019, p. 46). The HALEU O_2 powder would be placed in a canister that can hold 28.12 kg (62 lbs) of powder each, with 28 canisters per package. This configuration would require 1,009 canisters per year for transporting 28.4 MT of HALEU O_2. Hence, there would be about eight shipments annually, if all HALEU O_2 powder is transported to the storage facility.

The dose rate at 2 m (6.6 feet) from each package was determined to be 3.6 mrem/hr.[40] Multiple packages in a shipment will increase dose rate. However, for exclusive-use shipments, 10 CFR 71.47 specifies that the measurement for the 2-m limit be performed 2 m from the outer lateral surfaces of the vehicle rather than the outer surface of the package. The reduction in dose rate due to increased distance is expected to offset the increase in dose rate due to multiple package (INL, 2019, p. 42).

If OPTIMUS®-L design were selected for HALEU, it requires recertification by adding supporting safety basis evaluations that incorporate HALEU in the form of UO_2 powder as possible content. The selection of OPTIMUS®-L for transport provides operational advantages, and that is small enough for facilities with limited access and/or crane capacity, can be forklift-handled to eliminate the need for higher-capacity cranes for lifting, and could be left on the conveyance during the loading and unloading processes within a facility.

Because no specific location for the HALEU storage facility was identified, and for the purposes of the Technical Report, a conservative assumption is made by considering the distance between the enrichment facility and the storage facility would be as far as that of the distance between the GLE enrichment facility in Wilmington, North Carolina, and the Framatome fuel fabrication facility in Richland, Washington. For this assumption, the transportation risk results from the NRC's GLE EIS (NRC, 2012b) are used to estimate

[40] This dose rate is for the recovered Experimental Breeder Reactor-II (EBR-II) HALEU blend (INL, 2019). For a natural uranium HALEU, the dose rate would be smaller, as there are no high-dose impurities as exist in the recycled uranium.

the potential risks for this Technical Report. The distance between these two facilities is 4,786 km (2,975 miles). The GLE EIS (NRC, 2012b) indicates crew and population doses of 0.021 and 0.086 person-rem, respectively; a traffic fatality of 0.00005 for the transport of enriched uranium in 30B cylinders (five per truck) to the Framatome facility, and a radiological accident dose-risk of 9.6×10^{-6} person-rem per transport. The analysis assumes that each 30B cylinder can hold about 2.3 MT UF_6, or 11.4 MT of 5% enriched UF_6 per shipment, and a dose rate 0.98 mrem/hr at 1 m (3.3 feet) for the 30B cylinders shipment.

For the Technical Report, about 8 shipments of HALEU in the form of UO_2, or 36 shipments of HALEU metal are assumed for analysis. Using the route specific dose data listed above, and considering a dose rate of 1 mrem/hr and 5 mrem/hr at 1 m (3.3 feet) from the transporter for the HALEU metal and HALEU oxide (i.e., UO_2), respectively, the collective dose to the crew and population from transport of these HALEU products in routine transports (non-accident) would be very SMALL, as presented below:

- HALEU in the form of UO_2: Given that there are eight shipments, and the dose rate is about five times larger than that of the 30B cylinder shipments, the collective dose to workers and population would be 0.84 and 3.44 person-rem, or an LCF of 0.0005 and 0.002 among the exposed groups, respectively.
- HALEU metal: Given that there are 36 shipments, and the dose rate is the same as that of the 30B cylinder shipments, the collective dose to workers and population would be 0.76 and 3.1 person-rem, or an LCF of 0.00045 and 0.0019 among the exposed groups, respectively.

Given that the quantities of uranium in a HALEU shipment (maximum of 3.47 MT of uranium) is lower than that of 5% enriched UF_6 in five 30B cylinders (7.71 MT of uranium) and in an accident the release and respirable fractions of UF_6 is larger than that of the UO_2 or metal, the per-shipment accident dose-risks cited above for the 30B shipments would envelop the potential consequences of a HALEU shipment accident. Hence, at most, the accident dose-risks for the transport of HALEU in the form of UO_2 would be about 0.00008 person-rem or 4.6×10^{-8} excess fatalities among the exposed population. The risks from the transport of uranium metal would be orders of magnitude less, as metal would have a very small release fraction, comparatively. The potential expected traffic fatalities for the HALEU shipments would be 0.0004 and 0.0018. Hence, the annual accident risks for transporting HALEU product to and from a storage facility are SMALL, essentially zero.

6.7 Summary and Conclusion

The NRC has already codified the transportation impacts of nuclear fuel cycle and the transportation of fuel and wastes to and from light water reactors (LWRs) in Tables S-3 and S-4 of 10 CFR 51. The NRC's conclusions were based on generic analyses of the environmental effects of the transportation during fuel cycle in the *Environmental Survey of the Uranium Fuel Cycle*, WASH-1248 (AEC, 1974) and transportation of fuel and waste to and from LWRs in the *Environmental Survey of Transportation of Radioactive Materials To and From Nuclear Power Plants*, WASH-1238 (AEC, 1972) and in a supplement to WASH-1238, NUREG-75/038 (NRC, 1975). Impacts are provided for normal conditions of transport and accidents in transport for a reference 1,100 megawatts electric LWR. Table S-3 (10 CFR 51.51) summarizes the environmental impacts of transportation for the fuel cycle, exclusive of the transportation of cold (fresh) fuel and irradiated fuel and wastes, to be 2.5 person-rem exposure to the workers and public per year. Table S-4 (10 CFR 51.52) summarizes the estimated dose to transportation workers during normal transportation operations for transportation of cold (fresh) fuel and irradiated fuel and wastes to be

4 person-rem and collective dose to the public along the route and the dose to onlookers to be 3 person-rem per reactor per year of operation.[41]

Since the publication of WASH-1238 (AEC, 1972), WASH-1248 (AEC, 1974), and NUREG-75/038 (NRC, 1975), the NRC has undertaken additional studies regarding the risk from the transportation of fuel cycle, unirradiated fuel and spent nuclear fuel (SNF). In September 1977, the NRC published NUREG-0170, *Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes* (NRC, 1977b), which assessed the adequacy of the regulations in 10 CFR 71, *Packaging and Transportation of Radioactive Waste*. In that assessment, the measure of safety was the risk associated with radiation doses to the public under routine and accident transport conditions, and the risk was found to be acceptable. The approach and methodology in this study formed the basis of all future studies in determining the transportation risk involving radioactive materials. Later, the NUREG-0170 model for transport of SNF was further refined. In 1987, in a study known as the "Modal Study," (NUREG/CR-4829) (NRC, 1987), the accident consequences were described in terms of the resultant strains produced in transportation packages (for impacts) and the increase in package temperature (for fires). In 2000, in the reexamination study (NUREG/CR-6672) (NRC, 2000a), two generic truck packages and two generic rail packages were analyzed using the refined model on package structures and response to accidents. The study conservatively used semi-trailer truck and rail accident statistics for general freight shipments, because even though more than 1,000 spent fuel shipments had been completed in the United States by the year 2000 and many thousands more had been completed safely internationally, there had been too few accidents involving spent fuel shipments to provide statistically valid accident rates. These two studies concluded in smaller assessed risks than had been projected in NUREG-0170.

For the fuel cycle, the NRC issued two Generic EISs (GEISs) for the uranium recovery using the conventional mining and milling (NRC, 1980) and ISR mining (NRC, 2009a). Those GEISs concluded that the impacts of transporting various radioactive materials to and from the uranium recovery sites to be SMALL. The NRC has also issued EAs and/or EISs for the conversion facility, enrichment facilities, and fuel fabrication facilities, all showing the transportation impacts for radioactive materials transports to be SMALL, as well.

In the HALEU fuel cycle, the activities in uranium recovery, conversion, and shipments of UF_6 to and from enrichment facilities would be similar to those of the activities evaluated in the LWRs fuel cycle. The transport of the HALEU in the form of UF_6 to the fuel fabrication facilities also would be similar to those used in the LWRs fuel cycle, but with the use of a criticality modified packaging with lower quantities of enriched uranium per shipment. The HALEU fuel would be used in the advanced nuclear reactors (ANRs), as well as research reactors. Several of the potential non-LWR designs are expected to deploy non-UO_2 fuels (e.g., uranium metal, uranium carbide, uranium in a molten salt, etc.) or rely on recycled fissile material. In the *Generic Environmental Impact Statement for Advanced Nuclear Reactors (ANRs)* (NUREG-2249) (NRC, 2021e) (referred to as the "ANR GEIS"), the NRC evaluated the various potential fuel fabrication needs for the advanced nuclear reactors. In Section 3.14 of the ANR GEIS, the NRC concluded that the assessment of environmental impacts in Table S–3 is expected to bound the impacts for ANRs that rely on uranium oxycarbide/UO_2 fuels if such fuel fabrication is applying the existing processes of the NRC-licensed fuel fabrication facilities, resulting in SMALL impacts (NRC, 2021e, pp. 3-69). Any ANR fuel fabrication that cannot be bounded by WASH-1248 (AEC, 1974), namely metallic fuel and liquid-fuel molten salt reactors, requires a discussion of the anticipated ANR fuel fabrication process and environmental impacts in the project-specific application.

The treatment and management of the SNF in both the LWRs and the ANRs that use HALEU are the same, consistent with the findings in the NRC 2014 final rule on the environmental effects of continued storage

41 Table S-4 also indicates that although accident risks during transportation are at that time not capable of being quantified, qualitatively the risks are deemed to be SMALL.

of SNF (Federal Register 79, no. 182, September 19, 2014) and NUREG-2157, *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel* (NRC, 2014c) (referred to as the "SNF GEIS"), which concluded that impacts from continued storage of SNF for 60 years, including the potential impacts of transporting the SNF to a final repository would be SMALL. For the transportation of SNF, the NRC concluded that the radiological doses would be expected to continue to remain below the regulatory dose limits during continued storage and all of the related activities would have SMALL environmental impacts (NRC, 2014c, p. § 4.16).

Notwithstanding the above NRC's conclusions, an evaluation of transportation impacts for the various activity steps under the Proposed Action were evaluated in this section.

Table 6-3 summarizes the sources of NEPA documentation and major assumptions, along with the overall conclusions on transportation impacts for the various activities within the HALEU fuel cycle. Table 6-4 summarizes the results of the transportation impacts for the various activities within the HALEU fuel cycle. As shown in these tables, and consistent with the expectation as concluded in the 10 CFR 51, the impacts of transporting radioactive materials under the Proposed Action to be SMALL. Overall, there would be a maximum of 380 to 415 annual shipments[42] of various uranium products, and over 1 million km (621,371 miles) traveled annually covering the activities in various steps between the uranium recovery and storage facility. The results indicate that it is unlikely that the transportation activities under the Proposed Action would lead to an LCF among the workers or general populations from radiological exposures in these transports. If the uranium recovery uses only the mining and milling recovery; then there would be 57,400 additional shipments of uranium ore to a milling facility with the maximum estimated potential traffic fatalities of 2 annually. Given that the average number of traffic fatalities in the United States is about 34,030 per year for the 10-year period 2010 through 2019 (USDOT, 2021), the incremental increase in risk to the general population from shipments associated with the Proposed Action would, therefore, be very SMALL.

[42] This range shows annual shipments for a single enrichment location and two enrichment locations.

Table 6-3. Summary of the Transportation Impacts for the Various Steps in a HALEU Fuel Cycle

Activity	***Input: Material/Shipments Needed to Produce 25 MT/yr HALEU***	***Output: Material Type, Containers, and Shipments Needed for 25 MT/yr HALEU***	***NEPA Documentation Sources/Assumptions/Notes***	***Transportation Impacts and Conclusions***
Uranium Mining and Recovery – *Conventional Mining and Milling* *In-Situ Recovery (ISR) of Uranium*	*Mining*: 1,320,000 MT of ore (assuming ore quality of 0.001 [and 91% extraction]) Shipments About 185 truck shipments per day, each containing 23 MT of ore, for 310 days per year transport to the milling processing facility. *ISR*: 0 [all extraction occurs underground]	Output: 1,260 MT of U_3O_8 (yellowcake) [95% purity], leading to ~1,200 MT of yellowcake] Containers: 55-gal drums Shipments: 74 truck loads Based on using 55-gal drums containing U_3O_8, and 40 drums per truck, or 17.2 MT yellowcake, per truck	NEPA documentation: NUREG-0706 (NRC, 1980) for conventional mining NUREG-1910 (NRC, 2009a) and its Supplements for ISR facilities Also, DOE/EIS-0472 (DOE, 2014) [Uranium Leasing Program PEIS documents] for additional insights on mining	SMALL The annual 74 truck load shipments of yellowcake to the conversion facility are within the range of transports analyzed in NUREG-1910, and consistent with the conclusion in this NEPA document; the overall transportation impacts are SMALL.
Uranium Conversion - Uranium ore conversion to UF_6 at the ConverDyn facility[43] in Metropolis, IL, or a new conversion facility	Input: 1,260 MT of U_3O_8 With 74 truckloads per year	Output: 1,530 MT of UF_6 (assuming 98% pure UF_6) Container: 48-Y (12.5 MT maximum, or an average of 12 MT) cylinders containing UF_6. Shipments: 123–128 shipments per year	NEPA documentation: Metropolis EA (NRC, 2019a): The existing Metropolis facility (ConverDyn) is also used to supply feed for LEU fuel production and has sufficient conversion capacity to support both LEU and HALEU fuel production.	SMALL Given that the annual shipments of HALEU-related activities (e.g., 74 shipments of yellowcake and up to 128 shipments of UF_6) is a small fraction of the existing transports (e.g., 700 yellowcake and 600 UF_6), in the Metropolis EA, and consistent with the EA's conclusions, the overall transportation impacts are SMALL. If a new conversion facility is used, the conclusion will remain

43 ConverDyn's facility in Metropolis, Illinois (the Metropolis facility) is used as a surrogate for the purposes of analysis in the Technical Report.

Table 6-3. Summary of the Transportation Impacts for the Various Steps in a HALEU Fuel Cycle

Activity	***Input:*** ***Material/Shipments Needed to Produce 25 MT/yr HALEU***	***Output:*** ***Material Type, Containers, and Shipments Needed for 25 MT/yr HALEU***	***NEPA Documentation Sources/Assumptions/Notes***	***Transportation Impacts and Conclusions***
				unchanged, as the number of uranium-related shipments are relatively small—about 6 to 11 shipments per month.
HALEU Enrichment - HALEU enrichment using[44]: Centrifuges at Centrus in OH, Centrifuges at Urenco in NM, Lasers at GLE in Wilmington, NC[45]	Input: 1,530 MT of UF_6 in 123–128 shipments of 48-Y cylinders per year	Output: 38 MT HALEU UF_6 Container: 30B-20 cylinder in DN30-20 PSP (overpack with an average UF_6 mass of 1.25 MT per cylinder), leading to a minimum of 31 DN30-20 PSPs. Shipments: Eight shipments per year (assuming four PSPs per truck).	NEPA Documentation: Urenco, (or UUSA), NM, NUREG-1790 (NRC, 2005a) and NRC UUSA EA (NRC, 2015) Centrus, (ACP) OH, NUREG-1834 (NRC, 2006b) and DOE/EIS-0468 (DOE, 2011) [which adopted NUREG-1834] GLE, NC NUREG-1938 (NRC, 2012b) It was assumed that an enrichment building (NRC Category II facilities)[46] is constructed next to an existing LEU enrichment building (NRC Category III).	SMALL The three enrichment facilities evaluated transportation impacts of annual shipments between 900 (GLE) to 1,259 (UUSA) of UF_6 feed, and between 50 (GLE) to 300 (ACP) shipments of enriched uranium to a fuel manufacturing facility. Considering that the Technical Report has an estimate of 128 shipments of feed and 8 shipments of products, and consistent with the NRC's conclusions in the cited NEPA documents, the overall transportation impacts are SMALL.
HALEU Enrichment	Input: 1,767 MT of UF_6	Output: 38 MT HALEU UF_6	NEPA Documentation:	SMALL SMALL

[44] These facilities would be analyzed as representative of two types of technologies and facilities that could produce HALEU in the timeframe required.

[45] Even though the license for this facility was terminated on January 5, 2021 (NRC website| https://www.nrc.gov/materials/fuel-cycle-fac/new-fac-licensing.html, accessed on May 4, 2023). The facility was selected to represent a new enrichment process and provide a reasonable alternative to gaseous centrifuge.

[46] HALEU facilities would be NRC Category II facilities. LEU facilities are NRC Category III facilities. NRC Category II facilities require additional security measures.

Table 6-3. Summary of the Transportation Impacts for the Various Steps in a HALEU Fuel Cycle

Activity	***Input: Material/Shipments Needed to Produce 25 MT/yr HALEU***	***Output: Material Type, Containers, and Shipments Needed for 25 MT/yr HALEU***	***NEPA Documentation Sources/Assumptions/Notes***	***Transportation Impacts and Conclusions***
HALEU enrichment at two locations: First enrich up to 5% Second, enrich to 19.75%	In 148 Shipments of 48-Y cylinders per year in the first year; 1,627 MT of UF_6 in 136 cylinders then after. Note, about 140 MT of (about 1% enriched U-235) UF_6 would be transported (recycled) from second enrichment location to the first enrichment location, as feed materials.	Container: 30B-20 cylinder in DN30-20 PSP) overpack with an average UF_6 mass of 1.25 MT per cylinder), leading to a minimum of 31 DN30-20 PSPs. Shipments: Eight shipments per year (assuming four PSPs per truck). The LEU (5% enriched) product shipments between the enrichment locations: 178 MT of UF_6: 15 shipments In 30B cylinders, with an average UF_6 mass of 2.5 MT, as currently being used in the light water reactors fuel cycle.	Urenco, (or UUSA), NM, NUREG-1790 (NRC, 2005a) and NRC UUSA EA (NRC, 2015) Centrus, (ACP) OH, NUREG-1834 (NRC, 2006b) and DOE/EIS-0468 (DOE, 2011) [which adopted NUREG-1834] GLE, NC, NUREG-1938 (NRC, 2012b) It was assumed that an enrichment building (NRC Category II facilities)[47] is constructed at Centrus Plant, next to an existing LEU enrichment building (NRC Category III).	The three enrichment facilities evaluated transportation impacts of annual shipments between 900 (GLE) to 1,259 (UUSA) of UF_6 feed, and between 50 (GLE) to 300 (ACP) shipments of enriched uranium to a fuel manufacturing facility. Considering that the Technical Report has an estimate of maximum 148 shipments of feed in first year and 136 shipments then after, 15 shipments of LEU, and 8 shipments of HALEU products, and consistent with the NRC's conclusions in the cited NEPA documents, the overall transportation impacts are SMALL
HALEU Deconversion - HALEU deconversion at enrichment facilities at: Centrus in OH, Urenco in NM, GLE in Wilmington, NC	Input: 38 MT HALEU UF_6 in 31 30B-20 PSP and 8 shipments	Output: 25 MT HALEU metal or 28 MT HALEU O_2 (oxide) Container: *HALEU Metal*	Deconversion produces uranium oxide and/or metal. Note: If the deconversion is occurring at the enrichment facility, the	SMALL For the new deconversion facility at the IIFP facility, the transport of HALEU UF_6 was assumed to be from the GLE enrichment facility, in Wilmington, NC, which leads to

[47] HALEU facilities would be NRC Category II facilities. LEU facilities are NRC Category III facilities. NRC Category II facilities require additional security measures.

Table 6-3. Summary of the Transportation Impacts for the Various Steps in a HALEU Fuel Cycle

Activity	***Input: Material/Shipments Needed to Produce 25 MT/yr HALEU***	***Output: Material Type, Containers, and Shipments Needed for 25 MT/yr HALEU***	***NEPA Documentation Sources/Assumptions/Notes***	***Transportation Impacts and Conclusions***
or at a commercial facility		in ES-3100 with up to 35 kg of uranium per container This will lead to 715 ES-3100 packages. *HALEU O_2* in a generic cylinder that could contain 28.12 kg of UO_2 (INL, 2019), leading to 1,009 cylinders. Shipments: *HALEU Metal* 36 shipments of ES-3100 [Assuming 20 ES-3100 per shipment] *HALEU O_2* 8 shipments [Assuming that OPTIMUS®-L is certified, then each can contain 28 cylinders of UO_2, with 5 OPTIMUS®-L per semi-truck, or 3,937 kg of UO_2 per truck]	HALEU UF_6 is already at that facility. If new facilities to be constructed, assumed to be at the International Isotopes Fluorine Products, Inc. (IIFP) (NM) facility, as evaluated in NUREG-2113 (NRC, 2012a). The impact under this assumption is focused on transporting HALEU UF_6 to the deconversion facility.	farthest distance among the three facilities considered, above. Considering that the Technical Report has an estimate of eight shipments of HALEU UF_6, and consistent with the NRC's conclusions in the cited NEPA document (NUREG-2113) (NRC, 2012a) and adjustment for the expected external dose rate for the HALEU product, the overall transportation impacts are SMALL.
HALEU Deconversion - HALEU deconversion at existing FFFs at: Framatome (Richland, WA), GNF (Wilmington, NC),	Same as above	Same as above	Assumes deconversion produces O_2 and metal The impact analysis for this option is evaluated in the enrichment facilities analyses, as the HALEU UF_6 was assumed	SMALL Considering that the Technical Report has an estimate of eight shipments of products, and these are assumed to be transported from the enrichment facilities to

Table 6-3. Summary of the Transportation Impacts for the Various Steps in a HALEU Fuel Cycle

Activity	***Input: Material/Shipments Needed to Produce 25 MT/yr HALEU***	***Output: Material Type, Containers, and Shipments Needed for 25 MT/yr HALEU***	***NEPA Documentation Sources/Assumptions/Notes***	***Transportation Impacts and Conclusions***
Westinghouse (Columbia, SC)			to be transported to the farthest FFF from each enrichment facility to envelop the risk.	the FFF that is at the farthest distance, and consistent with the NRC's conclusions in the cited enrichment facilities NEPA documents, the overall transportation impacts are SMALL.
HALEU Storage – HALEU storage at existing enrichment facilities, deconversion facility, FFF, or a stand-alone facility	38 MT HALEU in the form of UF_6 in 31 30B-20 (Not considered) 25 MT HALEU metal in 715 ES-3100 28 MT HALEU O_2 in 1,009 generic cylinders	38 MT of HALEU in the form of UF_6 in 31 30B-20 (Not considered) 25 MT of HALEU metal in 715 ES-3100 36 shipments 28 MT of HALEU O_2 in 1,009 generic cylinders 8 shipments	For the purposes of the Technical Report, and to maximize the impacts in the absence of any specific location within an existing private commercial facility, it was assumed that the storage facility would be located at a location with the same route characteristics as that of route between GLE in Wilmington, NC, and Framatome fuel fabrication in Richland, WA.	SMALL The analysis of impact is based on the results presented in NUREG-1938 (NRC, 2012b) and adjusted for the differences in the expected external dose rates for HALEU in the form of UO_2 or metal in their respective transportation packages. Consistent with the NRC's conclusions in the cited enrichment facility NEPA document, the overall transportation impacts are SMALL.
HALEU Fuel Fabrication – HALEU fuel fabrication at: BWXT (Lynchburg, VA), TRISO-X (Oak Ridge, TN), USNC (Oak Ridge, TN), Framatome (Richland, WA), GNF (Wilmington, NC),	25 MT HALEU metal; or 28 MT HALEU O_2	Not specifically analyzed	It was assumed that new HALEU fuel fabrication buildings are constructed next to the LEU fuel fabrication buildings at existing LEU Fuel Fabrication Facilities. Assumes metal, oxide, and TRISO fuels are fabricated	SMALL The impact of transporting HALEU in the form of UO_2 or metal to a FFF is bounded by the impact analysis evaluated for the fuel storage facility, which was assumed to be located at the Framatome facility in Richland, WA; see above.

Table 6-3. Summary of the Transportation Impacts for the Various Steps in a HALEU Fuel Cycle

Activity	***Input: Material/Shipments Needed to Produce 25 MT/yr HALEU***	***Output: Material Type, Containers, and Shipments Needed for 25 MT/yr HALEU***	***NEPA Documentation Sources/Assumptions/Notes***	***Transportation Impacts and Conclusions***
Westinghouse (Columbia, SC)[48]				
HALEU use in Advanced Reactors HALEU SNF Off-Site Storage HALEU SNF Disposal	Not specifically analyzed	Not specifically analyzed	Draft NRC Advanced Reactor Generic EIS (NUREG-2249) (NRC, 2021e) evaluated the various aspects of HALEU use in advanced reactors, with the potential transportation impacts to be SMALL. The environmental effects of continued storage of SNF in NUREG-2157, *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel* (NRC, 2014c), concluded that impacts from continued storage of spent nuclear fuel for 60 years, including the potential impacts of transporting the SNF to a final repository would be SMALL.	SMALL Note: The HALEU SNF, for the most part, (except for the molten salt fuel) are similar to the LWR and other DOE SNFs that are currently being stored at various facilities. Therefore, the general conclusion for the storage and disposition of SNF would be applicable to the HALEU SNF. Given the conclusions in NREG-2249 (NRC, 2021e) and NUREG-2157 (NRC, 2014c), the transportation impacts for these HALEU-related activities are expected to be SMALL as well.

Key: % = percent; ACP = American Centrifuge Plant (Centrus); DOE = U.S. Department of Energy; DUF_6 = depleted uranium hexafluoride; EA = Environmental Assessment; EIS = Environmental Impact Statement; FFF = fuel fabrication facility; gal = gallon; GLE= Global Laser Enrichment; HALEU = high-assay low-enriched uranium; HALEU UF_6 = high-assay low-enriched uranium in the form of uranium hexafluoride; HALEU O_2 = high-assay low-enriched uranium dioxide; IL = Illinois; ISR = in-situ recovery; kg = kilograms; LEU = low-enriched uranium; LWR= light water reactor; MT = metric ton; NC = North Carolina; NEPA = National Environmental Policy Act; NM = New Mexico; NRC = U.S. Nuclear Regulatory Commission; O_2 = oxide; OH = Ohio; PSP = protective structure packaging; SC = South Carolina; SNF = spent nuclear fuel; TN = Tennessee; U_3O_8 = triuranium octoxide (i.e., yellowcake, a uranium oxide); UF_6 = uranium hexafluoride; UO_2 = uranium oxide; UUSA = Urenco USA; VA = Virginia; WA = Washington; yr = year

48 These six facilities/sites provide a range of facility sizes and locations that should be representative of other facilities at other locations.

Table 6-4. Estimated Annual Transportation Risks for the Production 25 Metric Tons of HALEU

Activity		*Shipment Type*	*Locations (from or to)*	*Number of Shipments*	*One-Way Kilometers Traveled*	*Incident-Free*		*Accident* [a]	
						Crew	*Population*	*Radiological Risk*	*Nonradio-logical Risk*
						LCFs [a]	*LCFs* [a]		
Uranium Recovery		Uranium Ore [b]	To mill	57,400	34,440,000	2×10^{-2}	3×10^{-3}	Note 1	1.6
Conventional [b]		Yellowcake [b]	To conversion	74	169,075	Note 1		1×10^{-2}	0.0001
In-situ recovery		Yellowcake	To conversion	74	169,075	Note 1		1×10^{-2}	0.008
Conversion [c]		UF_6	To enrichment	128	See enrichment				
Enrichment	**ACP:**	UF_6 Feed Note 2	From USA conversion	128	112,525	3×10^{-4}	9×10^{-4}	2×10^{-4}	0.005
			From Canada	128	115,034	3×10^{-4}	1×10^{-3}	5×10^{-4}	0.005
		HALEU UF_6	To FFF [d]	8	30,758	7×10^{-6}	2×10^{-5}	7×10^{-5}	0.001
		DUF_6	Note 3	124	Note 3				
		Empty Cylinder	Note 3	2	Note 3				
	GLE:	UF_6 Feed Note 2	From USA conversion	128	168,192	2×10^{-4}	2×10^{-4}	4×10^{-7}	0.002
			From Canada	128	178,816	2×10^{-4}	2×10^{-4}	9×10^{-7}	0.002
		HALEU UF_6	To FFF [d]	8	38,288	1×10^{-4}	4×10^{-4}	5×10^{-8}	0.0004
		DUF_6	Note 4	124	151,156	2×10^{-4}	2×10^{-4}	4×10^{-7}	0.002
		Empty Cylinder	Note 5	2	2,628	2×10^{-5}	4×10^{-5}	3×10^{-11}	0.00003
		LEU Product to ACP (Note 6)	To ACP	15	14,835	4×10^{-5}	5×10^{-5}	2×10^{-6}	0.0004
		UF_6 Feed Notes 6 and 7	From USA conversion	136	178,704	2×10^{-4}	2×10^{-4}	5×10^{-7}	0.002
			From Canada	136	189,992	2×10^{-4}	2×10^{-4}	1×10^{-6}	0.003
		Returned UF_6	From ACP	12	11,868	7×10^{-6}	1×10^{-5}	3×10^{-7}	0.0004
		DUF_6	Notes 4 & 6	133	162,127	2×10^{-4}	2×10^{-4}	4×10^{-7}	0.002

Table 6-4. Estimated Annual Transportation Risks for the Production 25 Metric Tons of HALEU

Activity	Shipment Type	Locations (from or to)	Number of Shipments	One-Way Kilometers Traveled	Incident-Free		Accident [a]	
					Crew	Population	Radiological Risk	Nonradiological Risk
					LCFs [a]	LCFs [a]		
UUSA:	UF_6 Feed Note 2	From USA conversion	128	228,851	7×10^{-5}	2×10^{-4}	1×10^{-2}	0.02
		From Canada	128	410,816	2×10^{-4}	4×10^{-4}	4×10^{-2}	0.04
	HALEU UF_6	To FFF [d]	8	28,303	3×10^{-6}	1×10^{-5}	3×10^{-3}	0.003
	DUF_6	Note 8	124	479,284	9×10^{-5}	3×10^{-4}	9×10^{-3}	0.02
	Empty Cylinder	Note 5	2	3,576	6×10^{-6}	2×10^{-5}	2×10^{-4}	0.0004
	LEU Product to ACP (Note 6)	To ACP	15	36,149	1×10^{-4}	2×10^{-4}	8×10^{-6}	0.001
	UF_6 Feed Notes 6 and 7	From USA conversion	136	243,154	8×10^{-5}	2×10^{-4}	1×10^{-2}	0.02
		From Canada	136	436,492	2×10^{-4}	4×10^{-4}	4×10^{-2}	0.04
	Returned UF_6	From ACP	12	28,919	2×10^{-5}	4×10^{-5}	1×10^{-6}	0.0009
	DUF_6	Notes 5 & 6	133	514,032	1×10^{-4}	3×10^{-4}	1×10^{-2}	0.02
Deconversion	HALEU UF_6	From enrichment	8	18,800	1×10^{-4}	2×10^{-4}	7×10^{-5}	0.0008
	HALEU O_2/metal	Note 9						
HALEU Storage	HALEU O_2	Note 10	8	38,288	5×10^{-4}	2×10^{-3}	5×10^{-8}	0.0004
	HALEU metal	Note 10	36	172,296	5×10^{-4}	2×10^{-3}	2×10^{-9}	0.002
Subtotal [e]	Various	Note 11	380	1,110,130	1×10^{-3}	4×10^{-3}	3×10^{-2}	0.05
Subtotal [f]	Various	Note 11	306	1,123,023	1×10^{-3}	4×10^{-3}	5×10^{-2}	0.06
Subtotal [g]	Various	Note 12	415	1,189,503	1×10^{-3}	4×10^{-3}	4×10^{-2}	0.05
Subtotal [h]	Various	Note 12	341	1,202,394	1×10^{-3}	4×10^{-3}	5×10^{-2}	0.07

Sources: (NRC, 1980; DOE, 2011; NRC, 2012b; DOE, 2014; NRC, 2015; NRC, 2012a)

Key: ACP = American Centrifuge Plant (Centrus); DUF_6 = depleted uranium hexafluoride; FFF = fuel fabrication facility; HALEU UF_6 = high-assay low-enriched uranium in the form of uranium hexafluoride; HALEU O_2 = high-assay low-enriched uranium dioxide; GLE = Global Laser Enrichment; LCFs = latent cancer fatalities; UF_6 = uranium hexafluoride; UUSA = Urenco USA

Notes:

1. The NRC NEPA for these activities did not specifically evaluate the radiation exposure to the public and the truck drivers during routine transports, as these have

Table 6-4. Estimated Annual Transportation Risks for the Production 25 Metric Tons of HALEU

Activity	Shipment Type	Locations (from or to)	Number of Shipments	One-Way Kilometers Traveled	Incident-Free		Accident [(a)]	
					Crew LCFs [(a)]	Population LCFs [(a)]	Radiological Risk	Nonradio-logical Risk

been determined to be SMALL impacts. The radiological consequences of accidents involving uranium ore are considered to be significantly smaller than those involving yellowcakes.

2. The feed material (natural uranium) UF_6 can come from a U.S. facility (e.g., ConverDyn's Metropolis facility in Illinois, or a new facility) or from Canada, as these were considered in the referenced source documents.
3. Because of the proximity of deconversion facility (e.g., Portsmouth site) to ACP, no DUF_6 transport is evaluated. Also, no return of empty cylinders is considered in the NRC NEPA document.
4. DUF_6 cylinders were transported to Paducah, Kentucky, for conversion to DU oxide for disposal, for maximizing the impacts.
5. Transport of empty cylinders back to the conversion facility in Illinois. Note, this transport includes two empty cylinders per truck and has a higher external dose rate (a dose rate of 2 mrem/hr at 1 m) than those of UF_6 or DUF_6 cylinders (a dose rate of 0.29 or 0.28 mrem/hr at 1 m). In the UUSA EA (NRC, 2015), a dose rate of 1 mrem/hr at 1 m is used for the return of empty cylinders.
6. This option considers two enrichment locations (enrich to 5% at the first location, transport to the second location and enrich up to 19.75%). For the purposes of this analysis, it was assumed that the first enrichment location would be either GLE or UUSA, and the second location would be ACP. Under this option the HALEU product would only be from ACP location; DUF_6 products would be from first enrichment location, and LEU products would be between the two enrichment locations.
7. In a two enrichment locations scenario, we would need 148 shipments of UF_6 in the first year and 136 shipments in years after. Here, the risk from an annual shipment of 136 is presented.
8. DUF_6 cylinders were transported to Portsmouth, Ohio, for conversion to DU-oxide for disposal, for maximizing the impacts.
9. Even though the deconversion was assumed to be at IIFP facility, the impacts for transporting the products are evaluated in the storage facility activity.
10. The final products (e.g., HALEU O_2, or HALEU metal) was assumed to come from an equivalent distance between Framatome in Richland, Washington; and GLE in Wilmington, North Carolina; for maximizing the impacts.
11. Subtotal represents the maximum number of shipments and impacts, annually. This sum does not include the uranium ore shipments or impacts.
12. Subtotal represents the maximum number of shipments and impacts for the option of using two enrichment locations, annually; see also Note 11.

[a] Risk is expressed in terms of LCFs. Radiological risk is calculated for one-way travel while nonradiological risk (traffic fatality) is calculated for two-way travel. Crew, population, and accident dose-risk(in terms of person-rem) can be calculated by dividing the risk values by 0.0006. LCF and traffic fatality risks are rounded to one non-zero digit.

[b] Conventional uranium recovery requires transport of the uranium ore to a milling processing facility. In the Technical Report, the distance to a processing facility (milling) could be as far as 600 km. The NRC GEIS on conventional mining and milling does not provide the risk estimates for the crew and population for the ore or the yellowcake routine transports. An estimate of the risks in terms of LCF is developed based on the dose rate per kilometer listed in DOE/EIS-0472 (DOE, 2014, pp. D-3).

[c] The impacts from transport of UF_6 to the enrichment facility is listed in the enrichment activities.

[d] The HALEU product (HALEU UF_6) is considered to have been transported to a fuel fabrication facility that leads to largest impact, in this case, it is at Framatome in Richland, Washington.

Table 6-4. Estimated Annual Transportation Risks for the Production 25 Metric Tons of HALEU

Activity	Shipment Type	Locations (from or to)	Number of Shipments	One-Way Kilometers Traveled	Incident-Free		Accident [(a)]	
					Crew	Population	Radiological Risk	Nonradio-logical Risk
					LCFs [(a)]	LCFs [(a)]		

[e] The subtotal summary reflects the maximum impacts from transporting yellowcake to conversion facility, UF_6 feed from a U.S. conversion facility (all) to the enrichment facility, HALEU UF_6 to fuel fabrication facility or deconversion facility, DUF_6 to Paducah or Portsmouth conversion facility (whichever maximizes the impact), empty cylinders to conversion facility, and HALEU oxide or metal to the storage facility, annually.

[f] The subtotal summary reflects the maximum impacts from transporting yellowcake to conversion facility, UF_6 feed from a Canadian source (all) to the enrichment facility, HALEU UF_6 to fuel fabrication facility or deconversion facility, DUF_6 to Paducah or Portsmouth conversion facility (whichever maximizes the impact), empty cylinders to conversion facility, and HALEU oxide or metal to the storage facility, annually. Note this subtotal does not include transport of yellowcake.

[g] The subtotal is similar to that of Note e, but for the option of two enrichment locations.

[h] The subtotal is similar to that of Note f, but for the option of two enrichment locations.

To convert kilometers to miles, multiply the numbers by 0.622.

6.8 Transportation – Cumulative

The assessment of cumulative transportation impacts for past, present, and reasonably foreseeable future actions concentrates on off-site transportation throughout the nation 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.

For the Technical Report, the comprehensive transportation cumulative impacts analysis that is presented in Section 5.6 of the *Versatile Test Reactor Environmental Impact Statement* (referred to as the "VTR EIS") (DOE, 2022b) was used as an initial source of information. 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 transportation impacts analysis began in 1943 and extended to 2090. Table 6-5 summarizes the overall cumulative impacts presented in the VTR EIS. As indicated above, the transportation impacts (Table 6-4) under the Proposed Action would be SMALL and would not contribute to the cumulative impacts.

Table 6-5. Cumulative Transportation-Related Radiological Doses and Latent Cancer Fatalities

Category	*Worker Dose (person-rem)*	*General Population Dose (person-rem)*
Cumulative Transportation-Related Radiological Doses [(a)]	**430,000**	**441,000**
Transportation Impacts under the Proposed Action [(b)]	14	44
Total	430,014	441,044
Total LCF [(c)]	258	265

Key: EIS = Environmental Impact Statement; HALEU = high-assay low-enriched uranium; LCF = latent cancer fatality; rem = roentgen equivalent man

Notes:

[a] VTR EIS, Section 5.6, total impacts (DOE, 2022b).

[b] Maximum transportation impacts, from Section 6.7, *Summary and Conclusion,* and adjusted for the 6 years of operations and 150 MT of HALEU, per contract. Worker and population dose-risk (in terms of person-rem) are estimated by dividing the corresponding LCF values by 0.0006 (DOE, 2003).

[c] Total LCFs are calculated assuming 0.0006 LCFs per person-rem of exposure (DOE, 2003).

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 523, or an average of about 4 LCFs per year. Over this same period (148 years), approximately 88.7 million people would have died from cancer, based on National Center for Health Statistics data. The annual number of cancer deaths in the United States in 2019 was about 599,600 (CDC, 2021). The transportation-related LCFs would be 0.0006 percent of the total annual number of LCFs; therefore, this number is indistinguishable from the natural fluctuation in the total annual death rate from cancer.

Attachment A
Radioactive Material Packaging and Annual Number of Shipments

Shipment packaging for radioactive materials must be designed, constructed, and maintained to ensure that it will contain and shield the contents during normal transportation. For more highly radioactive material, the packaging must contain and shield the contents in severe accidents. The type of packaging used is determined by the radioactive hazard associated with the packaged material. The basic types of packaging required by the applicable regulations are designated as Type A, Type B, or industrial packaging (generally for LSA material). Table A-1 summarizes the shipment packaging for the various materials considered in the Technical Report.

Table A-1. Radioactive Material Shipment Configuration and Annual Number of Shipments

Materials	*Shipment Configuration*	*Average Annual Number of Shipments*
Yellowcake (U_3O_8)	40 55-gallon drums	74
UF_6 feed	1 48-Y Cylinder	128
UF_6 product (HALEU)	4 30B-20 in DN30-20 overpack	8
Depleted UF_6	1-48-Y Cylinder	124
Empty cylinders	2-48-Y Cylinders	2
HALEU O_2	5 NA-OPTIMUS®-L	8
HALEU metal	20 ES-3100	36
Low-level radioactive waste	Various configurations	Varies

Key: HALEU O_2 = high-assay low-enriched uranium dioxide; UF_6 = uranium hexafluoride

The yellowcake, the UF_6 feed and tails, and the LLW shipments would use Type A packaging. This type of packaging must withstand the conditions of normal transportation without the loss or dispersal of the radioactive contents. "Normal" transportation refers to all transportation conditions except those resulting from accidents or sabotage. Approval of Type A packaging is obtained by demonstrating that the packaging can withstand specified testing conditions intended to simulate normal transportation. Type A packaging usually does not require special handling, packaging, or transportation equipment. The UF_6 feed and depleted tails would be shipped in Model 48-Y cylinders (USEC, 1995). LLW would be in various packaging, drums, bulk bags, or waste boxes. The dimensions of the Model 48-Y cylinder are shown in Figure A-1.

In addition to meeting all the Type A standards, Type B packaging must also provide a high degree of assurance that the package integrity will be maintained even during severe accidents, with essentially no loss of the radioactive contents or serious impairment of the shielding capability. Type B packaging must satisfy stringent testing criteria (as specified in 10 Code of Federal Regulations Part 71) that were developed to simulate conditions of severe hypothetical accidents, including impact, puncture, fire, and immersion in water. The most widely recognized Type B packaging are the massive casks used to transport highly radioactive spent nuclear fuel from nuclear power stations.

The enriched uranium (up to 5%) product would be shipped in 30B cylinders in type B over pack (UX-30) (NRC, 2012b, pp. D-9). Currently, the only certified fissile material packaging that could be used to transport HALEU UF_6 is the DN30-X (NRC, 2023b). The DN30-X transports 30B-X (x=10 [10% enriched], and =20 [20% enriched-HALEU]) UF_6 cylinders in Type B overpacks (DN30-protective structural package DN30-PSP). The 30B-20 cylinders are similar to the Model 30B cylinders with additional CCS. The CCS consists of CCRs containing neutron poison material in the form of boron carbide, and three lattice holders to keep each CCR in place. The separation of the lattice holders is maintained by 14 longitudinal stiffeners. The lattice holders are entirely made of steel. The length of the CCRs is fitted to the elliptical heads of the

30B-X cylinder (NRC, 2023b, p. 2 of Enclosure 2) (see Figure A-2 that shows the basic concept of 30B-20 design) (Daher, 2020). The 30B-20 cylinder can hold up to 1,271 kg (2,802 lbs)of UF_6; which is about half of the capacity that could be transported in a 30B cylinder. Figure A-3 displays the dimensions of the 30B cylinder, and Figure A-4 shows the DN30-X basic concept. The DN30-X is similar in structure with the DN30, which has a diameter of 1.22 m (48 inches) and a length of 2.44 m (96 inches) (NRC, 2023b, p. 2 of 4).

The DOE/NRC certified ES-3100 (NRC, 2021d, p. Table 2) can hold up to 35-kg (77-lb) uranium metal in exclusive-use transport for enrichment below 60%. For an annual production of 25 MT, 712 ES-3100 packages would be needed, about 36 shipments (with 20 ES-3100, per shipment). Figure A-5 shows a cross-section configuration of an ES-3100 package.

Currently, there are no certified packaging that can transport uranium oxide enriched up to 20% in large volume. However, NAC International Package certified Model No. OPTIMUS®-L (NRC, 2022b) that can be adapted to relicense for transport UO_2 HALEU in reasonable quantities per package. The OPTIMUS®-L is a certified Type B(U)F packaging consists of (1) a Cask Containment Vessel (CCV), (2) a CCV bottom support plate, (3) an Outer Packaging assembly, and (4) Shield Insert Assemblies. The CCV bottom support plate is a free-standing coated carbon steel plate positioned at the bottom end of the CCV cavity below the contents. The CCV fits within the cavity of the Outer Packaging. The packaging may also be configured with a Shield Insert Assemblies within the cavity of the CCV. Figure A-6 and Figure A-7 show a schematic of OPTIMUS®-L package and internal baskets.

A recent analysis for the UO_2 HALEU transportation (INL, 2019) has determined that if OPTIMUS®-L is re-certified to transport HALEU oxides, then about 3.937 MT of oxide could be transported in five OPTIMUS®-L packages per shipment (INL, 2019, p. 46).

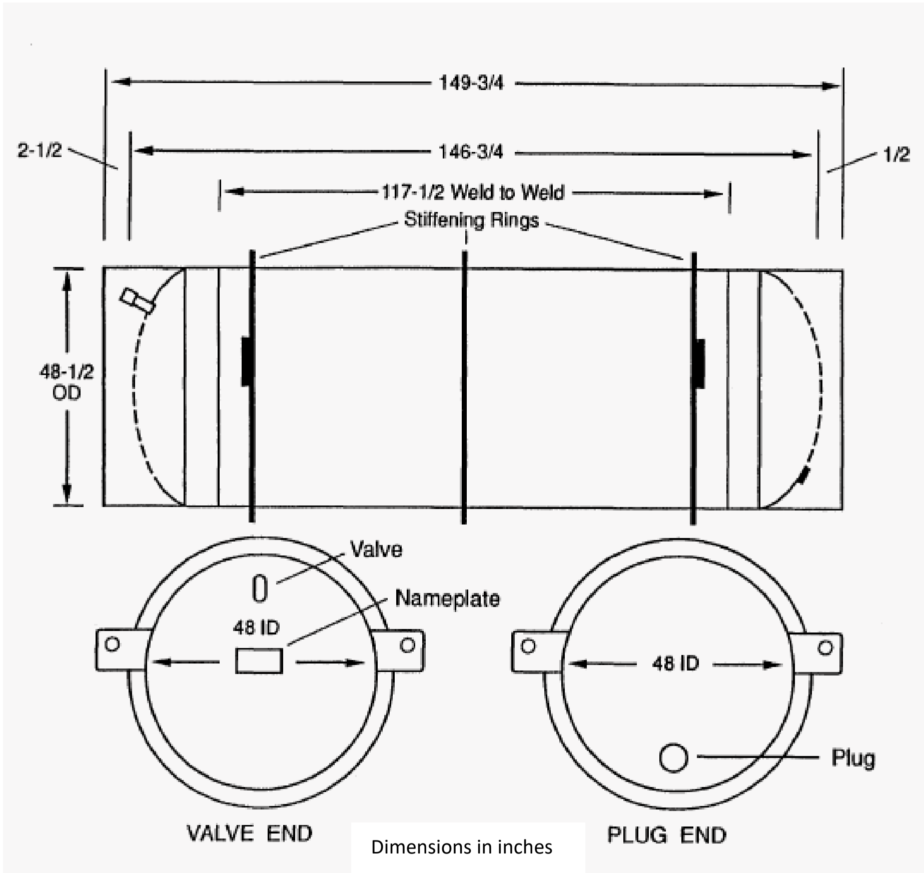


Figure A-1. Schematic of a Type 48-Y Cylinder (USEC, 1995)

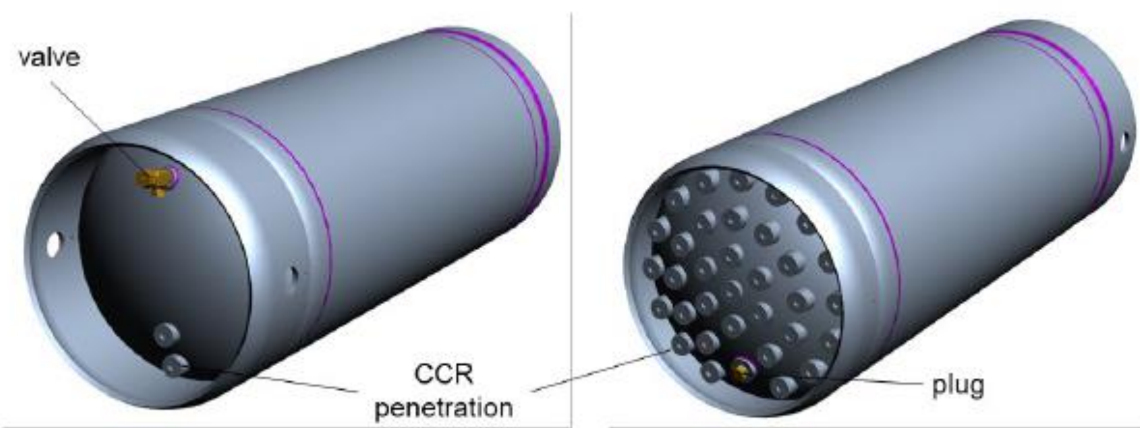


Figure A-2. Basic Concept of 30B-20 Design (Daher, 2020)

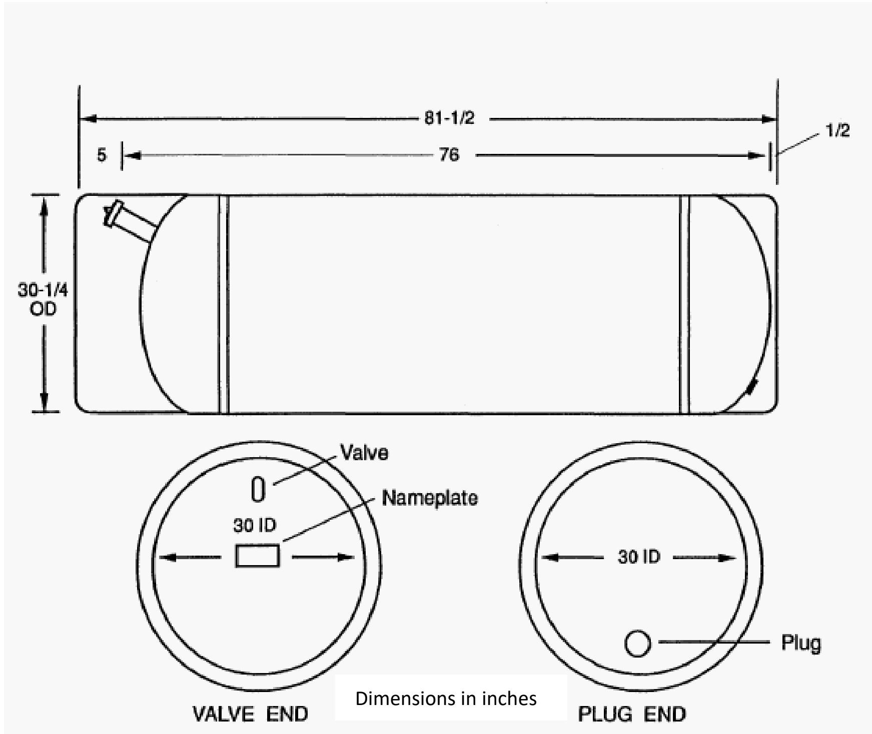


Figure A-3. Schematic of a Type 30B Cylinder (USEC, 1995)

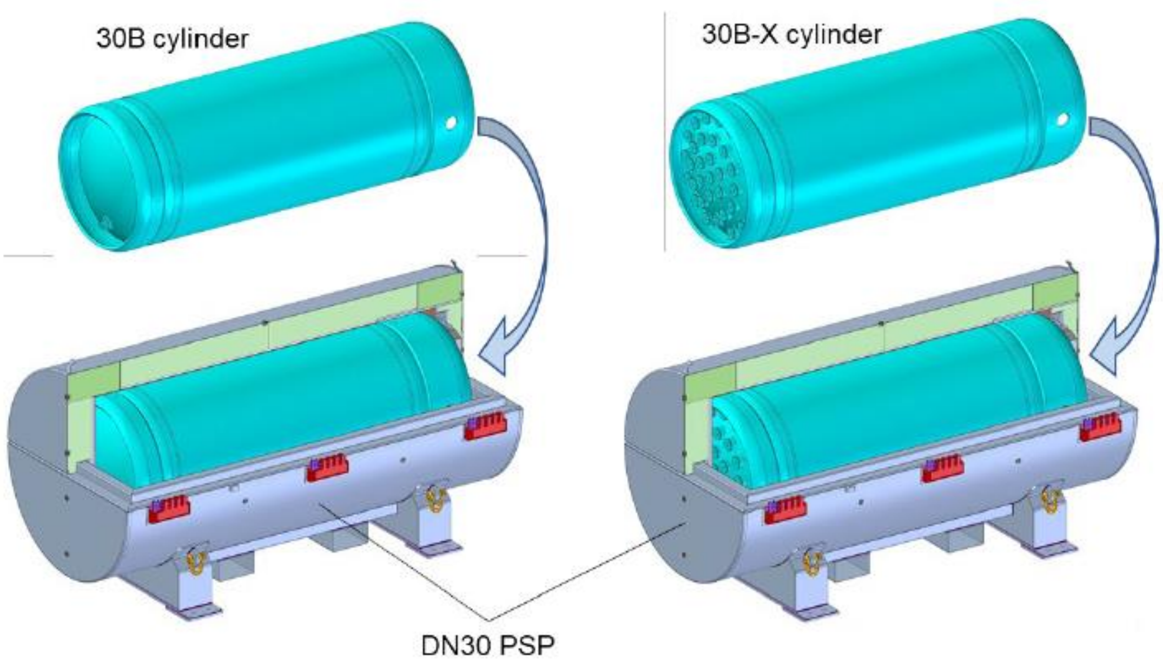


Figure A-4. The General Concept of DN30-X (Daher, 2020)

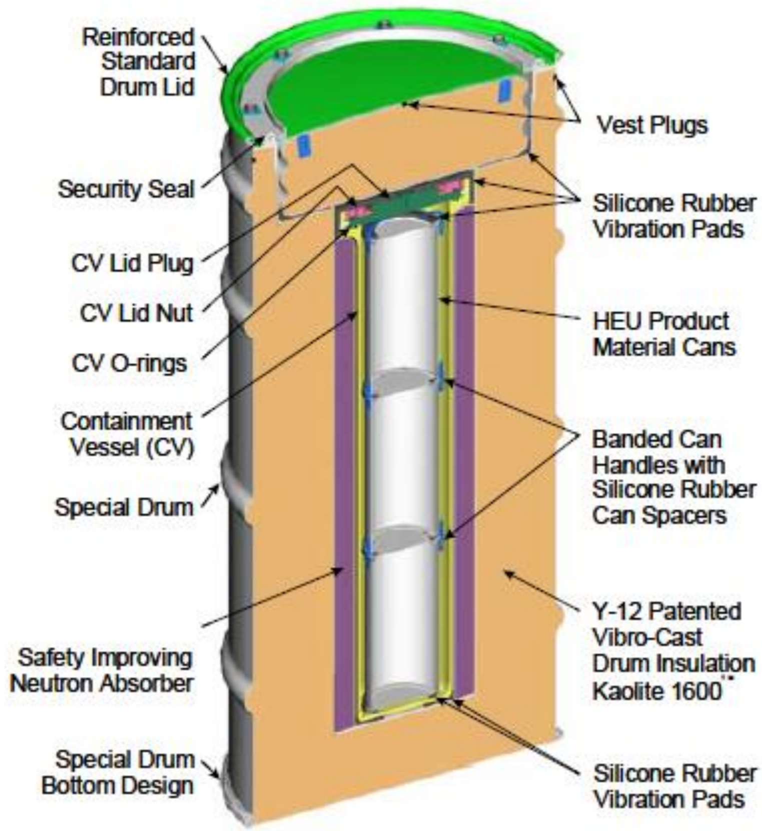


Figure A-5. ES-3100 Material Construction

Figure A-6. NAC International OPTIMUS®-L Packaging (INL, 2019)

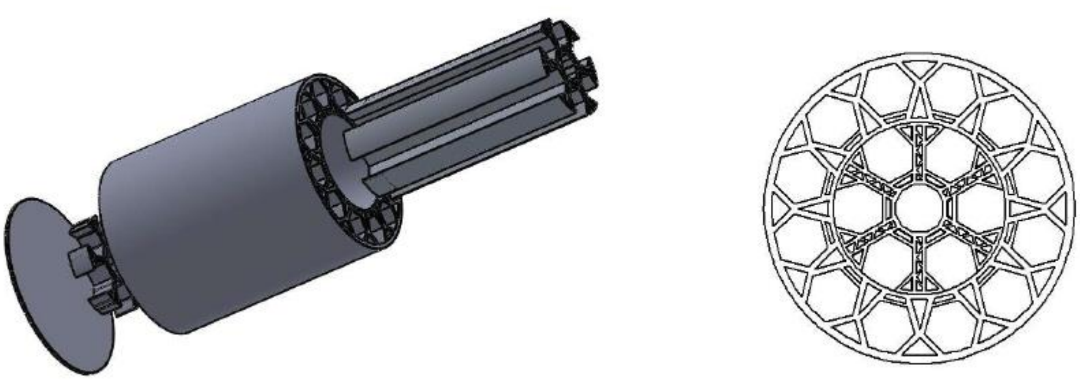


Figure A-7. NAC International OPTIMUS®-L Internal Basket (Stack of Two) (INL, 2019)

This page intentionally left blank.

7 HALEU Fuel Fabrication

7.1 Description of the Activity

7.1.1 General Description

Fuel fabrication is the last step in the process of turning uranium into nuclear fuel. The fabricated fuel forms the majority of core structure in an advanced nuclear reactor. Nuclear reactor fuel is specifically designed for particular types of reactors and are made to exacting standards. Utilities and fabricators have collaborated to greatly improve nuclear fuel performance and development of accident-tolerant fuels is being pursued. While all present fuel is oxide, research and development efforts are considering metal, nitride, and other forms for nuclear fuel.

7.1.2 Description of the Process

Fuel fabrication facilities would convert high-assay low-enriched uranium (HALEU) into fuel for nuclear reactors. Fuel fabrication operations with HALEU could produce forms such as pebbles, rods, or salts, and facilities could be sited anywhere in the United States (U.S.) that meet U.S. Nuclear Regulatory Commission (NRC) siting requirements. Nuclear fuels are fabricated to meet the requirements of each reactor design. A goal of designers is to develop accident-tolerant fuels that enhance the safety of nuclear reactors. Accident-tolerant fuels may use new cladding and fuel pellet designs that increase the performance and accident response of nuclear fuel. They may take advantage of new materials that reduce hydrogen buildup, improve fission product retention, and are structurally more resistant to radiation, corrosion, and higher temperatures. The design and composition of nuclear fuels are predominantly dictated by the engineering requirements necessary for their function in reactors of various designs. Depending on the reactor design, the fuel fabrication facility could produce advanced nuclear fuels of varying forms such as metal fuel, molten salt fuel, tri-structural isotropic (TRISO) particle fuel, uranium nitride fuel, and advanced ceramic fuel.

7.1.3 Potential Facilities

The fabrication of HALEU fuel is required to occur in a secure NRC Category II facility. However, fabrication of HALEU fuel could also be performed in an NRC Category I (greater security than NRC Category II) facility. The Nuclear Fuel Services, Inc. (NFS) Facility (NRC, 1999b; NRC, 2002a), in Erwin, Tennessee, is a Category I facility that could be modified to fabricate HALEU fuel. The BWX Technologies, Inc. (BWXT) facility (NRC, 2005b) in Lynchburg, Virginia, is a Category I facility and the site's Specialty Fuel Facility is the only U.S. facility currently capable of fabricating HALEU fuel using production-scale equipment.

Since the economics of the commercial business model are uncertain, the production of HALEU may be accomplished through modification of existing facilities or through development of new facilities. The Framatome (formerly AREVA NP) facility (NRC, 2009c) in Richland, Washington, the Global Nuclear Fuel – Americas (GNF-A) facility (NRC, 2009b) in Wilmington, North Carolina, and the Westinghouse Electric Company, LLC facility (NRC, 2022c), in Columbia, South Carolina, are NRC Category III facilities currently licensed to fabricate low-enriched uranium (LEU) nuclear fuel for light water reactors. These NRC Category III facilities could be modified to produce HALEU fuel.

Development of new fuel fabrication facilities may be preferred by some organizations because of specific fuel package requirements for their advanced nuclear reactors. Multiple domestic vendors, such as X-energy (Pappano, 2020; X-energy, 2022), GNF-A (GNF-A, 2021), and Ultra Safe Nuclear

Corporation (USNC) (WNN, 2022), either have small quantity HALEU fuel manufacturing capabilities or have expressed an interest in fabricating HALEU fuel. X-energy plans to produce TRISO fuel at its Pilot Fuel Manufacturing facility in Oak Ridge, Tennessee. The fuel fabrication capabilities for these existing and planned facilities are summarized in Table 7-1.

Table 7-1. Summary of Existing and Planned Fuel Fabrication Capabilities

Facility	*Location*	*NRC Security Category*	*Fuel Produced*	*Production*
Framatome, Inc.	Richland, WA	III	LEU	Maximum of 400 MT/yr (NRC, 2009c, p. 9)
Global Nuclear Fuel – Americas (GNF-A)	Wilmington, NC	III	LEU	1,100 – 1,400 MT/yr (GNF-A, 2021, p. 9)
Westinghouse Electric Company, LLC	Columbia, SC	III	LEU	1,500 MT/yr, maximum of 1,600 MT/yr (NRC, 2022c, pp. 1-1)
Nuclear Fuel Services, Inc. (Operated by BWX Technologies, Inc.)	Erwin, TN	I	HEU	Unavailable
BWX Technologies, Inc. (BWXT)	Lynchburg, VA	I	HEU/HALEU	Unavailable/10 MT/yr (DOE, 1996a, pp. 4-66)
X-energy, LLC (X-energy) / TRISO-X	Rockville, MD / Oak Ridge, TN	II	HALEU	Projected 16 MT/yr (TRISO-X, 2022, pp. 2-25)
Ultra Safe Nuclear Corporation	Seattle, WA	II	HALEU	Unavailable

Key: HEU = highly enriched uranium; LEU = low-enriched uranium; MD = Maryland; MT/yr = metric tons per year; NC = North Carolina; SC = South Carolina; TN = Tennessee; VA = Virginia; WA = Washington

Framatome, Inc. (formerly AREVA NP, Inc.) owns 131 hectares (ha) (320 acres) just inside the northern boundary of the city of Richland. Richland is located in the southeastern portion of Washington state and is approximately 180 kilometers (km) (110 miles) west of the Idaho-Washington border, 295 km (180 miles) south of the Canadian border, and 225 miles (369 km) east of the Pacific Ocean. The Framatome site is bordered on the north by the U.S. Department of Energy's (DOE's) Hanford site. Horn Rapids Road separates the Framatome site from the Hanford site. The uranium handling and processing facilities are located within a restricted 21.5-ha (53-acre) fenced area. Framatome, Inc. maintains a buffer of undeveloped, disturbed land between the facility and the rest of North Richland to the east and south. The undeveloped land on the site is semi-arid sage steppe. Framatome, Inc. leases land to the west for agricultural purposes.

The GNF-A facility is located on a 673-ha (1,664-acre) site in an unincorporated part of northwestern New Hanover County approximately 10 km (6 miles) north of the city of Wilmington, North Carolina. This is the southeastern portion of North Carolina, and the GNF-A facility is approximately 16 km (10 miles) west and 42.5 km (26.4 miles) north of the Atlantic Ocean (due to curvature of the coastline in the area), 80 km (50 miles) northeast of the South Carolina border, and 260 km (160 miles) south of the Virginia border. North Carolina Highway 133, also known as Castle Hayne Road, borders most of the east side of the site. About 9.7 ha (24 acres) of the site resides on the east side of Castle Hayne Road. The area east of Castle Hayne Road contains a truck parking lot and a small recreational park for GNF-A employee use. Immediately north of GNF-A is a 1,647-ha (4,069-acre) parcel owned by Hilton Properties known as the Sledge Forest. Undeveloped forestlands are located along much of the southern border of the site. The Northeast Cape Fear River borders the site's west side. About 122 ha (302 acres) of the site are developed (GNF-A, 2008). The developed area is located in the eastern portion of the site. Activities regulated under NRC material license special nuclear material (SNM)-1097 are conducted at only one of these facilities. A power line corridor occupies about 6.5 ha (16 acres) of the site. A network of service roads connects the various on-site facilities, and several unpaved roads provide access to selected areas in the undeveloped portion of the site. The terrain around the site consists of heavily timbered tracts of land on gentle rolling topography with rivers and creeks adjoined by swamps or marshlands. A 73.7-ha (182-acre) tract of land in the southwest portion of the GNF-A site is classified as swamp forest, which is a palustrine, forested, needleleaf, saturated, partly drained wetland.

The Westinghouse Columbia Fuel Fabrication Facility (CFFF) is located in a semi-rural area on approximately 469 ha (1,158 acres). The main manufacturing building, waste treatment areas, holding ponds, parking lots, and other miscellaneous buildings occupy approximately 24 ha (60 acres), or 5% of the site. About 444 ha (1,098 acres) of the site remain undeveloped. The manufacturing facilities are located about 488 meters (m) (1,600 feet) from the nearest site boundary. The main manufacturing building, which provides about 200,000 square feet (ft^2) of space, is set back approximately 762 m (2,500 feet) from the nearest public road. The main plant road provides access for vehicle and truck traffic. A continuously staffed security guard station is located on the main plant road. Access to the site is controlled by fencing and security barriers. The restricted area is defined as the area within the fenced area, including the main manufacturing building on the site. Workers in this area must enter through security and nonworkers must be escorted.

The BWXT facility occupies a 201-ha (497-acre) site approximately 8 km (5 miles) east of Lynchburg, Virginia, in the northeast corner of Campbell County. The site is located on a peninsula surrounded on three sides by the James River. Much of the area adjacent to the river consists of a relatively flat floodplain. Across the river to the north and west are rolling hills. The side of the BWXT site not bounded by the river is adjacent to Mount Athos. The main manufacturing and support facilities occupy approximately 6.8 ha (16.8 acres) and are located toward the center of the site with the main facility at an elevation of 173 m (568 feet) above mean sea level. The Lynchburg Technology Center facilities occupy approximately 5.5 ha (13.6 acres) and are located west of the main Nuclear Products Division Facility. The approximately 0.24-ha (0.6-acre) waste treatment facility with an elevation of 149 m (488 feet) above mean sea level, lies north of the main Nuclear Products Division Facility. A security fence encloses approximately 16 ha (39 acres) of the site.

The company TRISO-X, whose parent company is X-energy, LLC, is in the process of obtaining a license from the NRC to construct and operate a facility for fabricating TRISO fuel from HALEU (TRISO-X, 2022). The TRISO-X fuel fabrication facility (TRISO-X FFF) is designed to produce coated particle fuel for the next generation of nuclear power plants and new accident-tolerant fuels currently under development for existing light water reactors. While the baseline design targets the fabrication of pebble fuel forms for X-energy's Xe-100 Pebble Bed high-temperature gas-cooled reactor, the modular design of the process cells and areas anticipates additional production capabilities to satisfy the needs of a variety of reactors (e.g., prismatic gas cooled, molten salt cooled, accident-tolerant fuel, and others) and fuel designs. TRISO-X FFF manufacturing operations envision receiving HALEU in the form of triuranium octoxide (U_3O_8) powder enriched to less than 20 weight percent uranium-235 (U-235); converting the U_3O_8 into a uranyl nitrate (UN) solution, into gel spheres, and then into fuel kernels; and processing the fuel kernels through coating, overcoating, fuel form pressing, and high-temperature carbonization. These operations are supported by shipping and receiving, laboratory, quality control, research and development, uranium recovery, and waste disposal processes.

The TRISO-X FFF is located in the city of Oak Ridge, in Roane County, Tennessee. The TRISO-X FFF site encompasses approximately 45 ha (110 acres). The project layout consists of the main fuel process building, administration building, associated equipment yards, stormwater detention basin, internal roadways, stormwater ditches, permanent parking, and construction laydown area. Figure 7-1 shows the proposed site layout with major structures and the site boundary.

For comparison, the CFFF produces 1,500 metric tons (MT) of uranium per year (MT/yr) of LEU fuel with a maximum capacity of 1,600 MT/yr while the TRISO-X FFF is projected to produce 16 MT/yr of HALEU fuel. To achieve the goal of Proposed Action, it is assumed that 50 MT/yr (assuming metal) of HALEU fuel would need to be produced. Because of the amount of fuel needed and the different forms of fuel that likely would be produced (e.g., metal fuel, molten salt fuel, TRISO fuel, uranium nitride fuel, and advanced ceramic fuel) it is likely that more than one HALEU fuel fabrication facility would be needed.

7.1.4 Existing NEPA Documentation

The affected environment and environmental consequences at a facility that fabricates HALEU fuel are expected to be comparable to those at a facility that fabricates LEU fuel. To understand the impacts of developing a HALEU fuel fabrication facility, the Leidos Team reviewed the NRC's National Environmental Policy Act (NEPA) documentation for the Framatome, GNF-A, Westinghouse, and BWXT fuel fabrication facilities. Licensing is in progress for the TRISO-X facility and in the absence of a NEPA document for the facility, the Leidos Team reviewed the Environmental Report (ER) submitted to NRC in support of the license application for evaluation of the TRISO-X Fuel Fabrication Facility. These documents, which provide the Leidos Team with information and analyses for determining the impacts of construction and operation of a HALEU fuel fabrication facility, include:

- **Framatome, Inc.**

  Environmental Assessment for the Renewal of U.S. Nuclear Regulatory Commission License No. SNM-1227 for AREVA NP, Inc. Richland Fuel Fabrication Facility. Docket No. 70-1257. (NRC, 2009c)

- **Global Nuclear Fuel – Americas (GNF-A)**

  Environmental Assessment for the Renewal of U.S. Nuclear Regulatory Commission License No. SNM-1097 for Global Nuclear Fuel – Americas, Wilmington Fuel Fabrication Facility. Docket No. 70-1113. Referred to as the "GNF-A EA." (NRC, 2009b)

- **Westinghouse Electric Company, LLC**

  Final Environmental Impact Statement for the License Renewal of the Columbia Fuel Fabrication Facility in Richland County, South Carolina, NUREG-2248. Referred to as the "CFFF EIS." (NRC, 2022c)

- **BWX Technologies, Inc. (BWXT)**

  Environmental Assessment Related to the Renewal of NRC License No. SNM-42 for BWX Technologies, Inc. (BWXT). Docket No. 70-27. Referred to as the "BWXT EA." (NRC, 2005b)

- **X-energy, LLC (X-energy) / TRISO-X**

  Environmental Report for the TRISO-X Fuel Fabrication Facility. TRISO-X, LLC, Rockville, MD 20852, Docket 07007027. Referred to as the "TRISO-X FFF ER." (TRISO-X, 2022)

  Information related to licensing of the TRISO-X facility is available at https://www.nrc.gov/info-finder/fc/triso-x.html#environmental.

7.2 Approach to NEPA Analyses

The analyses in the Technical Report are based on resource conditions and impact analyses in the existing NEPA documents discussed in Section 7.1.4, *Existing NEPA Documentation*, as well as other online and available sources. The intent of the Technical Report is to provide a range of potential impacts from construction and operation of a HALEU fuel fabrication facility based on the existing NEPA documentation and other available sources.

In the Technical Report, the Leidos Team assumes that a new HALEU fuel fabrication facility could be constructed and operated at any one of the seven fuel fabrication facilities[49] described in Table 7-1. To bound the potential impacts, the Leidos Team has assumed that the HALEU fuel fabrication facility would have a full complement of support facilities and structures. If the HALEU fuel fabrication facility was constructed at an existing site with existing site infrastructure, many of the support facilities and infrastructure would likely be used to support the new HALEU fuel fabrication facility along with existing activities. For example, office buildings and warehouses may be able to support both activities, and fences and guards would likely provide protection for all the facilities at the site. Therefore, analyzing construction and operation of a new HALEU fuel fabrication facility would likely overestimate (or bound) the impacts of locating this facility at an existing site.

The LEU fuel fabrication facilities included in Table 7-1, have throughputs ranging from 400 to 1,600 MT of uranium per year. HALEU fuel fabrication facilities would need a maximum total production rate of 50 MT/yr. This could be accomplished by constructing and operating multiple smaller fuel fabrication facilities (less than 25 MT/yr) at multiple sites. Therefore, many of the attributes of the LEU fuel fabrication facilities would be much larger than needed for HALEU fuel fabrication and would likely bound the impacts of the HALEU fuel fabrication facility.

The Leidos Team has analyzed construction and operation of a HALEU fuel fabrication facility based on available data for the fuel fabrication facilities listed in Table 7-1. Most attributes of facilities that fabricate HALEU fuels are expected to be bounded by this analysis. In any event, project-specific NEPA documentation would be completed by the NRC before construction and operation of a HALEU fuel fabrication facility.

The developed area for a HALEU fuel fabrication facility is assumed to occupy 12 to 28 ha (30 to 70 acres). The site is assumed to be located within 10 miles of a city but outside the boundaries of that city. Based on information in Table 7-2, the fuel fabrication facility operations are assumed to occur in a 30,000 ft^2 building with supporting buildings. The primary facilities would consist of a main fuel fabrication building, administration building, utilities building, laboratory, wastewater treatment plant and lagoons, raw material storage buildings, finished material storage buildings, parking lots, and office space. The site is assumed to be accessed by a primary highway that provides access to a road into the fuel fabrication facility. A controlled area boundary would surround the fuel fabrication facility.

---

49 Although the Technical Report analyzes locating the HALEU fuel fabrication facility at one of the seven described sites, locating the HALEU fuel fabrication facility at another site would likely have similar impacts.

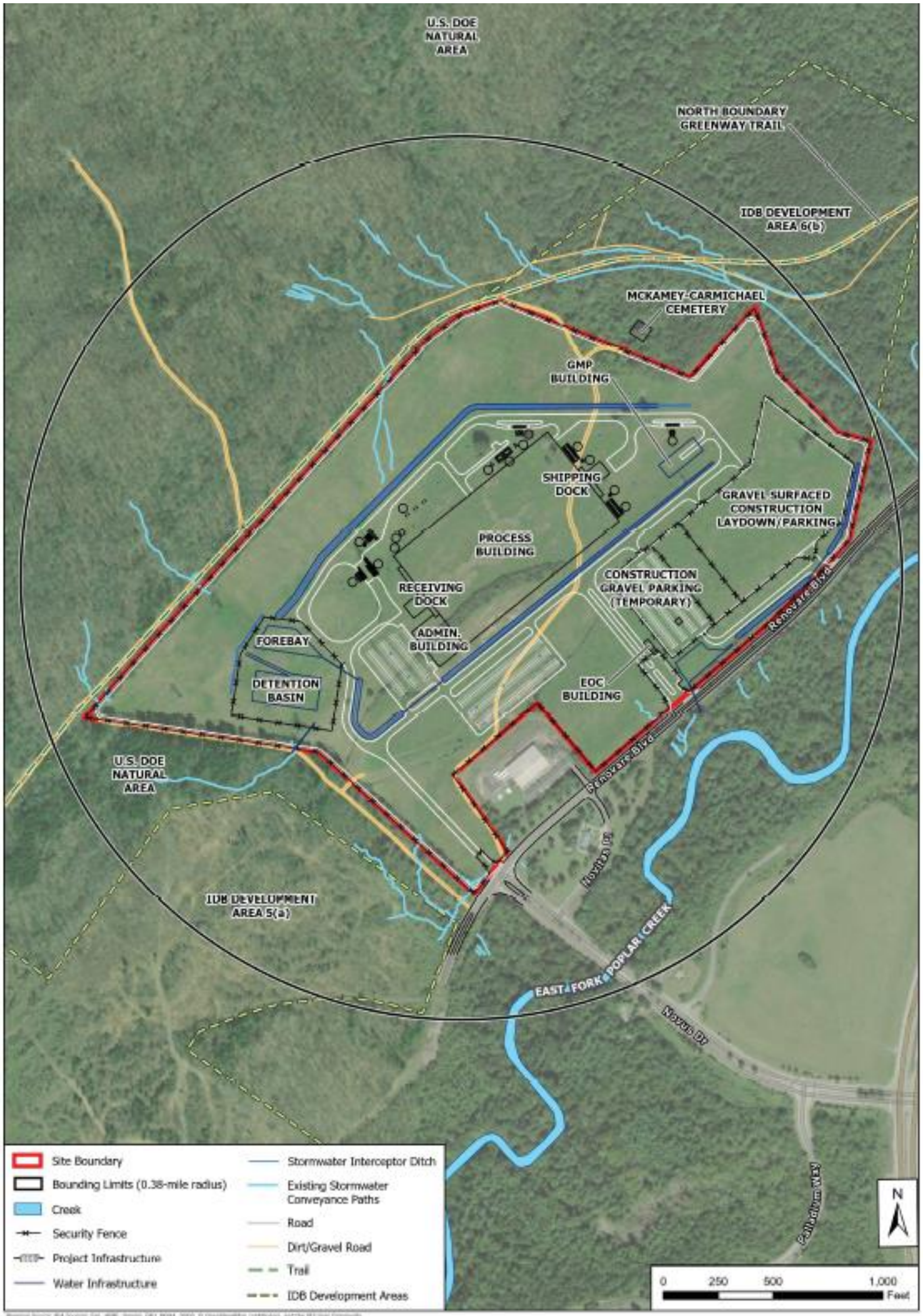


Figure 7-1. TRISO-X Fuel Fabrication Facility Site Layout

Table 7-2. Process Line Parameters for a Potential HALEU Fuel Fabrication Facility

Chemical/Rad Area		
Parameter	***Value***	***Comments***
First floor space	2,500 ft^2	50 ft × 50 ft area (includes all uranium processing)
Number of floors	3	Not all floors have to be installed
Total Area for Development	**7,500 ft^2**	
Overall ceiling height	50 ft	Allows gravity feed for chemical processing
Ventilated volume	125,000 ft^3	
Ventilation rate (air changes per hour)	7	
Ventilation flow	14,583 SCFM	
Process ventilation for hoods, etc.	1,458 SCFM	
Ventilation access for 3 ft × 8 ft hoods	4	Space available for four 24 ft^2 fume hoods; ventilation configured for ease of connect/disconnect
Ventilation access for 5 ft (deep) × 10 ft (long) × 8 ft (high) glove boxes	3	Space available for three 50 ft^2 glove boxes; ventilation configured for ease of connect/disconnect
Mechanical Area (Encapsulated Uranium Only)		
First floor space	20,000 ft^2	200 ft × 100 ft area (includes storage vaults, etc.)
Number of floors	1	Platforms/floors could be installed if needed
Total Area for Development	**20,000 ft^2**	
Overall ceiling height	30 ft	Allows vertical handling of fuel pins

Key: ft = feet; ft^2 = square feet; ft^3 = cubic feet; SCFM = standard cubic feet per minute

The controlled area boundary would be equivalent to the site's property boundary and encompass the restricted area, which is defined as the area within the fenced area. Security would be in accordance with the requirements for a security NRC Category II facility. Access to the site would be controlled by fencing and security barriers. Physical access would be through the main facility road, which would be controlled by a continuously staffed security guard station. Physical access to the restricted area would be limited to authorized individuals and visitors who are escorted. The manufacturing facilities are assumed to be located within 2,000 feet from the nearest residence. The CFFF employs approximately 1,100 employees working in one of three shifts. The annual average daily workforce is approximately 860 workers. Commuting by these workers results in approximately 1,700 vehicles on the road. For the TRISO-X FFF, approximately 166 employees are needed during construction; approximately 816 employees are needed during the facility operation phase; and up to 150 employees are required during the decommissioning phase.

Since specific details for a process line are not available for the TRISO-X facility, the parameters for a potential HALEU fuel fabrication facility process line from PNNL-31226 (Zbib et al., 2021) are presented in Table 7-2. Three of the process lines would facilitate three independent fuel fabrication efforts. The first process area is the chemical area that is provided with nuclear-grade ventilation to accommodate harsh process chemicals and unencapsulated HALEU. The area has a 15-m-by-15-m (50-foot-by-50-foot) floor area and a 15-m (50-foot) ceiling height. Metal platforms could be included to provide up to three floors of process area, allowing gravity flow of materials if desired. This area would also have ventilation to support glove boxes and fume hoods as needed for the particular developer.

The second process area is the mechanical area that allows handling of encapsulated uranium and mild chemicals similar to the rod and bundle fabrication areas in a conventional fuel fabrication facility. The area is 20,000 ft^2 (15 m [50 feet] by 122 m [400 feet]) with a 9-m (30-foot) ceiling and would include shipping container loadout as needed as well.

An additional area would house clean support areas such as change rooms, offices, lunchrooms, maintenance/machine shops, analytical laboratory, etc. This area is at least 15,000 ft^2 per process line.

The fuel fabrication facility would receive HALEU from the deconversion facility. The deconversion facility could provide HALEU in forms such as uranium oxides (e.g., uranium dioxide, UO_2), uranium metal, uranium fluorides, uranium silicides, and uranium nitrides. The fuel fabrication facility would process the source material into a physical form required by a particular reactor. The forms could include physical configurations such as particulates, pebbles, pellets, uranium metal alloys, uranium salts, compacts, planks, and rods.

As an example, particulate fuels are a class of fuels consisting of a spherical kernel of fissile fuel enveloped in concentric coatings. Among the particulate fuels, TRISO is a popular form. The basic particle consists of the UO_2 or uranium oxycarbide kernel with four layers consisting of three isotropic materials. The first layer is a porous carbon buffer over the kernel. The next three layers are dense pyrolytic carbon, silicon carbide, and dense pyrolytic carbon. These layers contain the radioactive materials and prevent fuel and fission products from being released. One process of TRISO fuel fabrication is illustrated in Figure 7-2, for the TRISO-X FFF (Pappano, 2020).

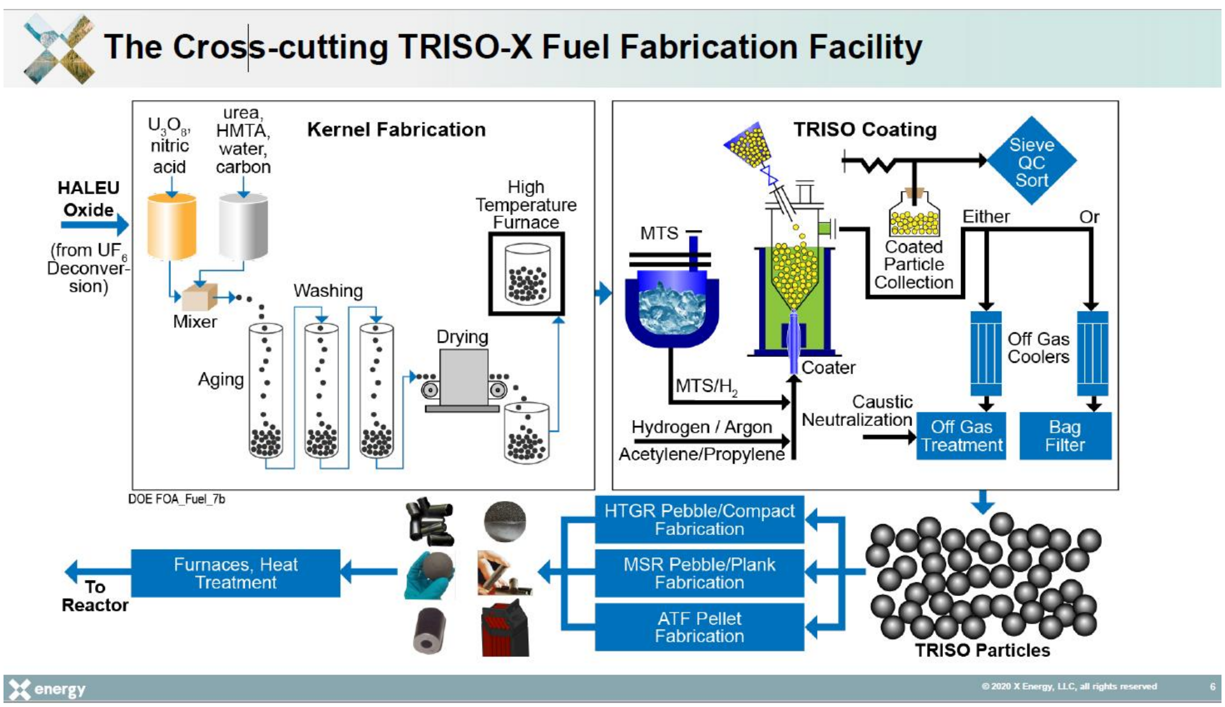


Figure 7-2. Example of TRISO Fuel Fabrication Process

The affected environment reflects the existing condition of environmental resources, as influenced by natural physical conditions and by past human activities, such as agriculture, forestry, mining, urbanization, and industrial or non-industrial development. The site might be situated at an existing fabrication facility or at sites not previously used for activities related to the nuclear fuel cycle. A fuel fabrication facility might be located on sites that have a history of industrial use or other development, or on greenfield sites that have not been previously developed.

7.3 Affected Environment and Environmental Consequences

The environmental impacts of constructing, operating, and decommissioning a potential HALEU fuel fabrication facility are discussed in the following subsections for each resource area. The environmental impacts of constructing and operating a HALEU fuel fabrication facility would likely be similar to the impacts of constructing and operating the TRISO-X FFF. The environmental impacts of constructing and operating the TRISO-X FFF are evaluated in the ER that is part of the license application (TRISO-X, 2022). Based on the much larger size of the Framatome fuel fabrication facility, CFFF, and the GNF-A fuel fabrication facility relative to the HALEU fuel fabrication facility, most of the environmental impacts of HALEU fuel fabrication facility operations would be expected to be less than the environmental impact of Framatome, CFFF, or GNF-A fuel fabrication facility operations. Example impact indicators for fuel fabrication facilities and a potential generic HALEU fuel fabrication facility are summarized in Table 7-10, in Section 7.4, *Summary of Impacts from a HALEU Fuel Fabrication Facility*.

7.3.1 Land Use

This section discusses potential impacts on land use from construction, operation, and decommissioning of a new HALEU fuel fabrication facility. Land use refers to human modification of land often for residential or economic purposes, and the use of land for preservation or protection of natural resources (such as wildlife habitat, vegetation, or unique geographic features). Attributes of land use include general land use and ownership, land management plans, and special use areas.

The region of influence (ROI) considered for land use includes the site for a new facility (assumed to be located in developed or industrialized areas), off-site land for affiliated uses such as construction laydown, intake and discharge structures, off-site rights-of-way, and the surrounding area(s).

Land use impacts from the construction and operation of a new HALEU fuel fabrication facility would be similar to those as those discussed in the TRISO-X FFF ER (TRISO-X, 2022), but would vary depending on the specific site characteristics of the new facility. Most land use impacts from an HALEU fuel fabrication facility would take place during the preconstruction and construction phases. Land uses are unlikely to substantially change during operation of a fuel fabrication facility, although minor changes could be necessary to refurbish or upgrade a facility during its operational life.

Conditions influencing potential land use impacts associated with a fuel fabrication facility include past and present land uses and land cover on and surrounding the site, applicable zoning regulations, and relevant planning documents such as comprehensive land use plans or installation land use plans. Zoning ordinances and land use plans are prepared to ensure that future development projects are compatible with other existing and reasonably foreseeable land uses in the area.

Construction and operation of a new fuel fabrication facility would require land acquisition of approximately 110 acres. Depending on the existing zoning of the site, the local government may need to rezone the industrial area for compatibility with construction and operation of the fuel fabrication facility. Similar to the TRISO-X FFF, impacts on land use from the construction could include effects from excavation, grading, placement of fill material, temporary staging and construction laydown, construction of permanent features, and potential operational disturbances (TRISO-X, 2022, pp. 4-11). Permanent land use changes could include the construction of facility buildings, parking lots, access roads, equipment yards, loading docks, and landscaping areas, as well as grading and drainage work. Temporary construction impacts would involve the use of land for construction laydown, parking, sedimentation basins, and ditches, which would be replanted with non-invasive herbaceous species after construction. Construction and operation of a new fuel fabrication facility would likely occur in a site that is already developed and disturbed, with only low-quality vegetation (e.g., weeds and plants growing in unsuitable growing conditions) remaining. Therefore, impacts on land use from construction would be considered SMALL.

The TRISO-X FFF ER analysis concluded that impacts to land use during operation of the facility would not occur (TRISO-X, 2022, pp. 4-13). As such, it is anticipated that operation of a new HALEU fuel fabrication facility would not impact land use; however, this would vary on the specific site characteristics of the new facility.

Potential land use impacts associated with the decommissioning of a fuel fabrication facility are typically similar to construction activities, in that decommissioning activities would involve heavy equipment to excavate/remove building materials and process equipment from the site. These impacts would be temporary, lasting only the duration of decommissioning activities, and localized within the previously disturbed 45-ha (110-acre) site boundary. Therefore, impacts on land use from decommissioning would be considered SMALL.

7.3.2 Visual and Scenic Resources

This section discusses potential impacts on visual and scenic resources on or near the site of a new HALEU fuel fabrication facility. The ROI includes any areas within line of sight of the facility and surrounding landscape.

Conditions influencing visual impacts include land cover and topography of the site and surrounding landscape, weather patterns and conditions, the height of existing structures and vegetation on-site, the proximity to other uses of the site, the extent of viewsheds (the area visible from a location sensitive to visual impacts, such as a residence or a park), and other landscape characteristics. Visual effects depend greatly on the setting.

Context plays a key role in the evaluation of visual impacts. The appearance of industrial structures in established industrial settings is better tolerated than the same structures in pastoral or residential settings. Tall or large structures, especially of a type not previously occurring on the landscape, tend to affect the visual properties of a landscape more than other structures. A fuel fabrication facility may consist of, or be housed in, smaller, low structures. Such structures would have little potential for visual impacts on viewsheds, whether or not those viewsheds contain existing nuclear facilities or other industrial facilities.

Fuel fabrication under the Proposed Action could occur at a number of existing facilities, or at an entirely new location. A brief summary of visual and scenic resource impacts analyzed in NEPA documentation for the existing facilities under consideration is provided below. Should a new location be selected in the future, site-specific NEPA analysis by the NRC would be required.

Westinghouse Electric Company Columbia Fuel Fabrication Facility (CFFF), Richland County, South Carolina

Potential impacts on visual and scenic resources associated with the continuation of operations at the CFFF were determined to be SMALL, as there are no nearby natural or man-made features that are considered distinctive, and the facility is difficult to view from the forested landscape of the surrounding rural area. It was determined that minor alterations to the facility associated with continued operations would be difficult to detect from the existing available views of the CFFF site from public locations (NRC, 2022c, pp. 3-92 to 3-93).

Framatome Facility, Richland, Washington

Potential impacts on visual and scenic resources associated with the continuation of operations at the Framatome site were determined to be SMALL, as no construction was proposed. The site was described as "a relatively flat and essentially featureless plain," and it was noted that if operations expansion or facility upgrades were planned in the future, visual/scenic changes would need to conform to the Benton County Planning Department's guidelines (NRC, 2009c, p. 43).

Global Nuclear Fuel – Americas (GNF-A) Facility, Wilmington, North Carolina

Although it was determined that the continuation of operations at the GNF-A site would not be expected to impose direct effects to visual and scenic resources, the overall impact of the existing facility was determined to be MODERATE, as the facility structures are prominent visual features in an otherwise flat landscape. Construction of the proposed GLE facility would have a SMALL impact on visual and scenic resources (NRC, 2009b, p. 40).

TRISO-X Fuel Fabrication Facility, Oak Ridge, Tennessee

The TRISO-X FFF ER facility analyzed the construction, operation, and decommissioning of the proposed facility. Potential impacts on visual and scenic resources associated with construction were SMALL, consisting of vegetation clearing and temporary visual intrusions to the landscape resulting from the use of tall cranes and other construction equipment. Operational impacts were determined to be SMALL because the site is surrounded by a forested buffer and because the proposed undertaking would be consistent with the site's zoning designation and other development in the area. Finally, decommissioning impacts were anticipated to be SMALL, resulting from temporary, localized visual intrusions to the landscape from the use of large construction equipment (TRISO-X, 2022, pp. 4-73 to 4-77).

BWX Technologies, Inc. Fuel Fabrication Facility, Lynchburg, Virginia

The Environmental Assessment (EA) for license renewal of the existing BWXT fuel fabrication facility did not analyze impacts on visual and scenic resources (NRC, 2005b).

New HALEU Fuel Fabrication (Generic Site)

A HALEU fuel fabrication facility could be located at any of the five locations discussed above, co-located at another existing fuel cycle facility, or constructed at an entirely new location. Potential impacts on visual and scenic resources resulting from this action would be expected to be similar to those described above but would vary depending on the specific characteristics of the chosen site.

Impacts on aesthetics from the construction of a new HALEU fuel fabrication facility include conversion of part of the site via site clearing and gradings. Although all areas of the site can be assumed to be impacted by construction activities, impacts would range as the site could be previously developed or vegetated. Heavily forested areas surrounding the site could provide a visual buffer between the facility and sensitive visual receptors in the vicinity. Temporary visual intrusions may result from the use of tall cranes and large construction equipment; however, these impacts would be short term and localized. Visual and scenic resource impacts resulting from the construction of a new HALEU fuel fabrication facility are expected to be SMALL, with the potential to be MODERATE depending on site-specific characteristics.

During operations, impacts would be primarily due to the visibility of the facility's structures and lighting. The process building would be the tallest structure and could be visible within a 3-mile radius. Taller structures like the heating, venting, and cooling vent stacks and the meteorological tower would be visible from a slightly larger portion of the vicinity, but due to their narrow width, the visual intrusion is expected to be minimal. The lighting associated with the facility might create visual intrusions, particularly at night, but these impacts are considered minimal as adjacent properties are likely to be undeveloped or are part of an industrial park, which are less sensitive to light intrusions, and exterior lighting would need to meet the design standards specified by the local zoning ordinance. A forested buffer may minimize the visibility of the facility from local roads and nearby public spaces. Impacts on aesthetics as a result of operations would be generally SMALL, with the potential for MODERATE impacts depending on site-specific characteristics.

During decommissioning of the HALEU fuel fabrication facility, impacts on visual and scenic resources could result from the use of large construction equipment; however, these impacts would be temporary, lasting only the duration of decommissioning, and localized. As a result, the aesthetic impacts from decommissioning of the HALEU fuel fabrication facility are considered SMALL.

7.3.3 Geology and Soils

The geologic and soils environment encompasses the physiographic or physical setting in which the facility has been constructed and the associated geologic strata and soils that comprise the site. Impacts on geology and soils from the construction and operation of a new HALEU fuel fabrication facility have not yet been previously analyzed (except for the TRISO-X fuel fabrication facility) but would likely have similar impacts to the construction and operation of an LEU fuel fabrication facility. The environmental impacts of the Westinghouse fuel fabrication facility in Columbia, South Carolina; Framatome fuel fabrication facility in Richland, Washington; GNF-A fuel fabrication facility in Wilmington, North Carolina; BWXT fuel fabrication facility in Lynchburg, Virginia; and the TRISO-X FFF in Oak Ridge, Tennessee, have been evaluated in NRC (2005b); NRC (2009b); NRC (2009c); NRC (2022c); and TRISO-X (2022).

Framatome Facility, Richland, Washington

The impacts on geology and soils of the license renewal and continued operation of the AREVA NP Richland Fuel Fabrication Facility are presented in the *Environmental Assessment for the Renewal of U.S. Nuclear Regulatory Commission License No. SNM-1227 for AREVA NP, Inc. Richland Fuel Fabrication Facility* (NRC, 2009c) (referred to as the “AREVA NP EA”). Since there is no proposed construction at this site, the EA concludes that continued operation of the fuel fabrication facility would have minimal impacts on geological features and topography. Impacts on soils would be primarily from spills and leaks, although these impacts would be mitigated through use of best management practices (BMPs) such as confining hazardous materials to closed systems within a building, double containment, and other techniques. Overall impacts on geology and soils were considered to be SMALL.

Global Nuclear Fuel – Americas (GNF – A) Facility, Wilmington, North Carolina

The impacts on geology and soils of the license renewal and continued operation of the GNF-A fuel fabrication facility are presented in the *Environmental Assessment for the Renewal of U.S. Nuclear Regulatory Commission License No. SNM-1097 for Global Nuclear Fuel – Americas, Wilmington Fuel Fabrication Facility* (NRC, 2009b) (referred to as the “GNF-A EA”). Historical operation of the GNF-A fuel fabrication facility has resulted in soil contamination including radiological and nonradiological constituents at the site. Past and ongoing remediation efforts have targeted and removed these soils from the site. Monitoring activities are also ongoing under the oversight of the NRC and North Carolina Department of Environment and Natural Resources. Since there is no proposed construction at this site, the GNF-A EA concludes that continued operation of the GNF-A fuel fabrication facility would have minimal impacts on geological features and topography. Impacts on soils would be primarily from spills and leaks, although these impacts would be mitigated through proper application of BMPs. Descriptions of these programs can be found in Section 3.2.5 of the GNF-A EA. Overall impacts on geology and soils were considered to be SMALL to MODERATE due to historical instances and potential for additional soil contamination.

Westinghouse Electric Company Columbia Fuel Fabrication Facility (CFFF), Richland County, South Carolina

The impacts on geology and soils of the license renewal and continued operation of the CFFF in the CFFF EIS (NRC, 2022c). Since there is no proposed construction at this site, the EIS concludes that there would be no impacts on geological features. Historical operation of the CFFF has resulted in soil contamination including radiological and nonradiological constituents at the site. Past and ongoing remediation efforts have targeted and removed these soils from the site. Environmental monitoring programs such as soil gas surveys, soil sampling, and groundwater monitoring have shown minimal impacts on soils far from the operating area. The EIS concludes that soil impacts from the continued operation of the facility would be similar and have no substantial impacts on on-site and off-site soils. Overall impacts on geology and soils were considered SMALL and could be mitigated with proper BMPs such as soil monitoring and remediation programs. Descriptions of these programs can be found in Section 3.2.5 of the CFFF EIS.

BWX Technologies, Inc. Fuel Fabrication Facility, Lynchburg, Virginia

The impacts on geology and soils of the license renewal and continued operation of the BWXT fuel fabrication facility are presented in the *Environmental Assessment Related to the Renewal of NRC License No. SNM-42 for BWX Technologies, Inc. (BWXT)* (NRC, 2005b) (referred to as the "BWXT EA"). Since there is no proposed construction at this site, the EA concludes that continued operation of the BWXT fuel fabrication facility would have minimal impacts on geology and soils.

TRISO-X Fuel Fabrication Facility, Oak Ridge, Tennessee

Impacts on soils from the construction of the TRISO-X FFF include erosion, compaction, and sedimentation, mainly due to grading and excavation activities. It was determined that construction of the TRISO-X FFF would disturb approximately 13 ha (32 acres) of land. The amount of rock and soil to be excavated is 560,234 cubic yds and the amount of backfill that would be needed is 362,661 cubic yds (TRISO-X FFF ER). Potential for soil contamination from spills were also considered and any contaminated soils removed from the site during the life of this facility would likely follow the NRC and U.S. Environmental Protection Agency (EPA) guidelines for remediation and disposal. Additionally, implementation of BMPs would be used to mitigate soil erosion and contamination. A list of these BMPs can be found in Section 4.3.1.3 of the 2022 TRISO-X FFF ER (TRISO-X, 2022). With the implementation of these BMPs to minimize impacts and considering that impacts would likely be local and limited to the site boundary, impacts on soils are considered to be SMALL. No additional impacts are expected during operation and decommissioning of the facility. Construction and decommissioning activities would likely have similar impacts, but decommissioning impacts would likely be much smaller due to being smaller in scale. No significant changes to site geology are expected due to most of the work occurring in shallow soils.

New HALEU Fuel Fabrication (Generic Site)

The construction, operation, and decommissioning of a new HALEU fuel fabrication facility would have similar impacts as those discussed in the TRISO-X FFF ER, but specific site characteristics would also need to be considered. Sites with a higher erosion potential or sensitive geology may require additional review or other BMPs to limit impacts. The impacts of construction and operation of a new HALEU fuel fabrication facility co-located at existing fuel fabrication facilities listed in Table 7-1 would have SMALL to MODERATE impacts, depending on the size of the facility footprint and the potential for soil contamination. Many of these facilities were designed to produce LEU fuel at capacities that are much larger than the 50 MT/yr of HALEU fuel required as part of the Proposed Action. Therefore, the impacts of construction, operation, and decommissioning of a HALEU fuel fabrication facility at one of these sites are expected to have smaller impacts than the LEU fuel fabrication facilities. Additionally, the HALEU fuel fabrication facility would likely utilize existing assets from a LEU facility, such as being constructed within existing buildings or sharing utilities and office space, which would limit the impacts even further. Overall impacts on geology and soils would range from SMALL to MODERATE in line with that of the existing NEPA documents, though likely smaller in scale.

7.3.4 Water Resources

Water resources comprise surface water bodies, such as rivers, streams, lakes, ponds, estuaries, oceans, and manufactured reservoirs, and groundwater aquifers, such as unconfined water table aquifers, deeper confined aquifers, and perched saturated zones. Exchange between surface water bodies and groundwater systems is common. Water may be used for many domestic, industrial (such as cooling processes) building-related activities, and general ecosystems support.

As discussed above, HALEU fuel fabrication under the Proposed Action could occur at a number of existing fuel fabrication facilities that could be modified for this purpose, or at an entirely new location. A brief summary of water resource impacts analyzed in NEPA documentation for the existing facilities under consideration is provided below. Should a new location be selected in the future, site-specific NEPA analysis prepared by the NRC would be required.

Westinghouse Electric Company Columbia Fuel Fabrication Facility (CFFF), Richland County, South Carolina

Potential impacts on nearby surface waters associated with the continuation of operations at the CFFF were determined to be SMALL and consisted of increased water use leading to a decrease in the resource's availability to other users in the region, and possible degradation of water quality resulting from site runoff, liquid effluent discharges, and inadvertent releases of contaminants (NRC, 2022c, pp. 3-28 to 3 29, 3-32). Impacts on groundwater at the CFFF were determined to be SMALL to MODERATE, with the primary impact being degradation of groundwater by inadvertent contaminant releases that have occurred during past operations and would be expected to occur in the future (NRC, 2022c, pp. 3-46 and 3-55). The CFFF EIS did not analyze facility construction.

Framatome Facility, Richland, Washington

Potential impacts on water quality (including surface and groundwaters) associated with fuel fabrication at the Framatome site were determined to be SMALL and consisted primarily of the potential for degradation from wastewater discharges, stormwater runoff, and inadvertent releases of contaminants. Procedures and controls are in place to minimize this potential, including compliance with relevant permits (NRC, 2009c, p. 38 to 39). The EA for license renewal did not analyze facility construction.

Global Nuclear Fuel – Americas (GNF-A) Facility, Wilmington, North Carolina

Potential impacts on water quality associated with continued fuel fabrication at the GNF-A site were determined to be SMALL and consisted of potential degradation from process and sanitary wastewaters and stormwater runoff. Adherence to relevant permits would minimize the potential for impact. The EA for license renewal further analyzed impacts on water quality that could result if existing facilities were to be expanded. It was determined that such expansion would result in SMALL to MODERATE impacts on water quality, due to increased water use and the potential for contamination of nearby waters from liquid effluents and inadvertent contaminant releases. Procedures and controls are in place at the existing facility to minimize this potential (NRC, 2009b, p. 34 to 35).

BWX Technologies, Inc. Fuel Fabrication Facility, Lynchburg, Virginia

The EA for license renewal of the existing BWXT fuel fabrication facility determined that continued operations would result in no change in impacts on water quality. The site is located on a peninsula surrounded on three sides by the James River. Much of the area adjacent to the river consists of a relatively flat floodplain. Since 1771, 11 major flood events have occurred (NRC, 2005b, p. 9). On-site water needs are fulfilled by the public water supply rather than surface or groundwaters on or adjacent to the site, and potential contamination of nearby waters is minimized through compliance with existing permits and implementation of controls and procedures to prevent and contain inadvertent releases of contaminants (NRC, 2005b, p. 17). This EA did not analyze facility construction.

TRISO-X Fuel Fabrication Facility, Oak Ridge, Tennessee

The TRISO-X FFF ER analyzes impacts on water resources associated with the construction, operation, and decommissioning of a HALEU fuel fabrication facility in Roane County, Tennessee. Potential impacts on groundwater associated with facility construction were determined to be SMALL and limited to potential decreases in water quality resulting from an inadvertent release of contaminants. Operational impacts on groundwater were likewise determined to be SMALL and consisted of potential degradation resulting from increased runoff of wastewater, stormwater, and inadvertent releases of contaminants. Potential impacts on surface waters associated with facility construction were determined to be SMALL and consisted of decreases in water quality resulting primarily from increased stormwater runoff. Operational impacts on surface waters were likewise determined to be SMALL and also consisted of decreases in water quality resulting from increased stormwater runoff, as previously permeable land surfaces would be converted to impermeable structures and paved areas. Adherence to relevant permits and implementation of BMPs would minimize potential contamination of surface and groundwaters on-site and nearby (TRISO-X, 2022, pp. 4-29 to 4-36).

New HALEU Fuel Fabrication (Generic Site)

A HALEU fuel fabrication facility could be located at any of the five locations discussed above, co-located at another existing fuel cycle facility, or constructed at an entirely new location. Potential impacts on water resources resulting from this action would be expected to be similar to those described above. Initial construction of the facility would likely require temporary increases in water consumption, which may impact the availability of water resources elsewhere in the region. Increases in wastewater discharges, stormwater runoff, and potential spills or leaks of contaminants from construction equipment may degrade water quality in nearby surface waters and groundwater. With the implementation of BMPs and adherence to all relevant permits, impacts on water resources resulting from the construction of a HALEU fuel fabrication facility would be expected to be SMALL to MODERATE, depending on site-specific conditions.

During operation of a HALEU fuel fabrication facility, water from municipal sources may be needed to support the potable and sanitary needs of facility personnel. Fuel fabrication facilities may require water for other systems, such as fire suppression. Reduction or elimination of water use and discharge may decrease the potential for impacts on water resources in the vicinity of the facility. The potential municipal water demand is expected to be relatively SMALL; however, this water demand may affect the ability of nearby municipal water systems to meet their planned obligations. Site-specific conditions (such as limited groundwater resources) could result in SMALL to MODERATE impacts on municipal water supplies.

Operations at a HALEU fuel fabrication facility may contribute to changes in water quality conditions. Conversion of previously permeable, vegetated surfaces to buildings, parking lots, and other impervious surfaces can increase runoff from a site and result in the entrainment of sediments and pollutants in the runoff that ultimately discharges to nearby water bodies. Water withdrawal for facility use may also affect the quality of the groundwater or surface water source. With implementation of BMPs and adherence to all relevant permits, impacts on water resources associated with operations of a HALEU fuel fabrication facility would be expected to be SMALL to MODERATE.

7.3.5 Air Quality

The following section discusses potential air quality impacts that could occur from construction and operation of a HALEU fuel fabrication facility at one of the locations described in Section 7.1.3, *Potential Facilities*. The analysis of impacts relies on analyses from previous NEPA documents that evaluated the impacts of construction and operation of fuel fabrication and enrichment facilities.

The ROI for the air quality analysis includes the areas surrounding a potential facility location and generally within a few miles of a proposed emission source. Conditions influencing potential air quality impacts associated with a fuel fabrication facility include regional meteorology, atmospheric stability, the potential for severe weather events, and regional air quality. The atmospheric processes that occur as a result of these conditions determine the transport of routine air emissions or accidental releases during operation and subsequent effects on regional air quality.

Construction and operation of a HALEU fuel fabrication facility would result in air emissions of criteria pollutants, hazardous air pollutants (HAPs), radiological compounds, and greenhouse gases. The following evaluates projected emissions relative to air quality conditions within a project region and applicable air pollution standards and regulations.

Under the Clean Air Act (CAA), EPA establishes National Ambient Air Quality Standards (NAAQS) for common air pollutants known as criteria pollutants. The NAAQS represent the maximum allowable atmospheric concentrations that may occur and still protect public health and welfare. The CAA establishes air quality planning processes and requires states to develop a State Implementation Plan that details how they will maintain the NAAQS or attain a standard in nonattainment within mandated time frames. Under the CAA, states are allowed to develop their own ambient air quality standards, so long as they are at least as stringent as the NAAQS.

EPA designates all areas of the United States as having air quality better than (attainment) or worse than (nonattainment) the NAAQS. Former nonattainment areas that have attained the NAAQS are designated as maintenance areas.

In addition to criteria pollutants, EPA also regulates HAPs that are known, or are suspected, to cause serious health effects or adverse environmental effects. EPA sets Federal regulations to reduce HAP emissions from stationary sources in the *National Emission Standards for Hazardous Air Pollutants* (EPA, 2023a).

Construction

The NEPA documentation for the locations described in Section 7.1.3, *Potential Facilities*, do not evaluate construction of a fuel fabrication facility except the TRISO-X FFF in Oak Ridge, Tennessee. Therefore, the air quality analysis relied on NEPA documentation that evaluated construction of a like-kind facility proposed for siting in the same location as one of the alternative fuel fabrication locations. The alternative fuel fabrication location is the General Electric Company (GE) site in Wilmington, North Carolina. The associated NEPA document is an EIS for construction and operation of the GE-Hitachi Global Laser Enrichment (GLE) Facility (NRC, 2012b) (referred to as the "GLE EIS").

Presently, EPA categorizes New Hanover County that surrounds the GLE site as in attainment of all NAAQS (EPA, 2023b). The North Carolina Department of Environment and Natural Resources Division of Air Quality (DAQ) regulates sources of air pollution in North Carolina. Additional descriptions of the air quality resource within the site ROI are presented in Section 3.5 of the GLE EIS (NRC, 2012b).

Air quality impacts from construction of GLE enrichment facility would occur from (1) combustive emissions due to the use of fossil-fuel-powered equipment, trucks, and worker commuter vehicles, and (2) fugitive dust emissions due to the operation of equipment on exposed soil. Impacts would occur primarily during site preparation and the building of facility components, such as administration buildings, parking lots, switchyards, and any on-site and off-site access roads or transmission lines.

The analysis of emissions associated with construction of the enrichment capabilities at the GLE site determined that criteria air pollutant concentrations at the property boundary would be below the NAAQS and state ambient air quality standards, except for 24-hour levels of coarse (particulate matter less than or equal to 10 microns, or PM_{10}) and fine particulates ($PM_{2.5}$). Therefore, the potential air quality impacts from construction of this facility would be MODERATE (NRC, 2012b, p. § 4.2.4.1). Implementation of mitigation measures identified in Section 4.2.4.3 of the GLE EIS (NRC, 2012b) would minimize impacts from construction emissions. These measures include the following:

- Water the facility site and unpaved roads to reduce dust.
- Remove dirt from truck tires by driving over a gravel pad prior to leaving the facility site or unpaved access road to avoid spreading sediments on paved roads.
- Cover trucks carrying soil and debris to reduce dust emissions from the back of trucks driving on roadways.
- Pave access road and parking lots as soon as practicable.
- Post speed limits (e.g., 16 km [10 miles] per hour) visibly within the construction site and enforce them to minimize airborne fugitive dust.
- Limit access to the construction site and staging areas to authorized vehicles only, through the designated treated roads.
- Stage construction to limit the exposed/disturbed area at any given time, when practical.
- Train workers to comply with the speed limit, use good engineering practices, minimize drop height of materials, minimize disturbed areas, and employ other BMPs as appropriate.
- To the extent practicable, conduct soil-disturbing activities and travel on unpaved roads during periods of favorable meteorological conditions, as conducting these activities during periods of unfavorable meteorological conditions may result in exceedances of air quality standards. Unfavorable meteorological conditions are infrequent and include (1) periods of low winds, stable, and relatively low mixing height conditions (primarily encountered around sunrise in colder months of the year) and (2) periods of high winds.
- All heavy equipment should meet emission standards specified in the State Code of Regulations, and routine preventive maintenance, including tune-up to the manufacturer's specification, should be implemented to ensure efficient combustion and minimum emissions.

- Fuel all diesel engines used in the facility and auxiliary diesel generator units with ultra-low sulfur diesel with a sulfur content of 15 parts per million or less.
- Limit idling of diesel equipment to no more than 10 minutes, unless idling must be maintained for proper operation; for example, drilling, hoisting, and trenching.
- Because GLE assumed a dust control efficiency of 55% (applying water twice per day for the unpaved north access road during land clearing), more aggressive dust control measures should be implemented (for the entire unpaved access road or for the segments that most contribute to exceedances) to minimize potential dust impacts at the Wilmington Site boundary and the nearby Wooden Shoe residential subdivision. Options include more frequent water spraying (e.g., at every 2-hour watering interval) and the application of a dust suppressant. Selection of the proper dust suppressant should be based on road conditions, environmental impacts (including surface and groundwater quality), and cost.

Operation

The following summarizes prior NEPA analyses for the fuel fabrication facilities identified above in Section 7.1.3, *Potential Facilities*. These analyses are used to describe air quality impacts that could occur from the operation of a HALEU fuel fabrication facility. There are several possible locations for the HALEU fuel fabrication facility. Operation of the HALEU fuel fabrication facility at any other location would have to comply with the applicable regulatory requirements at that location.

Framatome Facility, Richland, Washington

The area surrounding the Framatome fuel fabrication facility in Benton County currently attains all NAAQS. The nearest nonattainment area (PM_{10}) is about 24 km (15 miles) southeast of the facility (EPA, 2023b). The Benton Clean Air Authority regulates sources of air pollution in Benton County. Additional descriptions of the air quality resource within the Framatome site ROI are presented in the AREVA NP EA Section 3.4 (NRC, 2009c).

Continued operations of the Framatome facility would emit gaseous and particulate effluents that would include radiological and nonradiological constituents (NRC, 2009c). The facility operates under Order 95-05 administered by the Benton Clean Air Authority that sets operational and emission limitations for nonradiological air effluents. The facility is classified as a synthetic minor source for nonradiological emissions, as it is required to keep annual nitrogen oxide emissions below the threshold that would require the facility to obtain a Title V operating permit (100 tons per year). Historical data from the facility (2004–2008) shows that annual nitrogen oxide emissions were well below this threshold (an annual maximum of 5.4 tons per year). The order also imposes limits on the annual process throughputs of uranium through its three dissolvers and the amount of nitrogen oxides emitted per unit mass of uranium dissolved.

All process stacks that discharge to the atmosphere and contain significant concentrations of radioactive materials have high-efficiency particulate air filters (HEPA) and are continuously sampled for radioactive particulates. Radiological contaminant monitoring at the point of emission is performed continuously during licensed material production, as discussed in AREVA NP EA Section 2.5. The facility implements mitigation plans when effluents exceed established limits. Several stacks that emit chemical contaminants (nitrogen oxides and hydrogen fluoride [HF]) also are equipped with appropriate liquid scrubbers.

The facility also monitors effluent stacks for fluoride emissions as a condition of the NRC license. Historical data from the facility (2004–2008) shows that the facility complied with the Washington state standard for fluoride, as discussed in AREVA NP EA Section 3.4.

Emissions from facility operations would not exceed any NAAQS. The facility would comply with emission limits for radiological and nonradiological constituents identified in the facility State Order permit and NRC license. Therefore, impacts on air quality from continued operation of the Framatome fuel fabrication facility would be SMALL.

Global Nuclear Fuel – Americas (GNF-A) Facility, Wilmington, North Carolina

Presently, EPA categorizes New Hanover County that surrounds the GNF-A fuel fabrication site as in attainment of all NAAQS (EPA, 2023b). The DAQ regulates sources of air pollution in North Carolina. Additional descriptions of the air quality resource within the GNF-A site ROI are presented in Section 3.4 of the GNF-A EA (NRC, 2009b).

Continued operations of the GNF-A facility would emit gaseous and particulate effluents that would include radiological and nonradiological constituents. Air emissions from the Fuel Manufacturing Operation complex of the GNF-A site (where nuclear fuel is fabricated and nonradioactive fuel assembly components are manufactured) operates under a synthetic minor operating permit administered by the DAQ. The synthetic minor air permit specifies conditions and limitations for the permitted air emission sources to remain below the major source thresholds (100 tons per year of a criteria pollutant and 10 tons per year of a HAP or 25 tons per year of combined HAPs). Actual criteria pollutants/HF emissions reported for 2007 were less than 10/0.1% of these thresholds (GNF-A EA Section 3.4).

Process stacks that discharge to the atmosphere and contain radioactive materials have HEPA filters and are continuously sampled for radioactive particulates, as discussed in GNF-A EA Section 2.5. The facility also operates six ambient air stations to ensure that radiological emissions remain within regulatory levels. The facility also monitors effluent stacks for fluoride emissions as a condition of the NRC license.

Emissions from facility operations would not exceed any NAAQS. The facility would comply with emission limits for radiological and nonradiological constituents identified in the facility operating permit and NRC license. Therefore, impacts on air quality from continued operation of the GNF-A fuel fabrication facility would be SMALL.

Due to the impact of emissions from the nearby Sutton coal-fired power plant, the EA concluded that emissions from the relicensed GNF-A, in combination with these emissions, would result in MODERATE cumulative impacts on air quality (GNF-A EA Section 4.4). However, the Sutton power plant has been converted to a lower-emitting natural gas-fired unit. Therefore, current cumulative impacts from the GNF-A facility fuel fabrication are expected to be SMALL.

Westinghouse Electric Company Columbia Fuel Fabrication Facility (CFFF), Richland County, South Carolina

Presently, EPA categorizes Richland County, which surrounds the CFFF site, as in attainment of all NAAQS (EPA, 2023b). The South Carolina Department of Health and Environmental Control (SCDHEC) Bureau of Air Quality regulates sources of air pollution in South Carolina. Additional descriptions of the air quality resource within the CFFF site ROI are presented in the site CFFF EIS Section 3.7 (NRC, 2022c).

Based on the descriptions of the CFFF, air quality impacts from operation of the facility would occur from (1) uranium and fluoride compounds and ammonia released from rooftop vents; (2) natural gas-fired boilers for facility heating and process systems; (3) calciners; (4) an incinerator; (5) effluent stack scrubbers; (6) a diesel-powered electric generator for use in the event of power outages (otherwise, operated 1 hour per month for routine maintenance testing); (7) the transport by truck of HALEU fuel feed material and finished fuel forms; and (8) worker commuter vehicles. Mobile sources (trucks and worker commuter vehicles) that operate in association with the fuel fabrication activities would produce dispersed and minor impacts on air quality.

The analysis of emissions from operation of the fuel fabrication capabilities at the CFFF site determined that emissions of uranium and fluoride compounds would remain below their respective action levels for the facility, which are set lower than regulatory limits. In addition, the ambient impact of criteria pollutant emissions from facility operations would be below the NAAQS at the property boundary. To mitigate environmental impacts, radiological emissions would be ventilated to stacks that include HEPA filters. These stacks would also be equipped with continuous emission monitoring systems to ensure that concentrations would remain below the facility action levels. In addition, the facility would comply with emission limits for criteria pollutants, toxic air pollutants, nitric acid, and opacity identified in the facility operating permit provided by the Bureau of Air Quality (see CFFF EIS Section 2.2). Therefore, the CFFF EIS concluded that potential air quality impacts from operation of the CFFF would be SMALL (NRC, 2022c, p. § 3.7.2).

BWX Technologies, Inc. Fuel Fabrication Facility, Lynchburg, Virginia

EPA categorizes Campbell County, which surrounds the BWXT site, as in attainment of all NAAQS (EPA, 2023b). The Virginia Department of Environmental Quality (DEQ) regulates sources of air pollution in Virginia. Additional descriptions of the air quality resource within the BWXT site ROI are presented in the BWXT EA Section 3.3 (NRC, 2005b).

Continued operations of the BWXT facility would emit gaseous and particulate effluents that would include radiological and nonradiological constituents. The facility operates under a Title V operating permit administered by the DEQ. The operating permit limits the amount of throughput for certain industrial processes to control the amount of air pollutants. From 2000 to 2003, no regulated process ran at more than about 25% of the permitted operating level. The Title V permit requires BWXT to submit annual nonradiological emissions to the DEQ. This report includes criteria pollutant emissions as well as three HAPs: ammonia, hydrochloric acid, and hydrofluoric acid (BWXT EA Section 3.3).

Process stacks that discharge to the atmosphere and contain radioactive materials have HEPA filters and are continuously sampled for radioactive particulates, as discussed in BWXT EA Section 1.3.2. The facility also operates 13 ambient air stations at the facility boundary to ensure that radiological emissions remain within regulatory levels. From 1994 to 2003, the maximum concentration for any of the locations was 2.5% of the 10 Code of Federal Regulations (CFR) Part 20 limit (BWXT EA Section 3.3).

Emissions from facility operations would not exceed any NAAQS. The facility would comply with emission limits for radiological and nonradiological constituents identified in the facility Title V permit and NRC license. Therefore, impacts on air quality from continued operation of the BWXT fuel fabrication facility would be SMALL.

TRISO-X Fuel Fabrication Facility, Oak Ridge, Tennessee

Roane and Anderson Counties that encompass the TRISO-X site within the Oak Ridge Reservation currently are in attainment of all NAAQS. However, a portion of Roane County is a maintenance area for the 2006 $PM_{2.5}$ standard, and Anderson County includes maintenance areas for the 2006 $PM_{2.5}$ and 2008 ozone standards (EPA, 2023b). The Tennessee Department of Environment and Conservation Division of Air Pollution Control regulates sources of air pollution in Tennessee. Additional descriptions of the air quality resource within the TRISO-X site ROI are presented in the TRISO-X ER Section 3.6 (TRISO-X, 2022).

Based on the descriptions of the TRISO-X FFF, air quality impacts from operation of the facility would occur from (1) uranium compounds released from rooftop vents; (2) natural gas-fired boilers for facility heating and process systems; (3) particulates from mechanical draft cooling towers; (4) two diesel-powered electric generators for use in the event of power outages; (5) the transport by truck of HALEU fuel feed material and finished fuel forms; and (6) worker commuter vehicles. Mobile sources (trucks and worker commuter vehicles) that operate in association with the fuel fabrication activities would produce dispersed and minor impacts on air quality.

The analysis of emissions from operation of the fuel fabrication capabilities at the TRISO-X site determined that emissions of uranium compounds would remain below their respective action levels for the facility. Potential annual emissions of each criteria pollutant and HAP also would remain below their applicable major source threshold and therefore would be a minor source. To mitigate environmental impacts, radiological emissions in the form of dust, vapor, and particulates would be ventilated to stacks that include HEPA filters. These stacks also would be equipped with continuous emission monitoring systems to ensure that air effluent discharge concentrations would comply with the limits established in 10 CFR 20. In addition, the facility would comply with emission limits for criteria pollutants and HAPs identified in the facility operating permit provided by the Tennessee Department of Environment and Conservation Division of Air Pollution Control. Since emissions from the facility would comply with all regulatory requirements, the TRISO-X ER concluded that potential air quality impacts from operation of the TRISO-X facility would be SMALL (TRISO-X, 2022, p. § 4.6).

New HALEU Fuel Fabrication (Generic Site)

Construction

Air quality impacts from construction of a HALEU fuel fabrication facility would occur from the same types of sources as those evaluated above for the GLE enrichment facility location. Impacts would occur primarily during site preparation and the building of facility components, such as buildings and parking lots. The GLE EIS analysis determined that air quality impacts resulting from construction of a proposed enrichment facility could result in exceedances of some NAAQS, mainly for PM_{10} and $PM_{2.5}$ due to fugitive dust emissions. Since the effort needed to construct the HALEU fuel fabrication facility would be much smaller than the construction activities evaluated in the GLE EIS, it is expected that air quality impacts from construction of the HALEU fuel fabrication would not exceed any ambient air quality standard and therefore would be SMALL. Implementation of mitigation measures identified in Section 4.2.4.3 of the GLE EIS would minimize impacts from project construction emissions.

Operation

Air quality impacts from operation of a HALEU fuel fabrication facility would occur from the same types of sources as those evaluated above for the representative fuel fabrication locations. Impacts from criteria pollutants primarily would occur from natural gas-fired boilers needed for facility heating and process systems and diesel-powered electric generators for use in the event of power outages. Due to relatively low emission rates from these sources, the above five analyses determined that the ambient impact of criteria pollutant emissions from facility operations would be below the NAAQS for all pollutants. The above analyses also determined that the impact of HAPs and radiological emissions from facility operations would remain within acceptable regulatory levels. The HALEU facility fuel throughput and resulting impacts would range from substantially smaller (CFFF, GNF-A, and Framatome sites) to somewhat higher (TRISO-X site) than the throughputs and impacts evaluated in the above representative NEPA documents. With the implementation of emission control measures and monitoring systems identified in these documents and adherence to applicable air permit and licensing conditions, air quality impacts from operation of the HALEU fuel fabrication facility would be SMALL.

7.3.6 Ecological Resources

Prior NEPA analysis was completed for the fuel fabrication facilities as described in Section 7.1.4, *Existing NEPA Documentation.* The analysis was conducted in consideration of either facility license renewals, facility construction, and/or operation. Results from the analysis of impacts of the Proposed Action to ecological resources is summarized below.

Framatome Facility, Richland, Washington

The NRC staff consulted with the various Federal and state officials regarding the analysis of effects to ecological resources from the Proposed Action (i.e., license renewal that would allow the fuel fabrication facility to continue operations). Officials acknowledged that AREVA NP's site does not provide a habitat for any special status species and that normal operation does not cause an ecological impact. Therefore, the NRC staff determined there were no direct impacts on ecological resources and considered proposed impacts to be SMALL (NRC, 2009c, pp. 40-41).

Global Nuclear Fuel – Americas (GNF-A) Facility, Wilmington, North Carolina

This analysis concluded that impacts on terrestrial and aquatic ecology would be SMALL under the fuel fabrication facility license renewal. Continued fuel fabrication facility operations would not result in any additional terrestrial ecological resource impacts. Aquatic ecological resources could be affected by liquid or gaseous emissions or material spills. GNF-A minimizes the possibility of these impacts by operating within permit conditions and implementing material handling procedures. GNF-A processes its wastewater discharge through an on-site sewage treatment facility and performs testing and monitoring to assure releases are within regulatory limits. Also, GNF-A limits the spread of spills and leaks through a series of physical and administrative protocols (i.e., spill containment basins, double containment tanks, training, and inspections) that have proven to be effective since their implementation (GNF-A, 2008). With this considered, it was determined that there is a low probability that liquid effluents from GNF-A would impact any aquatic ecology. As such, the NRC staff considered the direct impacts on aquatic ecology to be SMALL (NRC, 2009b, p. 37).

Westinghouse Electric Company Columbia Fuel Fabrication Facility (CFFF), Richland County, South Carolina

For this analysis, it was determined that during continued operations, impacts on ecological resources could result from elevated noise levels from daily operational activities and increased turbidity or introduction of pollutants from site runoff and discharges. However, habitat disturbances during operations were found to be negligible, as disturbed wildlife could find similar habitat in the vicinity. Operation of the CFFF would result in some degradation of aquatic habitats due to direct impacts (e.g., effluent discharges into the Congaree River) and indirect impacts from site runoff. Direct impacts from the discharge of effluents into the Congaree River would be limited due to the chemical and quantity limits described in the NPDES permit. Impacts on aquatic resources are expected to be minimal because of the distance to the Congaree River and site-specific programs to prevent pollution from stormwater runoff. As such, the NRC staff ultimately concluded that impacts on ecological resources during continued operations would be SMALL (NRC, 2022c, pp. 3-60). Refer to Section 3.5 of the CFFF EIS for a detailed discussion of these findings (NRC, 2022c, pp. 3-56 to 3-60).

Section 3.6.2 of the CFFF EIS describes the eight federally listed species that may occur near the CFFF. Section 3.6.6.1 presents the history of Section 7 Endangered Species Act (ESA) consultation findings (from 2015 to 2020) between the NRC and the U.S. Fish and Wildlife (USFWS) regarding various actions on-site and their potential impacts on the eight species. In summary, the USFWS concurred with the NRC's determination that the various activities would not be likely to adversely affect the federally listed species under the USFWS's jurisdiction (NRC, 2022c, pp. 3-67 to 3-68).

BWX Technologies, Inc. Fuel Fabrication Facility, Lynchburg, Virginia

This analysis concluded that site ecology would not be affected by the license renewal of the existing BWXT facility, as no changes to facilities or operations were associated with the renewal. Impacts on native flora and fauna, including those on the Federal and state threatened or endangered species lists, were considered unlikely (NRC, 2005b, p. 17).

TRISO-X Fuel Fabrication Facility, Oak Ridge, Tennessee

This analysis concluded that site ecology would not be adversely affected by construction, operation, or decommissioning and impacts on biotic communities would be SMALL. Particularly important terrestrial habitats such as wetlands, riparian habitats, staging or resting areas for large numbers of waterfowl, rookeries, restricted wintering areas for wildlife, communal roost sites or breeding grounds, and areas containing rare plant communities were not found present within the Horizon Center site. Important species and important habitats would not be directly affected under the Proposed Action, and construction and sediment control BMPs through a project-specific SWPPP would be used to minimize indirect effects (TRISO-X, 2022, pp. 4-51).

New HALEU Fuel Fabrication (Generic Site)

As previously discussed in *S*ection 7.1.3, *Potential Facilities*, HALEU fuel fabrication could occur at several LEU fuel fabrication facilities or constructed at an entirely new location. The discussion below focuses on the potential impacts on ecological resources that could occur if implementation of the Proposed Action were to occur at any of the alternative site locations.

Impacts on ecological resources from an HALEU fuel fabrication facility would take place during the preconstruction and construction phases. Impacts could occur from removal or degradation of vegetation, wildlife habitats, wetlands, and Federal and state-listed species, or from contamination by radioactive or hazardous materials via airborne or waterborne pathway.

New construction that occurs entirely within previously developed and disturbed lands as part of a currently licensed facility would have SMALL impacts on ecological resources. The continuous disturbance from human activity, grounds maintenance, and disruptions from ongoing facility operations have likely degraded the once native habitats that were present within the area prior to facility development. The areas proposed for new construction likely support very little habitat for wildlife, other than for those species adapted to human disturbance (such as transient small mammals, insects, and birds).

New construction that occurs entirely within undeveloped lands could have SMALL to MODERATE impacts on ecological resources. Land-clearing activities as part of new construction would likely result in increased erosion, stormwater runoff, and loss of vegetation. Additionally, impacts on wildlife could include habitat disturbance, wildlife disturbance, and injury or mortality of wildlife. Habitats within the footprint disturbed by construction would be reduced or altered, and construction activities would result in habitat fragmentation. Loss of habitat could result in a long-term reduction in wildlife abundance and richness. Habitat disturbance could facilitate the spread and introduction of invasive plant species. Wildlife habitat could be adversely affected if invasive vegetation became established in the disturbed areas and adjacent off-site habitats. Construction activities could cause wildlife disturbance, including interference with behavioral activities. Wildlife could respond in various ways, including attraction, habituation, and avoidance. Principal sources of noise would include vehicle traffic and operation of machinery. Regular or periodic noise could cause adjacent areas to be less attractive to wildlife and result in a reduction in use. Construction activities could result in the direct injury or death of certain wildlife species. Wildlife could also be exposed to accidental fuel spills or releases of other hazardous materials.

To avoid these impacts on wildlife, any new construction associated with an HALEU fuel fabrication facility should be placed in other previously developed areas of the site, if possible. Pending site selection, an official USFWS Information for Planning and Consultation data request would need to be submitted for the project under Section 7 of the ESA (16 United States Code [U.S.C.] 1531-1544) to generate an *Official Species List* and identify if federally designated critical habitats are present. Additional analysis would be required to determine the severity and nature of impacts on the federally protected species as part of the final design and description of the proposed action. Removal of native habitats would impact vegetation, wildlife, and possibly special status species. Special status species are defined as those protected under the ESA, the Migratory Bird Treaty Act (U.S.C. 703–712), the Bald and Golden Eagle Protection Act (16 U.S.C. 668–668d), and state-listed species.

Migratory birds are protected under the Migratory Bird Treaty Act. Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act. Numerous migratory birds, including some birds of conservation concern and eagles, occur or have the potential to occur as transients within the proposed facility sites. The USFWS recommends conducting tree-clearing activities outside of the bird nesting season to avoid the need for active nest relocation or destruction, when appropriate. To avoid impacts on migratory birds, tree clearing within the land proposed for a new HALEU fuel fabrication facility would need to occur outside of the nesting season (late February through early August). Tree-clearing work during the nesting season would require a migratory bird nest survey 72 hours prior to the start of clearing activities. A permit would be required for the purposeful take of an active migratory bird nest. A permit is not required to destroy migratory bird inactive nests.

Wetlands and/or water features (such as streams, lakes, ponds, or other waters) subject to protection under Section 404 of the CWA (33 U.S.C. 1251 et seq.) could occur within the Proposed Action area. Wetlands could be impacted by alteration of surface water runoff patterns, soil compaction, or groundwater flow. Pending facility site selection, formal wetland delineation surveys would be required to determine presence or absence of jurisdictional wetlands. Impacts on federally protected wetlands could require consultation with the U.S. Army Corps of Engineers to obtain a permit. Additionally, subsequent NEPA analysis prepared by the NRC may also be required.

A summary of this site-specific NEPA analysis process is provided below.

Site-Specific NEPA Analysis Considerations Summary

Once the fuel fabrication facility site has been selected, a subsequent analysis would be required to complete the following**:**

- Define and assess the affected area/area of impact for ecological resources under implementation of the Proposed Action.
- Identify and describe the ecological resources (including terrestrial and aquatic vegetation, wildlife, special status species, and wetlands) within the affected area/area of impact that would be affected or have potential to be affected (directly or indirectly) under implementation of the Proposed Action. Special status species reviews can be completed through the USFWS's Information for Planning and Consultation and state game and fish department databases. Wetlands, streams, lakes, ponds, and other waters that may be impacted (regulated by state and Federal law) may be identified through the USFWS's National Wetlands Inventory dataset;

however, formal wetland delineation surveys would be required to determine presence or absence of jurisdictional wetlands.

- Conduct targeted species surveys to identify the presence/absence of special status species within the affected area/area of impact and conduct interagency coordination with the USFWS and applicable state agency/agencies, if warranted.
- Assess the effects of the Proposed Action on significant ecological resources and include a determination of effects for special status species—in accordance with the ESA, Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, and applicable state threatened and endangered species laws.
- Identify any necessary mitigations required to avoid or minimize adverse effects to special status species or wetlands.

Impacts on ecological resources are analyzed on a project-specific basis. The severity of impacts (i.e., SMALL to MODERATE) on ecological resources will be dependent on the current ecological conditions of the selected site, in comparison to the disturbance footprint associated with the facility designs. The NRC will perform the requisite NEPA analysis for impacts on special status species and wetlands, in accordance with ESA, Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, CWA, and applicable state threatened and endangered species laws in its site selection process, and prior to construction of a new fuel fabrication facility. The ESA Section 7 consultation, Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act analysis includes formal and or/informal consultations with the USFWS, while wetland impacts shall be coordinated with the U.S. Army Corps of Engineers. Local state action agencies shall be contacted for adverse impacts on state threatened and endangered species. Impacts on ecological resources could be expected to be lower (SMALL or none) if construction of a new facility were to occur in an already developed or disturbed site versus an undeveloped or undisturbed site. Locating a HALEU fuel fabrication facility within undeveloped lands could have SMALL to MODERATE impacts on ecological resources, depending on the resources disturbed and the effort to mitigate and minimize potential impacts. An inventory of threatened or endangered species would be developed during site-specific reviews to identify unique or special habitats, and ESA consultations conducted with the USFWS would assist in reducing/avoiding adverse impacts.

7.3.7 Historic and Cultural Resources

Historic and cultural resources are the remains of past human activities and include prehistoric and historic era archaeological sites, districts, buildings, structures, and objects. Prehistoric era archaeological sites pre-date the arrival of Europeans in North America and may include small temporary camps, larger seasonal camps, large village sites, or specialized-use areas associated with fishing or hunting, or with tool and pottery manufacture. Historic era archaeological sites post-date European contact with American Indian Tribes and may include farmsteads, mills, forts, residences, industrial sites, and shipwrecks. Architectural resources include buildings and structures. Historic and cultural resources also include elements of the cultural environment such as landscapes, sacred sites, and other resources that are of religious and cultural importance to American Indian Tribes, such as traditional cultural properties important to a living community of people for maintaining its culture. A historic or a cultural resource is deemed to be historically significant, and thus a "historic property" within the scope of the National Historic Preservation Act of 1966, if it has been determined to be eligible for listing, or is listed on, the National Register of Historic Places (NRHP). The NRHP is maintained by the U.S. National Park Service in accordance with regulations in 36 CFR 60. The NRHP criteria to evaluate the eligibility of a property are set forth in 36 CFR 60.4.14. In this regard, a historic property is at least 50 years old, although exceptions can be made for properties determined to be of "exceptional significance."

Framatome Facility, Richland, Washington; and Ultra Safe Nuclear Corporation (USNC), Oak Ridge, Tennessee

The NEPA documentation for two of the potential locations described in Section 7.1.3, *Potential Facilities*, do not evaluate construction of a fuel fabrication facility. These are:

- Framatome facility, Richland, Washington
- USNC facility, Oak Ridge, Tennessee

The potential impacts on historic and cultural resources from construction and operation of a new facility at the Framatome facility, Richland, Washington (NRC, 2009c), and the USNC Facility, Oak Ridge, Tennessee, have not been analyzed. At the time of preparation of the 2009 License Renewal EA for the Framatome facility (NRC, 2009c), no cultural resource surveys had been conducted at the site, and no cultural and historical resources had been identified. However, the NRHP database confirmed 32 prehistoric and historic listings within Benton and Franklin Counties (NRC, 2009c, p. § 3.9). Based on other studies in the area, there is the likelihood that cultural and historical resources could be found at the Framatome facility. No NEPA documentation for the USNC facility in Oak Ridge, Tennessee, was provided for incorporation by reference, although data from other NEPA analyses for the Oak Ridge National Laboratory indicate that at least 44 archaeological sites have been recorded at the Oak Ridge Reservation to date, of which at least 13 of those sites (prehistoric) are considered potentially eligible for the NRHP (DOE, 2022b, p. § 3.2.6). More than 250 historic resources have been recorded at the Oak Ridge Reservation, and 41 of those sites are considered potentially eligible for listing on the NRHP.

Construction

Preconstruction and construction activities for a new HALEU fuel fabrication facility at the Framatome or USNC sites have the potential to affect historic and cultural resources if siting of the facility is proposed in an area that contains historic and archaeological resources. The new HALEU fuel fabrication facility construction would be evaluated for historic and cultural resources impacts and subject to the National Historic Preservation Act (NHPA) Section 106 consultation process prior to implementation, including survey and identification of cultural resources within the area of potential effects (APE) of the proposed site, determination of any adverse effects, and consultation with either the Washington or Tennessee State Historic Preservation Officers, federally recognized Tribes, and other interested parties to resolve (mitigate) adverse effects. Potential construction impacts would then be expected to range from SMALL to MODERATE, depending on the new HALEU fuel fabrication facility's proximity to significant historic and cultural resources.

Operation

Operations and maintenance activities at a new HALEU fuel fabrication facility have the potential to affect historic and cultural resources. Because there would be no additional land disturbance, no impacts on undiscovered cultural resources would be expected during operation. Potential operational impacts would be expected to range from SMALL to MODERATE, depending on the HALEU fuel fabrication facility's proximity to significant historic and cultural resources.

Global Nuclear Fuel – Americas (GNF-A) Facility, Wilmington, North Carolina

The NRC has analyzed the potential impacts on historic and cultural resources of the license renewal for continuing operations of the GNF-A Wilmington fuel fabrication facility, which included construction of the laser enrichment facility at the site (NRC, 2009b). As described in the GNF-A EA, no known historic properties are within the GNF-A property, and the closest historic site is a 19th-century cemetery associated with the Rose Hill Plantation during its use as a rice plantation, which was not disturbed during the original construction of the plant and is located away from the developed portion of the site (NRC, 2009b, p. § 4.9). The GNF-A EA (NRC, 2009b, p. § 4.9) determined that the continuing operations at the GNF-A fuel fabrication facility and new facility construction at the GLE site in Wilmington, North Carolina, would result in SMALL impacts on historic and cultural resources.

Construction, Operation, and Maintenance

Potential impacts on historic and cultural resources from preconstruction, construction, operations, and maintenance activities for a new HALEU fuel fabrication facility at the GNF-A site would be the same as described previously for the Framatome facility, Richland, Washington, and the USNC site, Oak Ridge, Tennessee.

Westinghouse Electric Company Columbia Fuel Fabrication Facility (CFFF), Richland County, South Carolina

The CFFF site is located near the Congaree River basin, which was exploited by prehistoric inhabitants and historic Tribal groups for its diverse plant and animal resources. The area was home to a small Tribe of Congaree Indians who lived along the river. The South Carolina Department of Archaeology and Historic Preservation has indicated that the CFFF site has a high probability of significant archaeological resources (NRC, 2022c, p. § 3.9). On-site, there are five archaeological sites and five above-ground historic sites, including the Denley Cemetery, a small, fenced cemetery that operated from approximately 1900 to 1940. The cemetery contains more than 100 graves of African Americans (NRC, 2022c, p. § 3.9). None of these sites are considered eligible for the NRHP; however, the Denley Cemetery is protected under state laws such as South Carolina Code of Laws, Section 16-17-600, regarding burial sites and cemeteries (NRC, 2022c, p. § 3.9.2). There are more than 65 historic sites located within a 5-mile radius of the CFFF site, of which 5 are listed on the NRHP, and none are located on the CFFF property (NRC, 2022c, p. § 3.9). There are 58 archaeological sites within a 5-mile radius of the CFFF site, none of which has been formally evaluated for NRHP eligibility (NRC, 2022c, p. § 3.9).

Construction, Operation, and Maintenance

Potential impacts on historic and cultural resources from preconstruction, construction, operations, and maintenance activities for the HALEU fuel fabrication facility at the Westinghouse Richland County, South Carolina, site would be the same as previously described for the Framatome facility, Richland, Washington, and the USNC site, Oak Ridge, Tennessee.

BWX Technologies, Inc. Fuel Fabrication Facility, Lynchburg, Virginia

The NRC has analyzed the potential impacts on historic and cultural resources of continuing operations at the BWXT fuel fabrication facility in Lynchburg, Virginia (NRC, 2005b, p. § 3.7). As described in the 2005 BWXT EA, no known historic properties are within the BWXT boundaries, and the closest NRHP-listed sites are within 3 miles of the facility. The BWXT EA (NRC, 2005b, p. § 4.1) determined that the continuing radiological operations at the BWXT fuel fabrication facility would not result in impacts on the regional historic and cultural resources.

Construction, Operation, and Maintenance

Potential impacts on historic and cultural resources from preconstruction, construction, operations, and maintenance activities for a new HALEU fuel fabrication facility at the BWXT fuel fabrication facility in Lynchburg, Virginia, would be the same as previously described for the Framatome facility, Richland, Washington, and the USNC site, Oak Ridge, Tennessee.

TRISO-X Fuel Fabrication Facility, Oak Ridge, Tennessee

An archaeological survey of the entire approximately 45-ha (110-acre) site and an adjacent 16-ha (40-acre) parcel was completed for the construction of the TRISO-X FFF. The survey area included the areas where construction activities and ground disturbance were proposed, as well as a surrounding 0.8-km (0.5-mile) buffer (TRISO-X, 2022, p. § 3.8). The survey documented five archaeological sites and one historic cemetery. Two of the sites and the cemetery were within the APE, and none of them were recommended eligible for the NRHP (TRISO-X, 2022, p. § 3.8.4.1). The NRC determined that the preconstruction, construction, and operation of the facility could impact the archaeological sites and cemetery in the APE, and recommended additional work to minimize impacts, which includes the use of near-surface geophysics to identify any unmarked graves within or surrounding the cemetery and archaeological monitoring of all work within the cemetery or associated buffer. Since the sites in the APE were recommended as not eligible for listing on the NRHP, and with the proposed mitigation measures, the NRC defined the potential impacts on historic and cultural resources as SMALL (TRISO-X, 2022, p. § 4.8.2).

Construction, Operation, and Maintenance

Potential impacts on historic and cultural resources from preconstruction, construction, operations, and maintenance activities for the HALEU fuel fabrication facility at the TRISO-X FFF site in Oak Ridge, Tennessee, would be the same as previously described for the Framatome facility, Richland, Washington, and the USNC site, Oak Ridge, Tennessee.

New HALEU Fuel Fabrication (Generic Site)

Construction and Operation

Site selection for a HALEU fuel fabrication facility would be expected to include criteria to avoid areas with known cultural resources, and measures to identify resources and mitigate potential impacts through NHPA Section 106 and NEPA processes. Impacts from siting the facility at an existing uranium fuel cycle facility or industrial site would likely be SMALL to MODERATE and would not be expected to be greater than those for the facilities discussed above, as construction and operation activity would likely occur in developed or previously disturbed areas. Siting the facility on undeveloped lands would have a higher potential impact depending on site-specific conditions. Potential effects would be evaluated and subject to the NHPA Section 106 process. Because of this, the impacts of construction at a previously undeveloped site are expected to be SMALL to MODERATE.

7.3.8 Infrastructure

Infrastructure impacts were not analyzed for any of the facilities listed in Table 7-1, except for the TRISO-X FFF. Based on the TRISO-X FFF ER (TRISO-X, 2022), this facility would be located near Oak Ridge, Tennessee. The report noted that permanent and temporary impacts from construction of the facility would occur on-site and in/near off-site areas and rated infrastructure impacts as SMALL.

Impacts on infrastructure could occur if an action disrupted utility operations during construction or caused an increase in demand for utility services during construction or operations. A significant adverse effect to infrastructure would occur if construction and/or operation of the proposed HALEU fuel fabrication facility caused long-term disruption of utility operations, negatively affected the ability of local and regional utility suppliers to meet customer demands or required substantial public utility system updates.

For the existing facilities listed in Table 7-1, infrastructure use and connections are established; some modification to facilities would be required if new HALEU fabrication facilities were sited at these locations. As such, modification of an existing fuel fabrication facility would be expected to have SMALL infrastructure impacts during construction and operations.

Infrastructure impacts would generally be SMALL for construction and operation of fuel fabrication facilities. These include impacts on public utilities including electricity, fuel, and water. Other aspects related to infrastructure are considered in Sections 7.3.4, *Water Resources*, Section 7.3.13, *Traffic,* and Section 7.3.14, *Socioeconomics*. The utility infrastructure at fuel fabrication facilities typically interfaces with public infrastructure systems available in the region. The in-migration of workers and their families into an economic region for construction and operations, including outage activities, imposes new demands on local infrastructure. However, the peak project-related in-migrating workforce, including families, is assumed to not exceed established local planning and growth projections for infrastructure and service demands.

7.3.9 Noise

Any pressure variation that the human ear can detect is considered "sound," and "noise" is defined as unwanted sound. Sound is described in terms of amplitude (perceived as loudness) and frequency (perceived as pitch). Sound pressure levels are typically measured with a logarithmic decibels (dB) scale. To account for human sensitivity to frequencies of sound (i.e., less sensitive to lower and higher frequencies, and most sensitive to sounds between 1,000 and 5,000 hertz), an A-weighted decibels (denoted by dBA) (Acoustical Society of America, 1985, pp. 19-20), is widely used. This scale has a good correlation to a human's subjective reaction to sound. Most noise standards, guidelines, and ordinances use the A-weighted scale.

The day-night average sound level (L_{dn}) is the average over a 24-hour period, with the addition of 10 dB to sound levels from 10:00 p.m. to 7:00 a.m. to account for the greater sensitivity of most people to nighttime noise. The L_{dn} scale is widely used for community noise assessment and has been adopted by several government agencies (e.g., Federal Aviation Administration, Department of Housing and Urban Development, and the NRC). In general, a 3-dB change over an existing noise level is considered a barely discernible difference, and a 10-dB increase is subjectively perceived as a doubling in loudness and almost always causes an adverse community response (NWCC, 2002, p. 48).

Background noise is defined as the noise from all sources other than the source of interest. The background noise level can vary considerably, depending on the location, season, and time of day. Background noise levels in a busy urban setting can be as high as 80 dBA during the day. In isolated outdoor locations with no wind, vegetation, animals, or running water, background noise may be under 10 dBA. Typical noise levels in rural settings are about 40 dBA during the day and 30 dBA during the night, which correspond to an L_{dn} of 40 dBA; in wilderness areas, typical noise levels can be below 35 dBA (Harris, 1991, pp. 5.16-5.17).

At the Federal level, the Noise Control Act of 1972 and subsequent amendments (Quiet 4 Communities Act of 1978, 42 U.S.C. 4901–4918) delegate the authority to regulate noise to the states and direct government agencies to comply with local noise regulations. EPA guidelines recommend L_{dn} of 55 dBA as sufficient to protect the public from the effect of broadband environmental noise in typically quiet outdoor and residential areas and farms (EPA, 1974a, p. 4). For protection against hearing loss in the general population from nonimpulsive noise, EPA recommends an equivalent noise level of 70 dBA or less over a 40-year period.

Noise-sensitive areas are created to represent common noise environments within the same activity category, and are represented by receptors, which represent a discrete or representative location within the noise-sensitive area. Activity categories include land uses, such as residences, hotels, motels, active sport areas, schools, places of worship, hospitals, parks, and others.

Uranium fuel fabrication facilities that could potentially be used for HALEU fuel fabrication and existing NEPA documentation for those sites are discussed and summarized below.

Framatome Facility, Richland, Washington

Framatome, Inc. maintains a buffer of undeveloped, disturbed land between the facility and the rest of North Richland to the east and south (NRC, 2009c). With certain exceptions (i.e., limited allowable time excursions and exemptions as established by Washington Department of Ecology), the maximum daytime permissible noise level between AREVA NP and a residential neighbor is 60 dBA. The maximum daytime level between two industrial neighbors is 70 dBA. The historical daytime noise levels, as measured by AREVA NP at their fenceline, range from 40 to 55 dBA. For comparative purposes, bird calls have been measured at 44 dBA and typical conversations measure 60 dBA. A likely contributor to outdoor noise at this type of facility would be the heating, ventilation, and air conditioning equipment. The NRC staff considers that the short- and long-term environmental impacts from noise do not produce a significant impact on the environment. The NRC staff does not consider the noise level an audible intrusion (NRC, 2009c, pp. 42-43).

Global Nuclear Fuel – Americas (GNF-A) Facility, Wilmington, North Carolina

At the GNF-A facility in an unincorporated part of northwestern New Hanover County, approximately 10 km (6 miles) north of the city of Wilmington, North Carolina, the nearest sensitive receptors, areas of human habitation or use where the intrusion of noise has the potential to adversely impact the occupancy, use, or enjoyment of the environment, are located just next to the northeast site boundary and about 1.2 km (0.4 miles) directly to the east of the proposed facility. Other land uses adjacent to the site include a hunting and recreational area to the north, the Northeast Cape Fear River to the southwest, Interstate 140 to the south, and North Carolina Highway 133 (Castle Hayne Road) to the east. Interstate 140, which is elevated relative to the site, acts as a natural sound barrier and blocks noises from current site operations to the residences to the south. Industrial land uses are dominant on the west side of the Cape Fear River. No other residences and sensitive receptors (e.g., schools, hospitals, and nursing homes) are located in the immediate vicinity (within about 1.6 km [1 mile]) of the Wilmington site (NRC, 2009c, p. 39).

Westinghouse Electric Company Columbia Fuel Fabrication Facility (CFFF), Richland County, South Carolina

The CFFF site is located in a semi-rural area on approximately 469 ha (1,158 acres). The manufacturing facilities are located about 490 m (1,600 feet) from the nearest site boundary, and the main manufacturing building is set back approximately 760 m (2,500 feet) from Bluff Road, the nearest public road. The nearest resident is approximately 1,000 m (3,281 feet) to the northwest from the center point of the facility. Eight individuals and one church is located within 1.6 km (1 mile) of the CFFF site. There are no other noise-sensitive receptors (e.g., schools, hospitals, etc.) nearby (NRC, 2022c, pp. 3-78 to 3-92).

BWX Technologies, Inc. Fuel Fabrication Facility, Lynchburg, Virginia

The BWXT facility occupies a 201-ha (497-acre) site approximately 8 km (5 miles) east of Lynchburg, Virginia, in the northeast corner of Campbell County. The site is located on a peninsula surrounded on three sides by the James River. Much of the area adjacent to the river consists of a relatively flat floodplain. Across the river to the north and west are rolling hills. The side of the BWXT site not bounded by the river is adjacent to Mount Athos. The land around the BWXT facility is used for a variety of purposes. The area hosts other industrial facilities. Forestry and agriculture, however, dominate the activities in the predominately rural area. Because of the rolling terrain adjacent to the river, most of the population is located more than 4.8 km (3 miles) from the BWXT facility (NRC, 2005b, p. 13).

TRISO-X Fuel Fabrication Facility, Oak Ridge, Tennessee

The TRISO-X FFF is located in the city of Oak Ridge, in Roane County, Tennessee. The TRISO-X FFF site encompasses approximately 45 ha (110 acres) (X-energy, 2022). Primary noise receptors in the vicinity of the TRISO-X FFF are users of the North Boundary Greenway recreational trail bordering the HCS to the west, and the industrial and commercial businesses to the south. Except for the North Boundary Greenway, there are no other recreational facilities, schools, churches, or other sensitive noise receptors adjacent to the facility that are vulnerable to noise impacts from the TRISO-X FFF. Additionally, the nearest residences are approximately 1 km (0.6 miles) to the northwest and separated from the HCS by a heavily forested ridge that provides a natural noise barrier. Construction noise would dissipate at distances further from the site and noise impacts would not significantly detract from the overall use of the trail. Overall, noise impacts associated with construction on the land uses surrounding the TRISO-X FFF are temporary and SMALL. The predicted hourly equivalent noise level ranges from 50.7 to 59.3 dBA at the adjacent receptors during normal operation would be below 70 dBA; therefore, noise from normal operation would comply with the city of Oak Ridge Zoning Ordinance noise standards (TRISO-X, 2022, pp. 4-62 to 4-70).

New HALEU Fuel Fabrication (Generic Site)

A new HALEU fuel fabrication facility might be situated at an existing fuel fabrication facility discussed above or at sites not previously used for activities related to the uranium fuel cycle. A new HALEU fuel fabrication facility might be located on sites that have a history of industrial use or other development, or on greenfield sites that have not been previously developed. They might be located on government-owned or managed installations, such as national laboratories, or they might be located on privately owned sites. The range of existing environmental conditions that might possibly occur at any possible site is too broad to characterize.

Construction and operation of a HALEU fuel fabrication facility would have to comply with applicable Federal, state, or local guidelines and regulations on noise. The following descriptions provide some indication of the likely noise impacts associated with construction and operation of a new HALEU fuel fabrication facility.

Construction

Noise would come predominantly from construction equipment and traffic. Construction activities would be temporary and limited to daytime working hours. The HALEU fuel fabrication facility could be located at a commercial deconversion, enrichment, or fuel fabrication facility, at a former industrial site, or at a previously undeveloped site. The HALEU fuel fabrication facility is assumed to be in an existing industrial area or another rural area, away from existing residences and other sensitive noise receptors like schools, churches, or hospitals.

Because the construction equipment noise will attenuate within a short distance of a new HALEU fuel fabrication facility, the nearest residences and other land uses would likely not be adversely affected by construction noise. The duration of the construction noise would be temporary. Impacts due to construction noise would likely be SMALL, based on the likely distances to surrounding residences and recreational areas and the rate at which noise is attenuated with distance.

Operation

Noise from the operation of a new HALEU fuel fabrication facility would be minimal, occur mostly inside the buildings, and be attenuated by distance. The proposed facility would be in a rural location, surrounded by other industrial facilities, or far from lands uses that could be adversely affected by increases in noise levels. Noise at the nearest residences and recreational areas would not increase due to operation of the proposed HALEU fuel fabrication facility. Sources of noise at a fuel fabrication facility include various industrial machines and equipment such as materials handling equipment, paging and alarm systems, engines, and vehicular traffic. All noise-making activities would be performed in compliance with the Occupational Safety and Health Act of 1970 standards, BMPs, and other applicable regulatory requirements. Therefore, impacts from operations noise would be SMALL.

Best Management Practices

Ways to reduce noise-related impacts include the following:

- Maintain equipment in good working order in accordance with manufacturer's specifications.
- Limit noisy activities to the least noise-sensitive times of the day (daytime between 7:00 a.m. and 7:00 p.m.) and weekdays and limit idle time for vehicles and motorized equipment.
- Employ noise-reduction devices (e.g., mufflers) as appropriate.
- Provide a noise complaint process for surrounding communities.

7.3.10 Waste Management

This section describes the types of waste generated by a fuel fabrication facility and the disposition of the waste. Facility operations generate solid, gaseous, and liquid wastes. A fuel fabrication facility manages these wastes using a combination of on-site processing and storage, and off-site recycling, treatment, and disposal.

The gaseous effluents generated by fuel fabrication facility operations are monitored for uranium compounds and hazardous materials such as ammonia and acids. Nonradiological gaseous pollutants, such as particulate matter, sulfur dioxide, nitrogen oxide, carbon dioxide, and volatile organic constituents, are tracked. Gaseous effluents are treated by HEPA filters, scrubbers, or both prior to discharge from exhaust stacks. Liquid wastes, sanitary waste sewage (which includes multiple types of solid waste such as combustible, hazardous, mixed, nonhazardous, industrial), and radioactive wastes are also generated.

Combustible wastes are generated through the manufacturing process. Combustible wastes containing uranium are either incinerated and leached to recover the uranium or shipped off-site to other licensed facilities for recovery. Noncombustible wastes and selected combustible wastes are packaged in compatible containers, compacted when appropriate, measured to verify the uranium content, and placed in storage to await shipment for further recovery, treatment, or disposal.

A fuel fabrication facility may generate large quantities of hazardous wastes that include degreasing solvents, lubricating and cutting oils, spent plating solutions, and zirconium-laden wastes. Fuel fabrication operations also produce a variety of low-level radioactive waste (LLW), including used packaging, clothing, paper, and tools. After sorting, the LLW may be transferred to an on-site waste processing station, where radiation surveys are conducted. The waste may then be decontaminated for free release or reuse or shipped off-site for disposal at a licensed waste disposal facility.

Fuel fabrication facility operations may generate a limited amount of mixed waste and nonhazardous waste. Mixed waste contains both hazardous and radioactive components and is regulated by the Resource Conservation and Recovery Act of 1976 and the Atomic Energy Act of 1954. Mixed waste from fuel fabrication operations consists of materials that cannot be free-released, and includes items such as batteries (dry cell, lead acid, lithium), polychlorinated biphenyl-containing light ballasts, contaminated lamps, and lead shielding. Nonhazardous waste from facility operations consists of items from routine office and industrial activities. The nonhazardous waste includes items such as batteries, computers, oil filters, rags, and trash from office areas and lunchrooms. Decommissioning of the fuel fabrication facility is expected to generate significant volumes of LLW. However, waste minimization actions can include reuse and recycling of nonradioactive materials.

Framatome Facility, Richland, Washington

Construction

The NEPA source document for this facility was for relicensing (continued operations) and did not include any substantive construction activities.

Operation

Currently, Northwest Compact (Hanford, Washington) and Energy Solutions (Clive, Utah) process the non-combustible LLW generated by the Framatome facility. Based on use of the current disposal facilities and not considering future site expansions, the projected operating lifetimes are 50 years for Northwest Compact and 25 years for Energy Solutions. Framatome does not anticipate any loss of these services. The maximum timeline of 50 years provides sufficient disposal coverage for the proposed license renewal period (NRC, 2009c).

However, the possibility exists that the disposal facilities may not be available in the future, i.e., the facility becomes capacity constrained at an earlier date, expansion does not occur, or other disposal facilities are not available. If the service is lost, Framatome could implement several alternatives, such as storing the low-level waste on its Richland site within the fenced restricted area. With this decision, the environmental review would focus on the location and type of on-site storage being proposed (i.e., covered storage to lessen weatherization effects) and determine whether the applicant's current quality controls, inspection techniques, and tracking systems remain adequate. Framatome would also need to evaluate instituting enhanced waste reduction strategies to lessen the volume of wastes generated. As an example, Framatome may consider dismantling its HEPA filters to allow on-site incineration of the wooden frame followed by compaction/disposal of the filter. Or Framatome may consider reuse of materials and equipment by furthering its decontamination. The NRC staff considers that these actions may produce small direct, indirect, and cumulative impacts on the site, as follows. The zoning ordinance permits on-site storage, so this action is consistent with past, present, and future land use activities. Furthermore, the land has previously been disturbed so it is unlikely that historic or cultural resources will be found. On-site storage should lessen transportation and noise impacts (fewer trucks transporting materials from site to disposal) and may result in lower truck exhausts/improve air quality. However, additional storage facilities may produce a negative environmental effect on the scenic resource. Framatome is located within an industrial park that has many buildings on the various property lots. This area falls within the Hanford Reach Protection and Management Program Interim Action Plan; therefore, Framatome would need to conform accordingly (NRC, 2009c).

Through routine operations, Framatome does generate waste liquid effluents. Framatome recovers certain waste liquid effluents and either re-uses the component in its process line or sells it as a commercial product (i.e., hydrofluoric acid is recovered from the dry conversion process and is sold to a commercial chemical company for their use). Other liquid wastes designated for disposal are collected within the plant's wastewater treatment system, treated, combined with domestic sewage, sampled for radioactive and nonradioactive constituents, and then discharged with other nonhazardous liquid effluents. Framatome containerizes small volumes of certain liquid wastes for treatment and disposal at an off-site facility. Potential indirect effects from this waste management practice include changes in groundwater or soil quality due to releases of certain hazardous chemicals. Direct impacts from leaks or spills can affect runoff and eventually groundwater resources depending on the level of the accidental release. Direct impacts can occur by accidental releases during waste transportation. The direct, indirect, short-/long-term, and cumulative impacts are considered to be SMALL (NRC, 2009c).

Global Nuclear Fuel – Americas (GNF-A) Facility, Wilmington, North Carolina

Construction

The NEPA source document for GNF-A was for relicensing (continued operations) and did not include any substantive construction activities. Due to its relatively small size and operating staff, the contribution of the Natrium fuel fabrication facility on the local nonradioactive and nonhazardous waste and general sanitary waste management resources and disposal capacity is expected to be SMALL.

Operation

Through routine operations, GNF-A generates waste liquid effluents. GNF-A recovers certain waste liquid effluents and either reuses the component in its process line or sells it as a commercial product (e.g., HF is recovered and is sold to a commercial chemical company for their use). Other liquid wastes designated for disposal are collected within the plant's wastewater treatment system, treated, sampled for radioactive and nonradioactive constituents, and then discharged at the surface water discharge points. GNF-A containerizes small volumes of certain liquid wastes for treatment and disposal at an off-site facility. Potential indirect effects from this waste management practice include changes in groundwater or soil quality due to releases of certain hazardous chemicals. Direct impacts from leaks or spills can affect runoff and eventually groundwater resources depending on the level of the accidental release. Direct impacts can occur by accidental releases during waste transportation. The direct, indirect, and short- and long-term impacts are considered to be SMALL (NRC, 2009b).

Westinghouse Electric Company Columbia Fuel Fabrication Facility (CFFF), Richland County, South Carolina

Construction

The NEPA source document for this facility was for relicensing (continued operations) and did not include any substantive construction activities.

Operation

The gaseous effluents currently generated by the CFFF operations would continue. Gaseous effluents are monitored (uranium compounds, ammonia, and fluorides) and modeled (nonradiological gaseous pollutants, e.g., particulate matter, sulfur dioxide, nitrogen oxide, carbon monoxide, volatile organic compounds, toxic air pollutants). There are 42 exhaust stacks at the CFFF. Gaseous effluents from the CFFF are normally treated by HEPA filters, scrubbers, or both prior to discharge in accordance with 40 CFR 50 and 40 Part 61, and 10 CFR 20. Additionally, the SCDHEC requires a demonstration that a facility, such as the CFFF, will not cause an exceedance of the NAAQSs (40 CFR 50, *National Primary and Secondary Ambient Air Quality Standards*). The CFFF is a minor-source operator and operates under an air permit with the SCDHEC. Westinghouse's air permit renewal application with the SCDHEC will include a new emissions calculation and the elimination of plating activities that occurred prior to 2020. The CFFF has been below all regulatory limits for gaseous radiological effluents and nonradiological effluents (NRC, 2022c).

There are two types of liquid effluent streams from the CFFF operations: process liquid wastes and sanitary waste sewage. All liquid discharges must be in compliance with the facility's NPDES permit. Liquid discharges of radiological constituents (whether gross measurements or isotopic specific) must be in compliance with the radiological dose limits to the public and protection of the environment, in accordance with the facility's license under 10 CFR 20 and 70. The NPDES permit that authorizes discharge to the Congaree River also requires groundwater monitoring, and Westinghouse provides groundwater monitoring results to the SCDHEC annually. In addition, stormwater runoff from the site is permitted in accordance with the SCDHEC's general NPDES permit for Storm Waste Discharges Associated with Industrial Activities (NRC, 2022c).

The CFFF generates multiple types of solid waste: combustible, hazardous, mixed, nonhazardous, industrial, and radioactive wastes. The associated processes would continue under the proposed license renewal term. Combustible wastes are generated through the manufacturing process. Combustible wastes containing uranium are either incinerated and leached to recover the uranium or shipped off-site to other licensed facilities for recovery. Noncombustible wastes and selected combustible wastes are packaged in compatible containers, compacted when appropriate, measured to verify the uranium content, and placed in storage to await shipment for further treatment, recovery, or disposal. In the past, Westinghouse stored drums of combustible waste, containing uranium waiting for uranium recovery via on-site incineration, in intermodal containers (sea-land containers) in an outdoor storage area. This practice of storing the waste in intermodal containers led to leakage and subsurface contamination (NRC, 2022c).

The CFFF is a large-quantity generator of hazardous wastes that include degreasing solvents, lubricating and cutting oils, and zirconium-laden wastes. These hazardous wastes are regulated under 40 CFR 261, *Identification and Listing of Hazardous Waste*; 40 CFR 262, *Standards Applicable to Generators of Hazardous Waste*; and South Carolina Hazardous Waste Regulations R61-79.261. The rate of hazardous waste generated was approximately 92,360 kilograms (kg) (204,000 pounds [lbs]) annually from 2013 to 2018, except in 2017. In 2017, Westinghouse generated 105,607 kg (232,824 lbs) of hazardous waste based on an increase volume of waste from the plating process (NRC, 2022c).

The CFFF operations produce a variety of LLW, including used packaging, clothing, paper, and tools. After sorting, the LLW is transferred to an on-site waste processing station, where radiation surveys are conducted. The waste may then be decontaminated for free release or reuse or shipped off-site for disposal at the Waste Control Specialists facility in Andrews, Texas. The LLW is shipped off-site for disposal in 55-gallon (gal) drums or sea-land containers. Westinghouse stated that the amount shipped off-site between 2010 and 2018 has ranged from 12,000 cubic feet (ft^3) to 38,000 ft^3 (340 cubic meters [m^3] to 1,100 m^3), respectively, with an annual average of 24,000 ft^3 (680 m^3). The CFFF operations generate a limited amount of mixed waste. Mixed waste contains both hazardous and radioactive components and is regulated by the Resource Conservation and Recovery Act of 1976 and the Atomic Energy Act of 1954, as amended. Mixed waste from the CFFF operations consists of materials that cannot be free-released, and include batteries (dry cell, lead acid, lithium), polychlorinated biphenyl-containing light ballasts, contaminated lamps, and lead shielding. Westinghouse expects to generate 5 to 10 drums of mixed waste per year. Mixed waste is disposed of off-site through permitted contractors (NRC, 2022c).

Nonhazardous waste from the CFFF operations consists of items from routine office and industrial activities. The nonhazardous waste includes batteries, computers, oil filters, rags, and trash from office areas and lunchrooms. Nonhazardous waste generation rates have increased from 4,218 kg per year

(9,300 lbs per year) in 2013 to 178,446 kg per year (393,000 lbs per year) in 2017, as a result of changing recycling markets. Industrial trash waste from office areas and lunchrooms has decreased from 292 MT in 2013 to 201 MT in 2017. These wastes are stored on the on-site storage pad and disposed of off-site at a state-permitted landfill. In 2012, Westinghouse implemented a recycling program for wood, corrugated cardboard, and rigid plastics. Westinghouse also implemented a food composting program to reduce food waste from the site (NRC, 2022c, pp. 3-112).

BWX Technologies, Inc. Fuel Fabrication Facility, Lynchburg, Virginia

Construction

The NEPA source document for this facility was for relicensing (continued operations) and did not include any substantive construction activities.

Operation

BWXT operations produce airborne, liquid, and solid effluents. Airborne effluents are normally treated by HEPA filters or scrubbers before being discharged through one of the stacks. Nonradiological gaseous emissions are dominated by nitrogen oxides and volatile organic compounds. In 2003, an estimated 44.54 MT (49.10 tons) of nitrogen oxide and 16.39 MT (18.07 tons) of volatile organic compounds were emitted from the BWXT facility. Liquid effluents from the Nuclear Products Division (NPD) and Lynchburg Technology Center (LTC) facilities are treated at the waste treatment facility and discharged into the James River in accordance with Virginia Pollutant Discharge Elimination System and 10 CFR 20 requirements. For the 10-year period from 1994 to 2003, the average amount of water discharged annually through the three BWXT outfalls was 823.3 million L (217.5 million gal). The highest amount was discharged in 1998 with a value of 998.6 million liters (263.8 million gal). BWXT operations produce low-level and high-level radioactive solid waste. For the 4-year period from 2000 to 2003, an average of 825.2 m^3 (29,142 ft^3) of low-level radioactive solid waste was generated. The highest amount of this waste was generated in 2000 with a value of 1,217.6 m^3 (42,999 ft^3). The low-level radioactive solids are stored in 208-liter (55-gal) drums. Usually, these drums are sent to the Supercompactor facility on-site, crushed, and repackaged into 265-liter (70-gal) overpack drums. All drums containing LLW are sent off-site for disposal at licensed disposal facilities (e.g., the Barnwell site in South Carolina and the Envirocare site in Utah). For the 4-year period from 2000 to 2003, high-level radioactive solid waste was generated in only two of the years. In 2000, 1.8 m^3 (63 ft^3) was generated, and in 2001, 1.6 m^3 (57 ft^3) was generated. High-level radioactive solid wastes are stored in stainless steel drums and retained on-site (NRC, 2005b).

TRISO-X Fuel Fabrication Facility, Oak Ridge, Tennessee

Construction

Construction activities would occur in uncontaminated areas and would not generate LLW. Due to its relatively small size, the impacts from construction of the TRISO-X FFF would generate relatively small volumes of nonradioactive and nonhazardous waste and general sanitary waste. Therefore, impacts on waste management from construction would be SMALL (TRISO-X, 2022).

Operation

Waste management activities are described in Sections 2.1.2.1.1.8 and 2.1.2.1.1.9 of the ER for the TRISO-X FFF (TRISO-X, 2022, pp. 2-15 to 2-17, 2-31). The sources of radioactive liquid, solid, gaseous waste generated by the operation of the TRISO-X FFF are summarized as follows:

- Liquid and gaseous effluents associated with process streams (e.g., wet chemistry material recovery process, gelation process, TRISO particle washing, high-temperature carbonization furnace process); solid waste associated with receipt of feedstock material (e.g., empty containers that contained HALEU); dry active waste, including personal protective equipment, rags, and cleaning supplies; waste from consumables used in the production process; and material that gets carried over into the ventilation system (e.g., U_3O_8 powder, graphite matrix powder, abraded material from mechanical handling, and HEPA filters)

- Quality control laboratory wastes
- Routine waste from maintenance activities (e.g., trash generation from decontamination, filter replacement)

TRISO-X FFF wastes would be managed in accordance with applicable Federal, state, and local regulations. As a result, the direct impacts on the environment due to the on-site management and off-site disposal of waste would be SMALL (TRISO-X, 2022).

New HALEU Fuel Fabrication (Generic Site)

Construction

Due to its relatively small size, the impacts of constructing a HALEU fuel fabrication facility on the local waste management infrastructure and disposal capacity is expected to be SMALL.

Operation

Fabrication of HALEU fuel could occur at either an existing facility or at a new facility. In either case, the impacts discussed above are representative of the waste management impacts at a HALEU fuel fabrication facility. Management of wastes would be performed using a combination of recycling, on-site processing and storage, and off-site treatment and disposal. Wastes would be managed in accordance with applicable Federal, state, and local regulations. Due to the relatively small size of a HALEU fuel fabrication facility, the direct impacts on the environment due to waste management are expected to be SMALL.

7.3.11 Public and Occupational Health – Normal Operations

Normal activities involved in the fabrication of HALEU fuel include cleaning, casting, alloying, cutting, shearing, machining, extruding, drawing, welding, dissolving, calcining, drying, pelleting, sintering, and grinding. Normal release limits are specified in 10 CFR 20. During normal operations, radiologic impacts would be comparable to human health effects from operations at facilities fabricating fuel from LEU. Radiologic releases during normal operations would not result in adverse health impacts.

The exposure of workers in uranium fuel fabrication facilities results from external exposure to gamma radiation emitted by the uranium isotopes of concern and their decay products as well as internal exposure from inhalation of uranium and its decay products. The internal exposure depends on the design of the process equipment for minimizing airborne activity in the working area. Nonradiological effects on workers are minimized by following conventional safety procedures when handling equipment, chemicals, and other workplace hazards. The collective doses due to liquid discharges are much less than those from airborne discharges.

The effluent from fuel fabrication with the greatest potential environmental impacts is chemical in nature. Liquid effluent from fuel manufacture contains nitrogen compounds formed from ammonia in the production of powder and by nitric acid in the scrap recovery operations. Very small quantities of uranium are released with the effluent gases and liquids. Ammonia and nitrates are found in liquids released from the waste holding ponds.

Construction

Construction associated with the augmentation of existing fuel fabrication facilities to add a HALEU fuel fabrication capability could involve modification of existing process lines or the addition of new lines, and at some facilities, the addition of the needed security features to upgrade to an NRC Category II facility.

Generally, there are no public health impacts associated with new construction at an operating fuel cycle facility. Potential exposure could result from fugitive dust containing radiological materials, exposure resulting from direct radiation, and airborne particulates. BMPs would be employed to limit dust generation. The *Environmental Impact Statement for the Proposed GE-Hitachi Global Laser Enrichment, LLC Facility in Wilmington, North Carolina* (NRC, 2012b) identified construction worker doses of about 10.5 millirem (mrem) per year during construction activities at the GNF-A site in Wilmington, North Carolina. This worker dose was primarily from direct exposure to existing site sources. This same construction activity did not result in any impacts on public health as distance to the public and dispersion of dust created during construction have limited the dose to the public.

Operation

Any nonradiological impacts on workers or the public are expected to be SMALL. These hazards are managed by process controls, BMPs and adherence to as low as reasonably achievable principles. During normal facility operations, hazards to workers from nonradiological hazardous material and from occupational accidents would be addressed through facility safety and health programs.

Historically, exposure of fuel fabrication workers to radiological materials has resulted in relatively SMALL radiological exposures. Table 7-3 shows the most recent data published by the NRC for fuel fabrication facilities. Data in this table includes information for two facilities licensed to possess highly enriched uranium. On average, the fabrication facility worker dose in 2020 was less than 100 mrem. These are well below the NRC worker dose limit of 5 rem per year in 10 CFR 20.1201. It is anticipated that any HALEU fuel fabrication facility would also have a lower administrative worker dose limit. Worker doses at a HALEU fuel fabrication facility should be comparable to these doses.

Table 7-3. Fuel Fabrication Worker Exposure Data 2020

Facility	*Total dose (person-rem)*	*Number of Workers Receiving Dose*	*Average Dose (rem)*
Framatome, Inc.	44.65	682	0.065
Global Nuclear Fuel – Americas	46.85	551	0.085
Westinghouse Electric Company	116.7	516	0.226
BWXT Nuclear Operations Group, Inc.	15.20	307	0.050
Nuclear Fuel Services, Inc.	9.88	531	0.019
All Five Fuel Fabrication Facilities	**233.3**	**2,587**	**0.090**

Source: (NRC, 2022a, pp. A-4)

Data in the Environmental Assessments for operating fuel fabrication facilities and in the environmental report for the proposed TRISO-X FFF were examined to assess the potential for radiological exposure of the public:

- Framatome, Inc., Richland fuel fabrication facility in Richland, Washington
- GNF-A fuel fabrication facility in Wilmington, North Carolina

- Westinghouse CFFF in Richland County, South Carolina
- BWXT fuel fabrication facility in Lynchburg, Virginia
- TRISO-X FFF in Oak Ridge, Tennessee

Reported average doses (combined from airborne and liquid affluents) to the maximally exposed individual ranged from 0.03 mrem per year to 0.4 mrem per year (NRC, 2005b, p. pg 15; NRC, 2009c, p. pg 44; NRC, 2009b, p. pg 28; TRISO-X, 2022, pp. pg 4-110; NRC, 2022c, pp. 3-106). A high of 0.65 mrem was reported for the BWXT facility in 2003. The TRISO-X facility reported only a population dose (0.07 person-rem per year). A maximally exposed individual dose of significantly less than 1 mrem per year can be inferred from this population dose. All of these doses are below the public dose limits of 100 mrem per year contained in 10 CFR 20.1301(a)(1) for the general public; 10 mrem per year from airborne releases contained in 40 CFR 61, Subpart H; EPA's *National Emission Standards for Hazardous Air Pollutants*; and the EPA limit of 25 mrem per year in 40 CFR 190 for dose to members of the public from uranium fuel cycle facilities. While not considered in the maximum individual dose, GNF-A did report liquid effluent doses ranged between 9 and 21 mrem per year for the period from 2003 to 2007[50] (NRC, 2009b, p. pg 28). The dose is below both the 10 CFR 20.1301(a)(1) and 40 CFR 190 public dose limits.

Radiation dose from HALEU would be greater than the radiation dose from LEU due to the greater concentration of uranium-234 (U-234). As shown in Table 7-4, the total curie content of a gram of HALEU is about four times that of LEU due primarily to the higher percentage of U-234 in HALEU. Therefore, releasing a gram of HALEU instead of a gram of LEU would result in the release of about four times more curies and about four times more dose.[51] However external doses are low due to the low specific activity of uranium and the quantity of uranium released.

Table 7-4. Uranium Activity: LEU and HALEU

Uranium Isotope	***Specific Activity (Ci/g)***	***LEU***		***HALEU***	
		Weight percent	***Total Activity (Ci/g)***	***Weight Percent***	***Total Activity (Ci/g)***
U-238	3.35×10^{-7}	0.95	3.2×10^{-7}	0.803	2.69×10^{-7}
U-235	2.16×10^{-6}	0.046	9.9×10^{-8}	0.195	4.21×10^{-7}
U-234	6.24×10^{-3}	0.00037	2.3×10^{-6}	0.0018 [(a)]	1.10×10^{-5}
Total Activity	**--**	**100**	$\mathbf{2.7 \times 10^{-6}}$	**100**	$\mathbf{1.17 \times 10^{-5}}$

Key: Ci/g = curies per gram; HALEU = high-assay low-enriched uranium; LEU = low-enriched uranium; U = uranium
Note:
[a] Assuming the enrichment of U-234 enrichment is proportional to the enrichment of U-235 and accounting for the difference in mass between the two isotopes.

The annual public doses provided in the environmental documents for the LEU fuel fabrication facilities result from processing a much larger quantity of fuel than the 50 MT of HALEU associated with the proposed action.[52] The CFFF site is licensed to process 1,500 MT of LEU annually and the data from the Framatome facility reflects the doses associated with processing of up to 141 MT of LEU annually. Combining the effects of the lower throughput for HALEU fuel fabrication and the higher activity of

[50] This dose conservatively assumes that an individual continuously ingested the liquid effluent for a year and that the concentration of radionuclides ingested was in the final process lagoon effluent. Actual doses should be lower due to dispersion and more realistic consumption assumptions.
[51] The three uranium isotopes have slightly different dose conversion factors (dose per unit intake [internal]: curies to rem). However, the differences are relatively small and are ignored in this assessment.
[52] With the exception of the TRISO-X FFF, which is planned to have an initial capacity of 8 MT/yr, increasing to 16 MT/yr.

released HALEU, the health impacts should be no higher for the HALEU facility than those estimated for the fuel fabrication facilities discussed here. Airborne releases should result in individual doses of much less than a mrem per year. Impacts from direct radiation to the public would be dependent upon the location of the facility (particularly any container storage yards) with respect to distance from a controlled site boundary. Incorporating the impact of a direct dose to the public into the design layout of the HALEU facility would serve to limit this dose to an individual located at the site boundary. With similar population density and distributions, the population dose at a new HALEU fuel fabrication facility should be similar to that if located at any of the sites addressed in this section.

7.3.12 Public and Occupational Health – Facility Accidents

Companies holding licenses under 10 CFR 70, *Domestic Licensing of Special Nuclear Material*, must perform an integrated safety analysis (ISA) and submit a summary to the NRC for approval. An ISA (1) identifies potential accident sequences during operations of a fuel fabrication facility, (2) designates items relied on for safety (IROFS) to either prevent such accidents or mitigate their consequences to an acceptable level, and (3) describes management measures to provide reasonable assurance of the availability and reliability of IROFS. While the licensee maintains the full ISA and its supporting documentation at an existing licensed facility, the licensee annually submits the ISA Summary, which is subject to NRC review. The ISA Summary focuses on accident sequences with credible consequences that could exceed the criteria of 10 CFR 70.61, *Performance Requirements*. A criticality accident is considered a high-consequence event and IROFS to ensure that a criticality accident is highly unlikely are identified for the fuel fabrication facility. As a minimum, external events normally include the following: natural phenomena, such as floods, high winds, tornadoes, and earthquakes; fires external to the facility; and transportation accidents and accidents at nearby industrial facilities. Management measures (as described in NUREG-1520 (NRC, 2002b)) are activities performed by a licensee that are applied to IROFS to provide reasonable assurance that the IROFS will perform their intended safety function when needed to prevent accidents or mitigate the consequences of accidents to an acceptable level.

The performance requirements in 10 CFR 70, Subpart H, define acceptable levels of risk of accidents at nuclear fuel cycle facilities. The regulations in Subpart H require reduction of the risks of credible high- and intermediate-consequence events and assure that credible abnormal conditions all nuclear processes are subcritical. Table 7-5 describes the ISA consequence threshold limits used to determine the severity of accidents that could impact the public or the environment to comply with the performance requirements in 10 CFR 70.61. Accident consequences for each credible scenario are compared to the consequence threshold limits and a consequence level of “High,” “Intermediate,” or “Low” is assigned.

NRC regulations are designed to ensure that the high and intermediate accident scenarios would be highly unlikely (10 CFR 70, Subpart H). The combination of responses by IROFS that mitigate or prevent emergency conditions—and the implementation of emergency procedures and protective actions in accordance with the facility emergency plan—would limit the consequences and reduce the likelihood of accidents that could otherwise extend beyond the site and property boundaries. Receptors located at the property boundary represent worst-case exposures to members of the public. The would be designed with a number of features that would protect workers and mitigate the effects of accidents. In addition to physical design features, such as barriers, ventilation systems, and alarms, an emergency plan would be implemented to minimize the consequences of accidents to workers.

Table 7-5. Definition of High- and Intermediate-Consequence Events

Consequence Level	***Worker [(a)]***	***Radiological Public/Environment***	***Chemical Public/Environment***
High	Individual Radiation Dose > 100 rem Chemical exposure greater than or equal to AEGL-3	TEDE ≥ 25 rem	≥ AEGL-2 ≥ 30 mg soluble U
Intermediate	Individual Radiation Dose > 25 rem but less than 100 rem Chemical exposure greater than or equal to AEGL-2 but less than AEGL-3	25 rem > TEDE ≥ 5 rem 5,000 × 10 CFR 20, Appendix B, limits averaged over 24-hour period	≥ AEGL-1 < AEGL-2
Low	Lower than Intermediate	< Intermediate levels	< Intermediate levels

Sources: (NRC, 2022c, pp. 3-116, Table 3-23; TRISO-X, 2022, pp. 4-125, Table 4.12.2-9); 10 CFR 70, Subpart H

Key: > = greater than; ≥ = greater than or equal to; < = less than; AEGL = acute exposure guideline levels; CFR = Code of Federal Regulations; mg = milligram; TEDE = total effective dose equivalent; U = uranium

[a] AEGL are public and private sector derived consensus values intended to describe the risk to humans resulting from once-in-a-lifetime, or rare, exposure to airborne chemicals (https://www.epa.gov/aegl/about-acute-exposure-guideline-levels-aegls). ERPGs (emergency response planning guidelines) may be used if no AEGLs are available.

Facility accident analysis results for operational events are not available to the public for the Framatome, GNF-A, and BWXT fuel fabrication facilities. Accidents during construction at these three facilities are standard industrial hazards. Accidents from standard industrial hazards are not part of the accident analysis for a fuel fabrication facility.

Westinghouse Electric Company Columbia Fuel Fabrication Facility (CFFF), Richland County, South Carolina

Construction

Accidents during construction are standard industrial hazards. Accidents from standard industrial hazards are evaluated above in Section 7.3.11, *Public and Occupational Health – Normal Operations*.

Operation

Accident information for the CFFF (NRC, 2022c, pp. 3-115 to 3-118) is described in this section. Current operations at CFFF include receiving low-enriched uranium hexafluoride (UF_6) in cylinders, converting it to UO_2 powder, and processing the UO_2 powder into fuel. A range of possible accidents was selected for detailed evaluation to bound the potential human health impacts. The representative accident scenarios selected vary in severity from high- to intermediate-consequence events and include accidents initiated by natural phenomena, operator error, and equipment failure. Compliance with the NRC regulations ensures that high and intermediate consequences for credible accidents would be unlikely and highly unlikely, respectively. Identification of IROFS and the implementation of emergency procedures would reduce the consequences and the likelihood of accidents. The accident scenarios evaluated are:

- Spill of a UN solution from an outside storage tank
- Fire in the Conversion Enclosure Containment ventilation system

- Large release of UF_6 from the outdoor storage area
- Criticality accident at an outdoor UN storage tank

The potential radiological impacts of a spill of UN (liquid) from a ruptured UN outside storage tank were evaluated. The analysis assumed that part of the material would be precipitated out or adsorbed by the soil (75%), and approximately 25% of the uranium would be solubilized and transported to the storm drain and Sunset Lake. An individual would have to drink approximately 5 liters of lake water to get an uptake of 30 milligrams (mg) of uranium. An uptake is not likely since the lake not a source of potable water and is located within the CFFF site. For the CFFF, a worker or member of the public would not receive a 25-rem dose as a result of a spill of UN liquid from a ruptured UN outside storage tank. (NRC, 2022c, pp. 3-115 to 3-118)

A fire in the Conversion Enclosure Containment ventilation system was identified as an intermediate-consequence event to the public. The fire was assumed to release 20 kg (44 lbs) of uranium to the environment. The consequences of a fire that could release 20 kg of uranium to the environment that could be inhaled by a receptor downwind of the fire would be less than 3 rem. (NRC, 2022c, pp. 3-115 to 3-118).

The chemical consequences of a large release of UF_6 in the outdoor area where UF_6 cylinders are stored was analyzed. The accident involved a fire from a truck crashing into the UF_6 cylinders outdoor storage area and rupture of two of the UF_6 cylinders. UF_6 is solid at ambient temperature; however, sublimation and reaction with water vapor would form uranyl fluoride (UO_2F_2) and HF. The UO_2F_2 and HF could move downwind. The estimated average concentration of uranium and HF as the plume through the nearest residence under adverse meteorological conditions would be approximately 60 mg/m^3 and 20 milligrams per cubic meter (mg/m^3), respectively. Concentrations of HF at 25 mg/m^3 for several minutes would cause respiratory discomfort, while brief exposure to 40 mg/m^3 would be dangerous to life. The intake of uranium of an adult at the nearest residence standing in the plume for an hour would be approximately 50 mg, which exceeds the 30 mg uranium threshold for a high-consequence event to the public but below the fatal intake of 160 mg. (NRC, 2022c, pp. 3-115 to 3-118)

A criticality accident was identified as a high-consequence event and IROFS were identified to ensure that that all nuclear processes are subcritical and that a criticality accident is highly unlikely. The criticality analysis assumed a criticality in a UN nitrate tank located outside of any facility building. Estimated doses for multiple on-site locations were all below 13 rem. The dose at the nearest site boundary was less than 7 rem. (NRC, 2022c, pp. 3-115 to 3-118)

TRISO-X Fuel Fabrication Facility, Oak Ridge, Tennessee

Construction

Accidents during construction are standard industrial hazards. Accidents from standard industrial hazards are evaluated above in Section 7.3.11, *Public and Occupational Health – Normal Operations*.

Operation

Accident information for the TRISO-X FFF (TRISO-X, 2022) is discussed in this section. The representative accident scenarios selected vary in severity from high- to intermediate-consequence events, and include accidents initiated by natural phenomena (e.g., earthquake), operator error, and equipment failure. The ISA considered all credible accidents at the proposed facility.

Accidents that could occur at the TRISO-X FFF are both radiological and nonradiological in nature. The fabrication of fuel for advanced nuclear reactors involves the chemical processing of uranium enriched to less than 20 weight percent. The fuel fabrication process involves the encapsulation of each uranium fuel particle with multiple carbonous layers. The encapsulated uranium fuel particles are pressed into a fuel pebble, which has an additional outer layer of graphite that provides additional encapsulation of the uranium. Uranium materials are processed indoors in batch-limited quantities such that process upsets would pose minimal impacts on the environment. (TRISO-X, 2022, pp. 4-112 to 4-118)

The bounding radiological accidents identified in the ISA that could impact the environment or public are (TRISO-X, 2022, pp. 4-112 to 4-118):

- Major fire due to the ignition of an uncontained spill of hexamethyldisiloxane (HMDSO) inside the fuel fabrication building
- Nuclear criticality inside the fuel fabrication building

For a radiological release to the environment, calculations performed for the purpose of the ER (TRISO-X, 2022) determined that an upset of an HMDSO fire would have to involve at least 60 kg (132 lbs) of UO_2 to lead to an intermediate-consequence that corresponds to 5,000 times the 10 CFR 20, Appendix B limits averaged over a 24-hour period. For radiological exposure to the public, the ISA assumes the major fire results in a high-consequence event. The spill of HMDSO and subsequent fire is mitigated with the following measures and IROFS (TRISO-X, 2022, pp. 4-112 to 4-118):

- Flammable liquid volume limits
- Level alarms and isolation interlocks
- Clean agent fire suppression
- Fire alarm and smoke detection
- Fire resistant materials of construction
- Combustible Control Program
- Fire barriers
- Electrical Classification
- Site Emergency Plan, implementing procedures, and response actions

The dose from a nuclear criticality accident is calculated to be 1.25 rem at the closest location of public access to the site boundary of 122 m from the facility. The accident involves a postulated criticality event consisting of a 208-liter (55-gal) drum containing 200-gram (g) units per liter of ammonium diuranate with 1×10^{18} fissions. This is a low-consequence event to the public since the calculated dose of 1.25 rem is less than the 5-rem intermediate-consequence threshold in Table 7-5. (TRISO-X, 2022, pp. 4-112 to 4-118)

As required by 10 CFR 70.64(a)(9), the TRISO-X FFF employs the double contingency principle in its design for operations involving SNM. The double contingency principle incorporates sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible. A criticality accident is also demonstrated to be highly unlikely in the ISA.

The bounding accidents identified in the ISA that could result in chemical exposure to the public are as follows (TRISO-X, 2022, pp. 4-112 to 4-118):

- Flammable gas explosion inside the fuel fabrication building
- Major fire due to the ignition of an uncontained spill of HMDSO inside the fuel fabrication building that causes a nitric acid release
- Nitric acid release in the chemical storage area inside the fuel fabrication building
- Methyltrichlorosilane (MTS) release outside the fuel fabrication building from the bulk storage tank

The ISA assumes that release of multiple solution process vessels inside the fuel fabrication building, due to a flammable gas explosion, results in a high-consequence event to the public. Calculations for an accident involving the release of 208-liter (55 gal) of 70 weight percent nitric acid inside the fuel fabrication building due to an unmitigated HMDSO fire results in a chemical exposure to the public of approximately 124 mg/m^3. This exceeds the acute exposure guideline level (AEGL)-2 limit of 77.2 mg/m^3, indicating that the release of nitric acid due to a major fire results in a high-consequence event to the public (TRISO-X, 2022, pp. 4-112 to 4-118).

Flammable gas explosions and a major fire are mitigated with the following measures and IROFS (TRISO-X, 2022, pp. 4-112 to 4-118):

- Flammable liquid volume limits
- Level alarms and isolation interlocks
- Clean agent fire suppression
- Combustible gas detection and isolation interlocks
- Fire resistant materials of construction
- Fire alarm and smoke detection
- Combustible Control Program
- Fire barriers
- Electrical Classification
- Site Emergency Plan, implementing procedures, and response actions

Calculations for an accident involving the release of 2,498 liter (660 gal) of 70 weight percent nitric acid spill inside the fuel fabrication building result in a chemical exposure to the public of approximately 0.66 mg/m^3. This exceeds the AEGL-1 limit of 0.4 mg/m^3, indicating that the release of nitric acid due to unconfined spill of the entire tank contents results in an intermediate consequence to the public. Indoor spills of chemicals are mitigated with the following measures and IROFS (TRISO-X, 2022, pp. 4-112 to 4-118):

- Metering vessel volume limits
- Level alarms and isolation interlocks
- Containment materials of construction
- Welded piping and columns
- Overflow collection
- Site Emergency Plan, implementing procedures, and response actions

Calculations for an accident outside the fuel fabrication building due to a spill of 6,814 liters (1,800 gal) of MTS from the bulk storage tank was determined to be the bounding outdoor chemical release. The unmitigated release of MTS as an evaporating spill due to a one-inch hole in the storage tank resulted in a chemical exposure of approximately 304 parts per million (ppm). This resulted in a high-consequence event to the public since the calculated exposure of 304 ppm exceeded the AEGL-2 limit of 7.3 ppm for the public. Outdoor spills of chemicals are mitigated with designs following industry engineering practices and code requirements, which include the International Building Code and International Fire Code (TRISO-X, 2022, pp. 4-112 to 4-118):

- Containment materials of construction
- Welded piping and tanks

- Secondary containment
- Fencing and bollards
- Site Emergency Plan, implementing procedures, and response actions

The mitigation measures identified would limit the consequences and reduce the likelihood of accidents to an acceptable level.

New HALEU Fuel Fabrication (Generic Site)

Construction

Accidents during construction are standard industrial hazards. Accidents from standard industrial hazards are evaluated above in Section 7.3.11, *Public and Occupational Health – Normal Operations*.

Operation

Fabrication of HALEU fuel could occur at either an existing facility or at a new facility. In either case, facility design would reduce the likelihood of an accident. The use of safe-by-design components would prevent an inadvertent nuclear criticality. In addition, the proposed facility emergency plan would address all low-, high- and intermediate-consequence events. Through the combination of facility design, passive and active engineered controls (i.e., IROFS), administrative controls, and management of these controls, accidents at a HALEU fuel fabrication facility would pose an acceptably low risk to workers, the environment, and the public.

The consequences shown above are representative of the accident consequences at a HALEU fuel fabrication facility. The most significant radiological accident consequences of the accident scenarios analyzed are those associated with a spill, a fire, or an inadvertent nuclear criticality. Facility design would reduce the likelihood of a fire or spill and the use of safe-by-design components would prevent an inadvertent nuclear criticality. The radiological accidents would have low consequences and risk to the public and therefore, SMALL impacts. Chemical accidents could have SMALL impacts on the public if they were to occur although the chance of occurrence is low.

7.3.13 Traffic

This section discusses potential traffic impacts on nearby roadways resulting from vehicles during construction, operation, and decommissioning of a new HALEU fuel fabrication facility. The project would generate new vehicle trips during each phase of the project from trucks (transporting equipment, materials, supplies, and wastes) and personal vehicles of commuting workers. A vehicle trip is defined as a one-way trip movement; a round trip is defined as two vehicle trips. For purposes of the Technical Report, the focus of traffic impacts from a new HALEU fuel fabrication facility is limited to the principal roadways leading up to the site.

Because the HALEU fuel fabrication facility would be similar to the TRISO-X FFF, the number of workers and truck transportation estimates presented in the TRISO-X FFF ER (TRISO-X, 2022) were used to estimate new vehicle trips generated from construction, operation, and decommissioning phases of new fuel fabrication facilities as follows:

- As stated in Section 4.2.2.4 of the ER, the maximum number of construction workers on-site at any given time could be 134, which means approximately 134 daily vehicle round trips (or 268 daily vehicle trips) could be generated from personal vehicles.

- As presented in Table 4.2.2-1 of the ER, approximately 667 truck round trips (or 1,334 vehicle trips) could be required during construction. As discussed in Section 2.1.2.1.2 of the ER, 655 of the 667 truck round trips would result from the transport of excavated material and would be limited to the first 6 months of construction, after which only 12 truck round trips (or 24 daily vehicle trips) would be required for the remaining construction phase.
- As stated in Section 4.2.2.5 of the ER, the maximum traffic generated from personal vehicles due to commuting personnel and visitors during operation activities was estimated at 820 daily round trips (or 1,640 daily vehicle trips). The volume of truck traffic resulting from nonradiological and radiological transportation during operation was estimated to be approximately one daily truck round trip (or 2 vehicle trips per day).
- Therefore, as presented in Table 4.2.2-2 of the ER, a total of 821 round trips per day (or 1,642 vehicle trips per day) could be generated during operation.
- As discussed in Section 4.2.2.6 of the ER, it was estimated that up to 150 employees would be required during decommissioning. Additionally, it was estimated that 768 truck round trips per year (1,536 vehicle trips per year or approximately 7 daily vehicle trips, assuming 250 working days) could occur.

As discussed in Section 7.1.3, *Potential Facilities*, candidate sites for new HALEU fuel fabrication facilities are identified. As such, recent annual average daily traffic (AADT) data for public roadways near the candidate sites was reviewed. AADT is a measure of the average daily number of vehicles that pass through a given segment of roadway and is indicative of traffic conditions (i.e., higher AADT volumes lead to increases in traffic congestion and delays). To conservatively evaluate potential traffic impacts, project-related traffic estimates from the TRISO-X FFF were combined with baseline AADT data and compared against the operating capacities of public roadway segments closest to the candidate sites. Table 7-6 summarizes the baseline traffic volumes and new traffic volumes for the primary roadway segments serving each of the representative site locations. The table also includes design capacities for the roadway segments and estimates on the change in operating capacities during the construction and operation phases.

The “Daily Design Capacity” values presented in the table are based on estimates provided in the U.S. Department of Transportation’s “Simplified Highway Capacity Calculation Method for the Highway Performance Monitoring System” and represent the maximum daily traffic volumes that can be maintained and still be within an acceptable level of service (LOS). LOS is a qualitative measure of a roadway and designated with a letter, A to F, with A representing the best operating conditions and F the worst. Most engineering or planning efforts usually base design capacities at an LOS of C or D to ensure an acceptable operating service for users. For a more conservative analysis, the “Daily Design Capacity” values in Table 7-6 are based on an LOS of C. An LOS of C typically means that a roadway is operating under stable conditions and is at or near free flow (Transportation Research Board, 1994).

Table 7-6. Baseline and New Project Annual Average Daily Traffic at Representative Sites for a New HALEU Fuel Fabrication Facility

Roadway (Location of Segment)	*Number of Lanes*	*Daily Design Capacity [(a)] (vehicle trips per day)*	*Baseline AADT (vehicle trips per day)*	*New AADT [(b)] (vehicle trips per day)*	*Percent Increase in AADT*	*Percent of Design Capacity*
Framatome, Inc. (Richland, Washington) [(c)]						
Horn Rapids Road (west of Stevens Dr)	2	13,900	2,471	4,073 (con) 4,113 (ops)	65% (con) 67% (ops)	29% (con) 30% (ops)
Stevens Drive (south of Battelle Blvd)	6	44,600	13,910	15,512 (con) 15,552 (ops)	12% (con) 12% (ops)	35% (con) 35% (ops)
SR-240 (Jadwin Ave intersection, southwest alignment)	6	56,100	30,570	32,172(con) 32,212 (ops)	5% (con) 5% (ops)	57% (con) 57% (ops)
SR-240 (Jadwin Ave intersection, northwest alignment)	2	22,100	16,334	17,936 (con) 17,976 (ops)	10% (con) 10% (ops)	81% (con) 81% (ops)
Kingsgate Way (north of SR-240)	2	8,600	3,930	5,532 (con) 5,572 (ops)	41% (con) 42% (ops)	64% (con) 65% (ops)
GNF-A (Wilmington, North Carolina) [(d)]						
Castle Hayne Road (north of I-140)	4	33,400	12,000	13,602 (con) 13,642 (ops)	13% (con) 14% (ops)	41% (con) 41% (ops)
Castle Hayne Road (south of I-140)	4	33,400	14,000	15,602 (con) 15,642 (ops)	11% (con) 12% (ops)	47% (con) 47% (ops)
I-140 (west of Castle Hayne Road)	4	52,200	23,500	25,102 (con) 25142 (ops)	7% (con) 7% (ops)	48% (con) 48% (ops)
I-140 (east of Castle Hayne Road)	4	52,200	26,500	28,102 (con) 28,142 (ops)	6% (con) 6% (ops)	54% (con) 54% (ops)
Westinghouse Electric (Columbia, South Carolina) [(e)]						
SR-48 (north of project site)	2	13,900	7,500	9,102 (con) 9,142 (ops)	21% (con) 22% (ops)	65% (con) 66% (ops)
SR-48 (south of project site)	2	13,900	4,900	6,502 (con) 6,542 (ops)	33% (con) 34% (ops)	47% (con) 47% (ops)
Nuclear Fuel Services, Inc. (Erwin, Tennessee) [(f)]						
Carolina Avenue (north of Jones Rd)	2	9,300	2,310	3,912 (con) 3,952 (ops)	69% (con) 71% (ops)	75% (con) 76% (ops)
Jackson Love Highway (north of Washington St)	2	10,200	4,851	6,453 (con) 6,493 (ops)	33% (con) 34% (ops)	76% (con) 76% (ops)
Jackson Love Highway (west of Carolina Ave)	2	10,200	6,909	8,511 (con) 8,551 (ops)	23% (con) 24% (ops)	100% (con) 101% (ops)
BWX Technologies, Inc. (Lynchburg, Virginia) [(g)]						
SR-726 (near project site)	2	13,900	5,600	7,202 (con) 7,242 (ops)	29% (con) 29% (ops)	84% (con) 84% (ops)
US-460 (east of SR-726)	4	53,300	23,000	24,602 (con) 24,642 (ops)	7% (con) 7% (ops)	57% (con) 57% (ops)
US-460 (west of SR-726)	4	53,300	27,000	28,602 (con) 28,642 (ops)	6% (con) 6% (ops)	67% (con) 67% (ops)

Table 7-6. Baseline and New Project Annual Average Daily Traffic at Representative Sites for a New HALEU Fuel Fabrication Facility

Roadway (Location of Segment)	*Number of Lanes*	*Daily Design Capacity (a) (vehicle trips per day)*	*Baseline AADT (vehicle trips per day)*	*New AADT (b) (vehicle trips per day)*	*Percent Increase in AADT*	*Percent of Design Capacity*
X-energy / TRISO-X and Ultra Safe Nuclear Corporation (Oak Ridge, Tennessee) (h)						
SR-95 (near New Bedford Ln)	4	53,300	19,485	21,087 (con) 21,127 (ops)	8% (con) 8% (ops)	49% (con) 49% (ops)
SR-95 (near project site)	4	53,300	11,593	13,195 (con) 13,235 (ops)	14% (con) 14% (ops)	31% (con) 31% (ops)
SR-95 (Whipp Rd, near Bear Creek crossing)	2	13,900	6,234	7,836 (con) 7,876 (ops)	26% (con) 26% (ops)	91% (con) 92% (ops)
SR-58 (near project site)	4	53,300	12,560	14,162 (con) 14,202 (ops)	13% (con) 13% (ops)	33% (con) 33% (ops)

Key: AADT = annual average daily traffic; Ave = Avenue; Blvd = Boulevard; con = construction phase; Dr = Drive; GNF-A = Global Nuclear Fuel – Americas; HALEU = high-assay low-enriched uranium; I = Interstate; Ln = Lane; ops = operation phase; Rd = Road; SR = State Route; St = Street; US = U.S. Highway

Notes:

[a] These values are taken from the U.S. Department of Transportation's "Simplified Highway Capacity Calculation Method for the Highway Performance Monitoring System" (USDOT, 2017) and represent the maximum daily traffic volumes that can be maintained and still be within the level of service "C."

[b] For construction, New AADT = Baseline AADT + 1,602 vehicle trips per day. For operation, New AADT = Baseline AADT + 1,642 vehicle trips per day.

[c] Source of Baseline AADT for Richland, Washington: (City of Richland, 2023; WSDOT, 2023)

[d] Source of Baseline AADT for Wilmington, North Carolina: (NCDOT, 2023b)

[e] Source of Baseline AADT for Columbia, South Carolina: (SCDOT, 2023)

[f] Source of Baseline AADT for Erwin, Tennessee: (TDOT, 2023)

[g] Source of Baseline AADT for Lynchburg, Virginia: (VDOT, 2019)

[h] Source of Baseline AADT for Oak Ridge, Tennessee: (TDOT, 2023)

The "New AADT" estimates in Table 7-6 indicate that the daily traffic volumes for construction and operation would be similar. However, the construction estimates represent peak traffic values as it includes excavation transport that would occur during the first 6 months of construction. After this initial period, the total daily traffic volumes would be expected to substantially decrease (by about 1,300 vehicle trips per day) as truck transport of excavated materials would cease for the remaining construction phase.

Project-related traffic volumes could result in increased roadway congestion, delays, and safety hazards, especially during peak morning and evening commuting hours, during all phases of the project. An increase in roadway maintenance could also be required as increases in traffic volumes would deteriorate road surface conditions at a faster rate.

Table 7-6 shows that some of the roadways would experience relatively high increases in daily traffic volumes. However, most of the new total AADT volumes would be expected to be within "Daily Design Capacity" volumes of these roadways. Vehicles on roadway segments that are near or at the "Daily Design Capacity" (i.e., State Route [SR]-240 in Richland, Washington; Jackson Love Highway in Erwin, Tennessee; SR-726 in Lynchburg, Virginia; and SR-95 in Oak Ridge, Tennessee) would likely detect noticeable increases in congestion and delays, especially during the peak commute hours.

Because the total daily traffic volumes would be near or within the "Daily Design Capacity" volumes and considering that the traffic volume estimates are conservative as the candidate sites would require modifications and not a full build-out of a new facility, the level of traffic impacts at all of the representative sites would be expected to range from SMALL to MODERATE during construction and operation of new HALEU fuel fabrication facilities, as long as baseline AADT volumes do not substantially increase over the project timeframe. During decommissioning, the maximum labor force at any given time is expected to be at or below the labor force required for construction; truck traffic during decommissioning would also be comparable to estimates made for the construction phase (excluding the transport of excavation material). Therefore, the level of traffic impacts during decommissioning of a HALEU fuel fabrication facility would be within the level of impacts that would occur during construction and would also range from SMALL to MODERATE, as long as baseline traffic conditions remain similar to the decommissioning timeframe (e.g., no substantial increases in AADT volumes over the years).

Siting for a new HALEU fuel fabrication facility at an undeveloped site would likely result in SMALL to MODERATE traffic impacts as the siting criteria would include the consideration of baseline traffic conditions and ensuring adequate public roadway capacities. The siting process would have to take into greater consideration additional activities that provide a more accurate representation of existing and future traffic conditions. Such activities include, but are not limited to, expanding the ROI to include additional roadways that encompass truck and commuter routes important to the project; reviewing the weight and size restrictions along potential truck routes; obtaining the latest AADT data and conducting a detailed traffic analysis, especially for any road or intersection directly serving the project site; and reviewing local and regional land development and transportation projects that could directly impact relevant roadways. Additionally, any project-related traffic study and findings should be coordinated with local, county, and state transportation departments.

Impact Summary

Traffic generated from construction, operation, and decommissioning of a HALEU fuel fabrication facility would result in increases in roadway congestion, delays, and safety hazards; however, new AADT volumes would be within the "Daily Design Capacity" volumes of these roadways. As such, level of traffic impacts at all of the representative sites and at an undeveloped site would range from SMALL to MODERATE during construction, operation, and decommissioning of a HALEU fuel fabrication facility.

7.3.14 Socioeconomics

Major industrial projects have the potential to affect the socioeconomic dynamics of the communities in or around which they are situated. Capital expenditures and the migration of workers and their families into a community may influence factors such as regional income; employment levels; local tax revenue; housing availability; and area community services, such as healthcare, schools, and public safety. The proposed action includes potential construction and operation of a new HALEU fuel fabrication facility at one or more locations. Five of the sites are industrial sites, which include existing fuel fabrication facilities that have been the subject of previous NEPA analyses. The socioeconomic analysis was limited given each site was for a license renewal that included continued operations with minimal or no change in the existing workforce. Therefore, no population influx (i.e., workers and their families) was expected and no adverse socioeconomic impacts were identified. A sixth proposed fuel fabrication site has been recently characterized in an ER submitted by the applicant seeking an NRC license; this report evaluates the impacts from construction and operation of a new facility and has been used to support the analysis of socioeconomic impacts from construction and operation of a new HALEU fuel fabrication facility. A seventh site may be in Oak Ridge, Tennessee, and would have impacts similar to those of the proposed TRISO-X facility.

A brief description of the five existing sites and one proposed site, including their respective ROIs, is provided. The ROIs were identified in previous NEPA documents and are adopted for this analysis to evaluate socioeconomic impacts. The ROI for each site is defined as a multi-county region encompassing the area where the majority of proposed workers for a new HALEU fuel fabrication facility would be expected to reside and spend most of their salary, and in which a significant portion of site purchase and non-payroll expenditures from the construction, operation, and decommissioning phases of the proposed action are expected to take place.

Framatome Facility, Richland, Washington

The two-county ROI comprises Benton (host) and Franklin Counties, Washington (NRC, 2009c). The existing Framatome facility is located inside the northern boundary of the City of Richland, in Benton County, Washington; it is bordered on the north by DOE's Hanford site. The general locale is known as the Tri-Cities Metropolitan Statistical Area. In addition to Richland, other cities include Kennewick, Pasco, and West Richland—all three are within 16 km (10 miles) of the facility. Host Benton County had a population of 212,791 in 2022 (USCB, 2023a). Major employers in Richland and the Tri-Cities Metropolitan Statistical Area included the Pacific Northwest National Laboratory and several large contractors working on related environmental cleanup activities (NRC, 2009c). Framatome, Inc. is one of the major manufacturers in the Tri-Cities area; it employs 575 workers at the Richland site and recently added an 11,000 ft^2 scrap uranium recovery facility in late 2019 (Wojtnik, 2019).

Global Nuclear Fuel – Americas (GNF-A) Facility, Wilmington, North Carolina

The three-county ROI comprises Brunswick, New Hanover (host), and Pender Counties, North Carolina. The GNF-A facility is an existing facility located in New Hanover County, North Carolina, approximately 6 miles north of the city of Wilmington, North Carolina, which is the largest population center near the facility. Wilmington had a population of 117,643 and (host) New Hanover County had a population of 234,921 in 2022 (USCB, 2023a). There are 2,100 commuting workers at the GNF-A facility (NRC, 2009b), with the potential to grow to 3,000 in the coming years (NRC, 2012b; General Electric, 2022). Fuel fabrication activities appear to support approximately 650 workers (NRC, 2009b). This ROI has been described previously in Section 3, *Uranium Enrichment* (Section 3.3.14.3, *GLE Site – Wilmington, North Carolina*), as Wilmington is also a potential location for a HALEU enrichment facility. Wilmington and New Hanover County are much more urban than Pender or Brunswick Counties and have experienced high population growth rates since 2000. A press release from October 2022 indicated that GNF-A and TerraPower had agreed to build the Natrium Fuel Facility at the existing GNF-A plant site. The new facility, which would further grow the GNF-A and GE Hitachi Nuclear Energy workforce by approximately 500 new employees, is jointly funded by TerraPower and DOE through the Advanced Reactor Demonstration Program (General Electric, 2022).

Westinghouse Electric Company Columbia Fuel Fabrication Facility (CFFF), Richland County, South Carolina

The five-county ROI is comprised of Kershaw, Lexington, Orangeburg, Richland (host), and Sumter Counties in South Carolina. The facility is located 8 miles southeast of the Columbia, South Carolina Metropolitan Area, which is the nearest population center. The Richland County and Columbia Metropolitan Area had a population of 421,566 in 2022 (USCB, 2023a). There are currently 1,138 employees at the CFFF site (NRC, 2022c, pp. 3-94, 3-99, 3-148).

Nuclear Fuel Services Facility in Erwin, Tennessee

The four-county ROI comprises Carter, Sullivan, Unicoi (host), and Washington Counties (DOE, 1996a; NRC, 2002a). The existing NFS Erwin Plant is located in Unicoi County, Tennessee, about 32 km (20 miles) southwest of Johnson City, Tennessee, and 80 km (50 miles) northeast of Asheville, North Carolina. The plant is located in a rural area about 0.8 km (0.5 miles) from the town of Erwin, Tennessee. The facility employed 653 workers in 2000, 612 of whom commuted from within the ROI (NRC, 2002a). A comparison of population levels in (host) Unicoi County in 2000 and 2022 shows essentially no change, with a population of 17,667 in 2000 and 17,674 in 2022 (NRC, 2002a; USCB, 2023a). In comparison, the ROI population grew approximately 2.8% between 2010 and 2020 (from 355,539 to 365,448), compared to a 9% growth rate in the state during that period; and 9.2% since 2000 (up from 334,655) (USCB, 2023a).

BWX Technologies, Inc. Fuel Fabrication Facility, Lynchburg, Virginia

The four-county ROI comprises Amherst, Appomattox, Bedford, and Campbell (host) Counties in Virginia (DOE, 1996b; NRC, 2005b). The site is located in the northeast corner of Campbell County and in close proximity to the other three counties. Lynchburg, Virginia, is located about 8 km (5 miles) west of the BWXT facility. Except for Lynchburg, the four-county area is predominantly rural. The population of Lynchburg was 79,009 in 2022, up from 75,568 in 2010. The population of Campbell County was 59,141 in 2022, a slight increase from its 2010 population of 54,842. The population for the ROI in 2020 was 182,584, which showed a growth rate of 16.2% since 2000 (USCB, 2023a). BWXT is a major employer in the region, with a workforce at the Lynchburg facility of about 2,400 in 2004 (NRC, 2005b), although this presumably includes more than the fuel fabrication workers. According to the 2005 BWXT EA, the employment levels have ranged from 1,839 workers at the time of license renewal in 1995 to 2,579 employees reported in 1991 (NRC, 2005b).

TRISO-X Fuel Fabrication Facility, Oak Ridge, Tennessee

The five-county ROI comprises Anderson, Knox, Loudon, Morgan, and Roane (host) Counties in Tennessee. According to the ER (TRISO-X, 2022), the proposed site is located in Roane County, Tennessee, within limits of the city of Oak Ridge, which spans portions of both Roane and Anderson Counties. Oak Ridge had a population of 31,402 in 2020 while Roane County had a population of 53,404 (up from 51,078 in 2000). The ROI also includes the more populated Knox County and the city of Knoxville, which are the most populated county and city, respectively, within the ROI, with Knox County having a population of 478,971 in 2020. The other four counties are more rural in nature. Together, the counties comprising the ROI accounted for approximately 10% of the population of the state of Tennessee in 2020. Knox and Loudon Counties, and the ROI as a whole, have continued to grow between 2010 and 2020; however, the populations of Roane and Morgan Counties declined by 1.4% and 4.3%, respectively, during that time.

Table 7-7 summarizes and compares historic and updated socioeconomic data for the ROIs for six of the sites with respect to population, employment and housing inventories. Historical data include those data considered in previous analyses (as pulled from past NEPA documents) and more recent data pulled from the U.S. Census Bureau (USCB, 2023a; USCB, 2023b; USCB, 2023c).

To tailor the affected environment discussion to a level commensurate with the potential for impact, the characterization of socioeconomic data in the Technical Report focuses primarily on population, employment, unemployment, and housing data, where the potential for adverse impact is greatest. With respect to impacts on community services, it is assumed that the potential impacts from an in-migrating population on existing population levels in the ROI would serve as a surrogate for analyzing potential impacts on each of the community services that support that population currently. As such, this analysis does not include a discussion of community services within the ROI where the potential increase in population would be very small (e.g., less than 1%). At such small levels, the level of community services currently available to the population would be sufficient to accommodate the small population influx resulting from the proposed action. Detailed characterizations of these services have been included in previous NEPA documents. These descriptions are considered sufficient for purposes of the Technical Report and incorporated by reference. Only where concerning trends were identified during the data update effort that could affect the potential for impact, such as where levels of services have declined in recent years, are new data introduced in the site-specific discussions.

Similarly, the potential increases in income levels and tax revenues (e.g., corporate tax, sales tax, state income tax), which would be considered a beneficial impact from the proposed action on the economy, would be commensurate with both the number of new jobs the project creates and the associated in-migrating population associated with those new jobs. In general, the pay for these jobs would be considerably higher than the median household income of many of the counties within the ROI.

As seen in Table 7-7, all of the ROIs show positive historical growth, although at varying levels, with respect to population, employment, and housing inventories when more recent 2020 data are factored in. Note that the data for the Westinghouse and TRISO-X locations in South Carolina and Tennessee, respectively, were not updated since the NEPA documents were published in 2022 and included data for 2019–2020.

Table 7-7. Socioeconomic Data for Fuel Fabrication Site Regions of Influence

Data	*Framatome, Inc. Richland, WA*	*GNF-A Wilmington, NC*	*Westinghouse Electric/CFFF Columbia, SC*	*Nuclear Fuel Services Erwin, TN*	*BWXT Lynchburg, VA*	*TRISO-X – Oak Ridge, TN*
Population						
2000	191,822	274,532	803,223	334,655	157,048	564,115
2010	253,340	362,315	925,823	355,539	170,844	632,079
2020	303,622	422,598 [453,722 in 2022]	996,415	365,448	182,584	685,419
Percent Population Growth	58% (2006–2020)	29.6% (2006–2020)	7.6% (2010–2020)	9.2% (2000–2020)	16% (2000–2020)	21.5% (2000–2020)
2020 Population / Host County	206,873 (Benton)	225,702 (New Hanover)	416,147 (Richland)	17,928 (Unicoi)	55,696 (Campbell)	53,404 (Roane)
Employment						
Labor Force (2021)	141,394	204,807	Not identified	169,880	110,000	331,692
Employed (2021)	134,047	193,678	512,470 in 2018 (only provided for Columbia Metropolitan Area/Richland County)	159,577	85,845	315,658
Unemployed (2021)	7,347	11,129	Not provided	10,303	3,495	15,463
Construction Workforce (2021)	12,053	18,168	25,673 in 2018 (just in Columbia Metropolitan Area)	8,366	6,783	1,7238

Table 7-7. Socioeconomic Data for Fuel Fabrication Site Regions of Influence

Data	***Framatome, Inc. Richland, WA***	***GNF-A Wilmington, NC***	***Westinghouse Electric/CFFF Columbia, SC***	***Nuclear Fuel Services Erwin, TN***	***BWXT Lynchburg, VA***	***TRISO-X – Oak Ridge, TN***
Housing						
Total Housing Units (2021)	112,291	239,519	413,036 (2018)	172,324 for ROI 2021	84,350	298,372
Occupied Units (2021)	102,011	178,317	Not provided	153,068	73,237	267,055
Owner Occupied 2021	70,087	123,821	240,178	106,306	57,512	67.2% owner occupied
Renter Occupied 2021	31,924	54,496 (total rental; rental occupancy not specified)	120,332	46,762	15,725	32.8% renter occupied
Vacant Units 2021	6,203	51,150	52,526	19,256	10,619	31,317 (total) 5,640 for rent and 3,257 for sale = 8,897 available

Sources: (NRC, 2002a; NRC, 2005b; NRC, 2009c; NRC, 2009b; TRISO-X, 2022; NRC, 2022c; USCB, 2023a); (USCB, 2023b; USCB, 2023c)
Framatome data: NRC (2009c) (AREVA NP EA NRC License)
GNF-A data: NRC (2009b) (GNF-A EA Renewal License)
Westinghouse CFFF data: NRC (2022c) (CFFF EIS)
NFS Erwin data: NRC (2002a) (2002 NFS License Renewal EA)
BWXT data: NRC (2005b) (BWXT EA SNM-42 License Renewal)
TRISO-X data: TRISO-X (2022) (FFF ER, submitted September 2022)
2021 data for all sites: USCB (2023b; 2023c), except 2010 and 2020 population data and 2021 total housing units, which are from USCB (2023a)
Starting year for population growth varies by site, based on most recent data year in original NEPA document; all compared to 2020
Key: BWXT = BWX Technologies, Inc.; CFFF = Westinghouse Columbia Fuel Fabrication Facility; GNF-A = Global Nuclear Fuel – Americas; NC = North Carolina; ROI = region of influence; SC = South Carolina; TN = Tennessee; VA = Virginia; WA = Washington

New HALEU Fuel Fabrication (Generic Site)

The Technical Report analysis considers projected workforce requirements for a potential new HALEU fuel fabrication facility and more recent socioeconomic data, where needed, to identify any significant updates or changes in overall growth trends (increase or decrease) that could affect the analysis and potential impacts from the proposed facility.[53] The evaluation of employment impacts typically includes estimating the level of direct and indirect employment created by the proposed action. Direct employment refers to jobs created by the proposed construction activities and facility operations. Indirect employment refers to jobs created in the ROI to support the needs of the workers directly employed by the proposed action and jobs created to support site purchase and non-payroll expenditures. The number of direct jobs

[53] Note that no site has been identified for the Ultra Safe Nuclear site in Seattle, Washington, and it will require a future site-specific analysis at the appropriate time and has not been included in this analysis.

created in each stage is estimated based on anticipated labor inputs for various engineering and construction activities. Indirect employment was typically estimated using an economic model known as an input-output model (RIMS-II). The relative magnitude of the impact on regional employment is assessed by comparing total project-generated employment to current regional employment levels.

Workforce Requirements/Assumptions

Only one of the potential sites included the construction and operation of a new facility, the TRISO-X site in Oak Ridge, Tennessee, and the construction and operations workforce projections developed for this facility in the TRISO-X ER (2022) are assumed to be applicable to this analysis and are incorporated by reference and summarized; the development of these estimates is described in detail in Section 4.10.2 of the ER.

Facility construction would require a construction labor force of approximately 166 employees overall, with the on-site number varying from month to month, reaching a peak on-site workforce of approximately 134. Construction would last for fewer than 2 years.

Facility operation would require a workforce of approximately 816 full-time employees when fully staffed; characteristics of the operational workforce are shown in Table 4.10.2-3 of the ER. Current workforce numbers at existing facilities vary, where identified in existing documentation and noted in the facility descriptions above, and are slightly smaller than 816 (where identified), even with higher production levels (in terms of MT/yr) than required for HALEU. Potential economies of scale, where existing workers could be transitioned over to support HALEU fuel fabrication activities, may help further reduce the workforce requirements at an existing facility, thus the actual workforce requirements for a new HALEU fuel fabrication facility may be smaller than 816. However, the estimate of 816 operations workers is used in this analysis as an upper bound for impacts. Another relevant comparison is that the TRISO-X facility would produce 16 MT/yr, which is less than that required for HALEU (50 MT/yr).

Finally, the ER calculates that construction of the facility would also lead to the creation of up to 1,748 indirect jobs per year (based on construction costs where 10.1 jobs would be added for every $1 million in construction costs) and 1,831 indirect jobs per year from operations. These estimates are also carried forward in the analysis of impacts.

Construction

The direct impacts on population from construction of the HALEU fuel fabrication facility is dependent upon how many of the approximately 166 workers are obtained from within the ROI. If all construction workers were obtained from within an ROI, then there would be no change in the ROI total population; however, if any workers were introduced from outside the ROI, there would be potential impacts on regional demography in conjunction with the in-migration of the supporting workforce and their families. There may be a need for certain specialty workers (e.g., ironworkers, millwrights, cement masons, and finishers) to be obtained from outside the ROI, especially for sites located in the more rural areas. However, all of the sites, even the TRISO-X site given its proximity to the DOE nuclear complex in Oak Ridge, include existing industrial facilities that have been in operation for decades and may have specialty workers—or access to these workers—to fill most of the needed positions. The TRISO-X ER assumed that approximately 12 of the 166 full-time employees would originate from outside the ROI (Section 4.10.2.1.1 of the TRISO-X ER) and that the impacts of this small influx of workers would not result in noticeable impacts on population, employment, housing, or community services, and socioeconomic impacts are considered SMALL. Similar results would be expected for a new HALEU fuel fabrication facility at the other sites, although again, the extent of impacts (e.g., such as on community services in the case of construction workers) would depend on the number of workers that may have to relocate to the ROI. Given the relatively short construction period, it is likely that any construction workers who would relocate to the ROI would come on a temporary basis, occupying rental units or temporary housing, such as extended-stay hotels, and would not bring their families. They would be expected to be few in number and would not be expected to result in a notable increased demand for housing, educational services, healthcare services, or public safety resources.

With respect to the 1,748 estimated indirect jobs created by the additional demand on goods and services resulting from construction employment, most indirect jobs are assumed to be service related, and that those jobs would be filled by the existing workforce within the ROI. Overall, construction-related annual employment (direct construction jobs and indirect jobs) is estimated to represent between approximately 0.3% and 2% of the total labor force within the six ROIs, based on 2021 data. Finally, various tax revenues on construction of a new HALEU fuel fabrication facility and earnings spent would be expected to result in a relatively minor increase in income and revenue, which would be considered a beneficial impact on the local and regional economy.

Operation

<u>Determination of In-Migrating Workforce</u>

The TRISO-X ER relied on Bureau of Labor Statistics occupational employment statistics to estimate the number of employees who would need to be obtained from outside the ROI. Based on a series of comparisons between the estimated labor force within the ROI and the number of employees needed for each occupational category, 507 employees would be needed from outside the ROI to support the operational workforce. This number was further adjusted down to account for the fact that current commuting patterns for Roane County show that 13.5% of the existing workforce in the county commute from outside the ROI. Applying this percentage to the TRISO-X workforce, an additional 68 workers (13.5% of 507) were taken off, leaving 439 workers (54%) that were assumed to in-migrate to the ROI to support the operations workforce. Based on an average household size in Tennessee of 2.52 persons per household, 439 workers relocating to the ROI would result in an influx of 1,105 people (workers and their families), including approximately 210 school-age children.

Based on current commuting patterns of Roane County workers, the ER determined that the estimated population increases would have the greatest impact on Roane County, where the new residents would increase the county's population by approximately 1.8% (based on 2025 projections). The other four counties in the ROI, and the ROI as a whole, would experience population increases of less than 0.2%. Such a small increase would not be expected to notably affect the population characteristics of the ROI and impacts of operation on regional population would be SMALL.

Regarding the 1,831 indirect jobs, they are assumed to be service related, as described for construction workers above; the combined direct and indirect employment of 2,647 jobs (1,831 + 816) would represent approximately 0.8% of the total labor force within the ROI in 2019. In addition, based on an analysis of the tax revenue that would be generated from project operations, the increased revenues would result in a minor (approximately 0.8%) increase in regional employment and in tax revenues and income (note that Tennessee does not have a state income tax). Revenue payments throughout the operational life of the TRISO -X facility to the city of Oak Ridge and Roane County would be SMALL to MODERATE and beneficial. Within the rest of the ROI, economic impacts also would be SMALL to MODERATE and beneficial on the regional economy, based on annual earnings that would be generated by the facility.

The impacts associated with operation of the TRISO-X FFF on housing and community resources and services are dependent on the number of operational workers and family members that relocate to the ROI. Depending on the size of the influx, the increased population could potentially affect housing, educational services, healthcare services, and public safety resources. In the case of the TRISO-X facility operational impacts, and assuming 430 workers would relocate to the ROI from other areas and each worker represents a single household, a demand for an additional 439 housing units would represent 4.9% of the 8,897 housing units for sale or rent within the ROI in 2019. Impacts on available housing within each county would depend on both the number of available units and the number of workers who reside in each county. Based on current commuting patterns, Roane County would experience the greatest demand for housing and Knox County would experience the lowest demand. Given that the demand for housing to accommodate the TRISO-X FFF fuel fabrication facility operational workforce represents a small fraction of the available housing stock in the ROI as a whole, the operation of the facility does not adversely impact the availability of housing in the ROI; therefore, the impacts are SMALL. An increase in 209 school-age children would represent an approximately 0.2% increase in total enrollment within the ROI (based on enrollment for 2018–2019 school year) and impacts on educational services would be SMALL. Similarly, the small increase in overall population from an in-migrating workforce (0.2%) would not be expected to adversely affect the provision of public safety services in the ROI. Impacts on public safety and emergency services would be considered SMALL.

The potential operational impacts described for the TRISO-X facility would be applicable to the other sites as well. In general, given the industrial nature of the existing sites and long-term operation of the existing facilities, each ROI is assumed to have an available labor force to fill the majority of new jobs created directly and additional jobs created indirectly by a new HALEU fuel fabrication facility. Potential socioeconomic impacts would be expected to be SMALL to MODERATE, with the level of impact dependent on the size of the in-migrating workforce, and where they choose to reside. For example, the impacts on a host county, especially if it is rural in nature with a low population, may be MODERATE, if a large percentage of the incoming workforce want to live close to work. But in general, the lower the number of project-related in-migration, the fewer additional demands there would be for employment, housing units, and community services in the ROI. Conversely, a higher in-migrating workforce would result in greater impacts in these areas. Similarly, economic impacts would be SMALL to MODERATE depending on the size of the incoming population, although they would all be considered beneficial.

A comparison of the population, employment, and housing levels in Table 7-7 shows a population influx of 1,105 persons into each ROI would represent less than 1% in the ROI for each site (ranging from 0.1% and 0.6% across all sites) with respect to population, and represent between 0.52% to 2.4% across the sites (2.4% in BWXT Lynchburg) for employment. The highest percentage both occurred at the BWXT site in Lynchburg, Virginia; these results further support a range of impacts of SMALL to MODERATE. A general ranking of these sites in terms of the select socioeconomic data, from highest to lowest in terms of population, employment, and housing (where higher numbers would result in potentially less impact) reveals the same order for all three variables, as follows:

- Westinghouse CFFF in Columbia, South Carolina (highest numbers and less percentage increase)
- TRISO-X in Oak Ridge, Tennessee
- GNF-A in Wilmington, North Carolina
- NFS in Erwin, Tennessee
- Framatome in Richland, Washington
- BWXT in Lynchburg, Virginia (lowest numbers and greater percentage increase)

Also of note is that the host counties for NFS in Erwin (Unicoi County, Tennessee), TRISO-X (Roane County, Tennessee), and BWXT (Campbell County, Virginia) are more rural and less populated, and have the potential for higher county-specific impacts on employment, housing, and community services.

Impact Summary

The TRISO-X ER assumed a small influx of construction employees would originate from outside the ROI and that the impacts of this small influx of workers would not result in noticeable impacts on population, employment, housing, or community services, such that socioeconomic impacts would be SMALL. Similar results would be expected for a new HALEU fuel fabrication facility at the existing fuel fabrication facilities. In addition, the relatively minor increase in income and revenue would be considered a SMALL and beneficial impact on the local and regional economy.

In general, given the industrial nature of the existing fuel fabrication facilities and long-term operation of the existing facilities, each ROI is assumed to have an available labor force to fill the majority of new jobs created directly and additional jobs created indirectly by a new HALEU fuel fabrication facility. Potential socioeconomic impacts from project operations would be expected to be SMALL to MODERATE, with the level of impact dependent on the size of the in-migrating workforce, and where they choose to reside. In the event a larger workforce in-migrated to one area or local community with a small population, potential local impacts could be greater (MODERATE). Similarly, economic impacts would be SMALL to MODERATE depending on the size of the incoming population, although they would all be considered beneficial.

7.3.15 Environmental Justice

The location of a new fuel fabrication facility is not known but could involve modification of an existing facility or construction of a new facility. For the purposes of this analysis, the Leidos Team provided information on Justice40, as described hereafter, and general information on minority and low-income populations by state and county for representative locations where a fuel fabrication facility could be constructed and operated. Once a location has been selected, the applicant would need to provide a site-specific analysis on any disproportionate and adverse impacts on minority or low-income populations.

On January 27, 2021, President Biden issued Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*, which established the Justice40 Initiative. This initiative mandates 40% of the benefits of Federal climate and clean energy investments to be provided to disadvantaged communities. As a part of this initiative, DOE has conducted an analysis to identify disadvantaged communities in the United States, which DOE defines as underserved, overburdened front-line communities (DOE, 2022a). DOE's analysis considers a disadvantaged community to be a census tract that ranks in or above the 80th percentile of the cumulative sum of 36 burden indicators for a state and has at least 30% of the households identified as low-income populations (DOE, 2022a). The cumulative burden includes fossil fuel dependence, energy burden, environmental and climate hazards, and socioeconomic vulnerabilities. Project priorities for DOE include a decrease in energy burden and environmental exposures; an increase in clean energy jobs, job training, and contracting opportunities; and access to clean energy and resilience.

As part of the environmental justice analysis, DOE's analysis and rankings are presented in Table 7-8. Data are provided for cities as a representative location and may not be the location for any future fuel fabrication facility locations. These cities were chosen as representative cities because existing or proposed fuel cell cycle facilities occur in these locations. As shown, Wilmington, North Carolina; Columbia, South Carolina; and Oak Ridge, Tennessee, are considered disadvantaged by DOE's analysis.

This section provides general information on minority and low-income populations by state and county. Representative locations for construction and operation of a new fuel fabrication facility are shown in Table 7-9. As shown in the table, using the 50% analysis, Columbia, South Carolina, and Rockville, Maryland, have a higher than 50% minority population. Upon applying the DOE threshold of 20% for minority population, none of the other cities show meaningfully greater percentage of minority population compared to the state. Low-income populations are present and show meaningfully greater populations compared to the state for Wilmington, North Carolina; Columbia, South Carolina; Erwin, Tennessee; and Lynchburg, Virginia.

Table 7-8. The Leidos Team Environmental Justice Dashboard for Cities Representative of a New Fuel Fabrication Facility Location

City, State	*National Ranking*	*State Ranking*	*DAC Score*
Richland, WA	28%	24%	15
Wilmington, NC	89%	**97%**	21
Columbia, SC	88%	**93%**	21
Erwin, TN	39%	35%	16
Lynchburg, VA	25%	44%	14
Rockville, MD	49%	58%	16
Oak Ridge, TN	89%	**93%**	21
Seattle, WA	53%	59%	17

Key: % = percent; DAC = disadvantaged community; MD = Maryland; NC = North Carolina; SC = South Carolina; TN = Tennessee; VA = Virginia; WA = Washington

Bold indicates a census tract that ranks in or above the 80th percentile of the cumulative sum of 36 burden indicators for a state.

Table 7-9. Minority and Low-Income Demographics for Representative Fuel Fabrication Facility Locations

Area Name	*Total Population*	*Minority*	*% Minority*	*Population for Whom Poverty is Calculated*	*Low-Income Population*	*% Low Income*
United States	333,036,755	136,997,971	41.1%	325,180,754	42,062,633	12.9%
Washington	7,617,364	2,553,514	33.5%	7,478,757	746,904	10.0%
Richland	59,718	14,271	23.9%	59,138	4,798	8.1%
Seattle	726,054	274,685	37.8%	706,425	70,824	10.0%
North Carolina	10,367,022	3,933,101	37.9%	10,092,759	1,379,672	13.7%
Wilmington	115,976	33,747	29.1%	111,240	20,861	18.8%
South Carolina	5,078,903	1,872,123	36.9%	4,946,116	718,345	14.5%
Columbia	137,276	71,417	52.0%	110,704	26,890	24.3%
Tennessee	6,859,497	1,856,642	27.1%	6,692,912	955,929	14.3%
Erwin	6,052	743	12.3%	5,828	1,076	18.5%
Oak Ridge	31,087	6,372	20.5%	30,520	4,453	14.6%
Virginia	8,582,479	3,381,720	39.4%	8,337,068	828,664	9.9%
Lynchburg	78,973	30,113	38.1%	68,869	12,123	17.6%
Maryland	6,148,545	3,112,738	50.6%	6,006,777	550,074	9.2%
Rockville	67,095	35,088	52.3%	66,399	4,638	7.0%

Key: % = percent

Notes: Green shading = greater than 50% minority; yellow shading = meaningfully greater percentage of low-income population compared to the state.

Since the location of a new HALEU fuel fabrication facility is not known, a preliminary analysis on the types of impacts that might be anticipated to occur to environmental justice populations in the vicinity of a new fuel fabrication facility are described hereafter. Impacts are described for construction and operations. Environmental consequences that are dependent on a specific location and site-specific designs are only mentioned in general terms. For facilities that have environmental justice populations within 6.4 km (4 miles), detailed site-specific analyses would be required in NEPA documents prepared by the NRC once an application and facility design have been developed.

Construction

Minority and low-income populations could be directly or indirectly affected by the construction of a HALEU fuel fabrication facility. For example, construction of a HALEU fuel fabrication facility in an urban area with minority or low-income populations proximate to the construction site could increase exposure to dust and other particulates related to land disturbance and construction. Increased demand for rental housing during construction could disproportionately affect low-income populations. However, demand for rental housing could be mitigated if the plant is constructed near a metropolitan area. Construction would also create employment opportunities for minority and low-income individuals. However, construction could disproportionately affect minority and low-income populations residing in the vicinity of the site by air emissions and noise from construction and increased truck traffic. Air emissions, noise, worker traffic, and equipment operation during construction would only occur for the duration of construction.

Existing NEPA documentation from sites where a new HALEU fuel fabrication facility could be located describe impacts from similar construction projects. The NEPA documents selected and described hereafter are representative of the types of impacts that could occur.

The CFFF EIS, for the CFFF site in South Carolina, discusses the magnitude of impacts on environmental justice communities affected by the facility (NRC, 2022c). The NRC evaluated whether there are minority or low-income populations in proximity to the project in a meaningfully greater proportion (typically by at least 20 percentage points) to those populations in the wider comparison area (e.g., the state). In this case, the site is located in and surrounded by census block groups that have minority populations. Therefore, the NRC staff evaluated the identified health and environmental impacts to determine if pathways could be established linking project impacts with the locally affected populations. All the health and environmental impacts identified for construction were identified as SMALL. Thus, the NRC concluded that no disproportionately high and adverse health or environmental effects could be identified from the proposed action.

The GLE EIS, for the proposed GLE facility in Wilmington, North Carolina (NRC, 2012b), noted that preconstruction activities would result in environmental and socioeconomic (e.g., noise, dust, traffic, employment, and housing impacts) impacts on minority and low-income populations. Noise and dust impacts would be short term and limited to on-site activities. However, due to the short duration of preconstruction activities and the availability of rental housing, impacts on minority and low-income populations would be short term and limited. The majority of environmental impacts associated with the construction of the proposed GLE facility would be SMALL to MODERATE.

The ER for the TRISO-X FFF in Oak Ridge, Tennessee, stated that impacts would occur in the immediate vicinity of the fuel fabrication facility and the area lacks residential population (TRISO-X, 2022). Therefore, construction of the facility would not result in disproportionately high and adverse impacts on minority and low-income populations. During construction, there may be increased truck and vehicle traffic associated with delivery of construction materials and labor, air emissions from this traffic, water resource impacts from ground disturbance, increased noise due to operation of construction machinery, and visual impacts with the presence on construction equipment. A minority population (Census Tract 201 Block Group 2) was identified, but the population was located greater than 6.4 km (4 miles) from the center of the facility so potential impacts on this community were identified as negligible and SMALL. Any potential noise impacts off-site would be limited to people engaging in recreation and visitors to the Horizon Center Industrial Park. The NRC concluded that construction of the facility would not result in disproportionately high and adverse impacts on low-income or minority residents. Thus, impacts of construction of the facility on environmental justice populations would be SMALL.

Operation

Minority and low-income populations could be directly or indirectly affected by the operation of a new HALEU fuel fabrication facility. Existing NEPA documentation from sites where a potential HALEU fuel fabrication facility could be located analyzed more extensive operations compared to the proposed operations of a HALEU fuel fabrication facility. Impacts would be anticipated to be less than the facility operations described in these NEPA documents. However, detailed site-specific analyses would still need to be conducted by the NRC to determine impacts on environmental justice communities in the vicinity of a new HALEU fuel fabrication facility.

The GLE EIS (NRC, 2012b) noted that even where environmental impacts would be SMALL for the general population, some population subgroups, such as individuals participating in outdoor recreation, home gardening, or subsistence hunting and fishing, could be disproportionately affected through the inhalation or ingestion of radionuclides. One census block group, which has a high percentage of low-income and minority residents, is located downstream of the proposed GLE facility on the Northeast Cape Fear River. Residents of this census block group could have a risk of exposure due to fish consumption; however, releases of total uranium and UF_6 were projected to be extremely low and exposure through fish consumption would be even lower. The GLE EIS concluded that any impacts on the minority and low-income populations from the operation of the proposed GLE facility would not be disproportionately high and adverse. The radiological doses at the nearest residents from operation of the proposed GLE facility and current GE operations are projected to be well below the EPA 10 mrem (0.1 millisievert) per year standard (20 CFR 190) and the NRC total effective dose equivalent limit of 100 mrem per year (1 millisievert) (10 CFR 20).

According to the ER for the TRISO-X FFF in Oak Ridge, Tennessee (TRISO-X, 2022), operation of the facility would result in increased truck and vehicle traffic associated with transportation of materials, products, and employees; associated air emissions from the increased traffic; water resources impacts; increased noise; trace radiological releases; and production of radioactive and nonradioactive wastes. The EA concluded that impacts from operation of the facility would mainly affect areas in the immediate vicinity of the TRISO-X FFF, which has no residential populations. Additionally, the closest residents do not have a significant minority or low-income population based on NRC thresholds. Therefore, the operation of the TRISO-X FFF would not be expected to result in disproportionately high or adverse impacts on low-income or minority residents. However, even where environmental impacts would be generally SMALL, the behaviors of some subpopulations may lead to disproportionate exposure through inhalation or ingestion.

Operation of a HALEU fuel fabrication facility at a location such as the GLE facility, TRISO-X facility, or a similar facility would not be anticipated to have impacts on minority or low-income populations that are disproportionate and adverse. However, a site-specific analysis would need to be conducted to make a final determination of impacts.

7.4 Summary of Impacts from a HALEU Fuel Fabrication Facility

Section 7.3.1, *Land Use*, through Section 7.3.15, *Environmental Justice*, provide resource area impacts based on NEPA documentation for fuel fabrication facilities identified in Section 7.1.3, *Potential Facilities*. Considering impacts identified in the NEPA documents, Table 7-10 provides a summary of anticipated impacts from construction and operation of a new HALEU fuel fabrication facility.

Table 7-10. Summary of Impacts for Fuel Fabrication Facilities

Resource Area	***Impact Indicator***	***Framatome FFF Richland, WA (NRC, 2009c)***	***GNF-A FFF Wilmington, NC (NRC, 2009b)***	***Westinghouse FFF Columbia, SC (NRC, 2022c)***	***BWXT FFF Lynchburg, VA (NRC, 2005b)***	***TRISO-X FFF Oak Ridge, TN (TRISO-X, 2022)***	***New HALEU FFF***
Land Use	Developed Area	53 acres (NRC, 2009c, p. 2)	302 acres (NRC, 2009b, p. 2)	68 acres (NRC, 2022c, pp. 2-1)	39 acres (NRC, 2005b, p. 6)	32 acres scaled from TRISO-X, 2022 (pp. 51, Figure 1.3-3)	SMALL – Construction of HALEU fuel fabrication facility at an existing industrial site would occur on previously disturbed areas and have the potential to impact 68 to 110 acres. Construction and operation would be compatible with land use plans and zoning.
	Site Size	320 acres (NRC, 2009c, p. 2)	1,164 acres (NRC, 2009b, p. 2)	1,151 acres (NRC, 2022c, pp. 2-1)	497 acres (NRC, 2005b, p. 5)	110 acres (TRISO-X, 2022, pp. 2-10)	
	Compatible with land use plans and zoning	Yes (NRC, 2009c, p. 33)	Yes (NRC, 2009b, p. 30)	Yes (NRC, 2022c, pp. 1-7)	Not addressed	Yes (TRISO-X, 2022, pp. 5-5)	
	Impact	SMALL (NRC, 2009c, pp. 33, 34)	SMALL (NRC, 2009b, p. 30)	SMALL (NRC, 2022c, pp. 3-1 to 3-4)	Not addressed	SMALL (TRISO-X, 2022, pp. 4-11 to 4-13)	
Visual and Scenic Resources	Tallest Substantial Structure	Not addressed	Structures are prominent (NRC, 2009b, p. 40)	No distinct visual or scenic resources (NRC, 2022c, pp. 3-92)	Not addressed	Process building vent stack – 100 feet Meteorological Tower – 200 feet (TRISO-X, 2022, pp. 4-74)	SMALL to MODERATE – The visual character at an existing industrial site is unlikely to change with addition of structures needed for HALEU fuel fabrication facility. Temporary visual intrusions may result from use of tall cranes and large construction equipment, but these impacts would be temporary and localized. New structures would be similar in character to
	Distance to Nearest Full-Time Residence	1.5 miles (NRC, 2009c, p. 42)	0.4 miles (NRC, 2009b, p. 38)	3,300 feet (NRC, 2022c, pp. 3-72)	0.5 miles east-northeast (NRC, 2005b, p. 6)	3,800 feet (TRISO-X, 2022, pp. 4-103)	
	BLM VRM Rating	No VRM but structures are shielded from view or blended into the existing landscape (NRC, 2009c, p. 31)	No VRM but facilities highly visible (NRC, 2009b, p. 27)	No VRM but no change in visual resources (NRC, 2022c, pp. 3-160)	Not addressed	Class IV (TRISO-X, 2022, pp. 4-76)	

Table 7-10. Summary of Impacts for Fuel Fabrication Facilities

Resource Area	*Impact Indicator*	*Framatome FFF Richland, WA (NRC, 2009c)*	*GNF-A FFF Wilmington, NC (NRC, 2009b)*	*Westinghouse FFF Columbia, SC (NRC, 2022c)*	*BWXT FFF Lynchburg, VA (NRC, 2005b)*	*TRISO-X FFF Oak Ridge, TN (TRISO-X, 2022)*	*New HALEU FFF*
	Impact	SMALL (NRC, 2009c, p. 43)	SMALL to MODERATE (NRC, 2009b, p. 40)	SMALL (NRC, 2022c, pp. 3-92 to 3-93)	Not addressed	SMALL (TRISO-X, 2022, pp. 4-73 to 4-77)	existing structures. Overall impacts would be SMALL, with the potential for MODERATE impacts depending on site-specific characteristics.
Geology and Soils	Disturbed Area	53 acres (NRC, 2009c, p. 2)	302 acres (NRC, 2009b, p. 2)	68 acres (NRC, 2022c, pp. 2-1)	39 acres (NRC, 2005b, p. 6)	208 acres scaled from TRISO-X, 2022 (pp. 51, Figure 1.3-3)	SMALL to MODERATE – Potential impacts include disturbance of up to approximately 100 acres of previously disturbed soils, soil erosion due to ground disturbance, and the potential for spills due to construction and operations. Implementation of BMPs for erosion control and spill prevention would limit impacts.
	Rock and Soil Excavated	Not applicable	Not applicable	Not applicable	Not applicable	560,234 cubic yds (TRISO-X, 2022, pp. 4-23 to 4-28)	
	Backfill Needed	Not applicable	Not applicable	Not applicable	Not applicable	362,661 cubic yds (TRISO-X, 2022, pp. 4-23 to 4-28)	
	Impact	SMALL (NRC, 2009c, pp. 39, 40)	SMALL to MODERATE (NRC, 2009b, pp. 36, 37)	SMALL (NRC, 2022c, pp. 3-4 to 3-16)	Minimal impacts	SMALL (TRISO-X, 2022, pp. 4-23 to 4-28)	
Water Resources	Effluent Discharge	Wastewater is discharged to the city of Richland sewers (NRC, 2009c, p. 3). Maximum wastewater	Treated liquid effluents are discharged to on-site streams (NRC, 2009b, p. 3). Between 1995-2000 process and sanitary effluents ranged between	Process liquid wastes and sanitary waste sewage effluents average 100,000 gal/day (NRC, 2022c, pp. 2-16). Stormwater runoff is managed by an	Treated effluent discharged into James River in accordance with a Virginia Pollutant Discharge Elimination System permit	(TRISO-X, 2022, pp. 3-276, 4-109) Effluent releases would occur primarily in the event of an inadvertent leak or spill. BMPs would be designed to	SMALL to MODERATE – Water consumption, either from surface waters or groundwater is unlikely to impact water levels. Effluent discharges from construction and operation of a HALEU fuel fabrication facility

Table 7-10. Summary of Impacts for Fuel Fabrication Facilities

Resource Area	***Impact Indicator***	***Framatome FFF Richland, WA (NRC, 2009c)***	***GNF-A FFF Wilmington, NC (NRC, 2009b)***	***Westinghouse FFF Columbia, SC (NRC, 2022c)***	***BWXT FFF Lynchburg, VA (NRC, 2005b)***	***TRISO-X FFF Oak Ridge, TN (TRISO-X, 2022)***	***New HALEU FFF***
		discharges 400,000 gal/day (NRC, 2009c, p. 10) Stormwater runoff is handled with a dry well system, which is regulated by the state (NRC, 2009c, p. 39).	462,000 and 692,000 gal/day (NRC, 2009b, p. 8)	existing NPDES permit (NRC, 2022c, pp. 3-30).	(NRC, 2005b, p. 4).	minimize impacts from wastewater and stormwater effluents, and all stormwater discharges would be managed by a NPDES permit (TRISO-X, 2022, pp. 4-30 to 4-34).	are subject to permit limits but still have the potential to cause changes in water quality. Inadvertent releases of contaminants may additionally impact water quality.
	Water Use	Not addressed	Average annual groundwater withdrawal is approximately 0.6 million gal/day (NRC, 2009b, p. 22)	Water is supplied by the city of Columbia and is not taken from on-site surface waters or groundwater (NRC, 2022c, pp. 3-28). Average facility use is 0.12 million gal/day (NRC, 2022c, pp. 3-28). 4.4×10^7 gal/year (NRC, 2022c, pp. 3-20)	Water is supplied by the public water supply and is not taken from on-site surface waters or groundwater (NRC, 2005b, p. 9).	Water is supplied by the city of Oak Ridge and is not taken from on-site surface waters or groundwater (TRISO-X, 2022, pp. 4-29).	
	Floodplains	Not in floodplain (NRC, 2009c, p. 22)	Developed areas above floodplain (NRC, 2009b, p. 36)	Congaree floodplain (NRC, 2022c, pp. 3-24)	Since 1771, 11 major flood events (NRC, 2005b, p. 9)	Not in floodplain (TRISO-X, 2022, pp. 4-40)	

Table 7-10. Summary of Impacts for Fuel Fabrication Facilities

Resource Area	*Impact Indicator*	*Framatome FFF Richland, WA (NRC, 2009c)*	*GNF-A FFF Wilmington, NC (NRC, 2009b)*	*Westinghouse FFF Columbia, SC (NRC, 2022c)*	*BWXT FFF Lynchburg, VA (NRC, 2005b)*	*TRISO-X FFF Oak Ridge, TN (TRISO-X, 2022)*	*New HALEU FFF*
	Impact	SMALL (NRC, 2009c, pp. 38, 39)	SMALL to MODERATE (NRC, 2009b, pp. 34, 35)	SMALL to MODERATE (NRC, 2022c, pp. 3-16 to 3-55)	No change in impacts on water quality anticipated (NRC, 2005b, p. 17).	SMALL (TRISO-X, 2022, pp. 4-29 to 4-44)	
Air Quality	NAAQS Attainment Status	Attainment (NRC, 2009c, p. 20)	Attainment (NRC, 2009b, p. 20)	Attainment (NRC, 2022c, pp. 3-74)	Attainment (NRC, 2005b, p. 8)	Attainment (TRISO-X, 2022, pp. 4-53)	SMALL –Construction impacts would be managed using BMPs and would be temporary. Emissions from operations would be lower than regulatory levels. Emissions from diesel generators associated with HALEU fuel fabrication facility would be minor.
	Construction Emissions	Not applicable	Not applicable	Not applicable	Not applicable	Yes (TRISO-X, 2022, pp. 4-53 to 4-56)	
	Operations Emissions	Annual emissions average 3.6 T/yr of NOx, which is substantially below the established threshold of 100 T/yr. The facility also monitors fluoride emissions to ensure compliance with regulatory limits. (NRC, 2009c, p. 37)	Emissions from facility operations would not exceed any NAAQS. Facility emissions would be substantially below the limits for criteria pollutants and toxic air pollutants identified in the facility state operating permit. Year 2007 annual emissions were 0.2 T of SO_2, 7.0 T of NOx, 0.2 T of	Emissions from facility operations would not exceed any NAAQS. The facility would comply with emission limits for criteria pollutants, toxic air pollutants, nitric acid, and opacity identified in the facility state operating permit (NRC, 2022c, pp. 3-73 to 3-76).	Annual emissions for years 2000–2003 were no more than 25% of the limits identified in the facility Title V operating permit (NRC, 2005b, p. 8). Emission levels due to re-licensing would be similar.	The facility would comply with emission limits for criteria pollutants and HAPs identified in the facility state operating permit (TRISO-X, 2022, pp. 4-53 to 4-56)	

Table 7-10. Summary of Impacts for Fuel Fabrication Facilities

Resource Area	*Impact Indicator*	*Framatome FFF Richland, WA (NRC, 2009c)*	*GNF-A FFF Wilmington, NC (NRC, 2009b)*	*Westinghouse FFF Columbia, SC (NRC, 2022c)*	*BWXT FFF Lynchburg, VA (NRC, 2005b)*	*TRISO-X FFF Oak Ridge, TN (TRISO-X, 2022)*	*New HALEU FFF*
			HF, and 0.4 T of PM_{10} (NRC, 2009b, p. 33)				
	Emergency Generator Emissions	Not addressed	Yes (NRC, 2009b, p. 20)	Yes (NRC, 2022c, pp. 2-15 and 3-76)	Not addressed	Yes (TRISO-X, 2022, pp. 4-53 to 4-56)	
	Greenhouse Gas Emissions	Not addressed	Not addressed	7,224 T/yr CO_2e FFF (NRC, 2022c, pp. 3-76)	Not addressed	Not addressed	
	Impact	SMALL (NRC, 2009c, pp. 37, 38)	SMALL to MODERATE (MODERATE due to cumulative impacts with Sutton coal-fired power plant, which is now a lower-emitting natural gas-fired unit – current cumulative impact would be SMALL) (NRC, 2009b, pp. 33, 34).	SMALL (NRC, 2022c, pp. 3-68 to 3-77)	SMALL – Facility complies with emission limits	SMALL (TRISO-X, 2022, pp. 4-53 to 4-56)	
Ecological Resources	Native Vegetation Disturbed	SMALL (NRC, 2009c, pp. 33, 34)	No changes to vegetation (NRC, 2009b, p. 37).	No changes to vegetation (NRC, 2022c, pp. 3-58).	No changes to vegetation (NRC, 2005b, p. 17).	Yes (TRISO-X, 2022, pp. 4-45 to 4-52)	SMALL to MODERATE – Construction of a HALEU fuel fabrication facility at a new location has the potential to impact terrestrial and aquatic vegetation, wildlife, and
	Aquatic Habitat Disturbed	Not addressed	Pollution, contamination, and sediment levels monitored	Pollution, contamination, and sediment levels monitored	Pollution, contamination, and sediment levels monitored	SMALL (TRISO-X, 2022, pp. 4-45 to 4-52)	

Table 7-10. Summary of Impacts for Fuel Fabrication Facilities

Resource Area	*Impact Indicator*	*Framatome FFF Richland, WA (NRC, 2009c)*	*GNF-A FFF Wilmington, NC (NRC, 2009b)*	*Westinghouse FFF Columbia, SC (NRC, 2022c)*	*BWXT FFF Lynchburg, VA (NRC, 2005b)*	*TRISO-X FFF Oak Ridge, TN (TRISO-X, 2022)*	*New HALEU FFF*
			(NRC, 2009b, p. 24).	(NRC, 2022c, pp. 3-59). Herbicides affect aquatic habitat (NRC, 2022c, pp. 3-59).	(NRC, 2005b, pp. 5, 19, 20).		special status species. Follow-on NEPA will be required to determine the site-specific impacts. No additional land would be disturbed from operations and emissions would be below regulatory limits.
	Wildlife Habitat Disturbed	Not addressed	Increased noise could affect wildlife (NRC, 2009b, p. 38)	Wildlife is habituated (NRC, 2022c, pp. 3-58)	Impacts on native flora and fauna unlikely (NRC, 2005b, p. 17)	SMALL (TRISO-X, 2022, pp. 4-45 to 4-52)	
	Protected Species Present	No (NRC, 2009b, p. 3)	SMALL impacts on endangered fish (NRC, 2009b, p. 26).	Various species known to occur or with potential to occur at fuel fabrication facility (NRC, 2022c, pp. 3-61 to 3-68).	Various species with potential to occur (NRC, 2005b, pp. 11, 12).	No (TRISO-X, 2022, pp. 4-45 to 4-52)	
	Impact	SMALL (NRC, 2009c, pp. 40, 41)	SMALL to MODERATE (NRC, 2009b, p. 37)	SMALL to MODERATE (NRC, 2022c, pp. 3-56 to 3-68)	None (NRC, 2005b, p. 17)	SMALL (TRISO-X, 2022, pp. 4-45 to 4-52)	
Historic and Cultural Resources	NRHP Property Disturbed	No identification surveys conducted (NRC, 2009c)	None (NRC, 2009b, p. 39)	Evidence exists (NRC, 2022c, pp. 3-79)	None within the BWXT property; Multiple sites within 3 miles (NRC, 2005b, pp. 12, 13)	None within the TRISO-X property; two NRHP properties within 2 miles (TRISO-X, 2022, pp. 4-71 to 4-72)	SMALL to MODERATE – Construction of a HALEU FFF at an analyzed site would occur on previously surveyed and disturbed areas. Construction of a HALEU FFF at a new location could impact historic and cultural resources.
	Traditional Cultural Property (TCP) Present	None identified (NRC, 2009c, p. 42)	None identified (NRC, 2009b, p. 39)	None identified (NRC, 2022c, pp. 3-83 to 3-86)	None identified; Native Americans occupied area	None identified (TRISO-X, 2022, pp. 4-71 to 4-72)	

Table 7-10. Summary of Impacts for Fuel Fabrication Facilities

Resource Area	*Impact Indicator*	*Framatome FFF Richland, WA (NRC, 2009c)*	*GNF-A FFF Wilmington, NC (NRC, 2009b)*	*Westinghouse FFF Columbia, SC (NRC, 2022c)*	*BWXT FFF Lynchburg, VA (NRC, 2005b)*	*TRISO-X FFF Oak Ridge, TN (TRISO-X, 2022)*	*New HALEU FFF*
		Consulted (NRC, 2009c, p. 42)			(NRC, 2005b, p. 12)		No additional land would be disturbed for operations.
	Impact	SMALL (NRC, 2009c, pp. 42, 43)	SMALL to MODERATE (NRC, 2009b, p. 39)	SMALL to MODERATE (NRC, 2022c, pp. 3-78 to 3-92)	Not addressed	SMALL (TRISO-X, 2022, pp. 4-71 to 4-72)	
Infrastructure	Electrical Use	Not addressed	Not addressed	Not addressed	Not addressed	Not addressed	SMALL – Demands for electrical, water, and fuel would be a small increase. Some minor utilities construction for modification of existing facilities or a new HALEU FFF would be required.
	Water Use	Provided by city of Richland (NRC, 2009c, p. 3)	Growth accompanied by necessary infrastructure (NRC, 2009b, p. 13)	4.4×10^7 gal/yr from city of Columbia (NRC, 2022c, pp. 3-20, 3-28)	Water supplied by Campbell County Utilities (NRC, 2005b, p. 9)	From City System (TRISO-X, 2022, pp. 4-83 to 4-84)	
	Fuel Use	Not addressed	Not addressed	112 million cubic feet natural gas 1.09×10^6 gal diesel (NRC, 2022c, pp. 3-76)	Not addressed	28,931-gal diesel for construction (TRISO-X, 2022, pp. 2-18) Annual 6.5×10^7 SCF natural gas (TRISO-X, 2022, pp. 2-15)	
	Impact	Not addressed	Not addressed	SMALL	Not addressed	SMALL (TRISO-X, 2022, pp. 4-13)	
Noise	Distance to Nearest Residence	1.5 miles (NRC, 2009c, p. 42)	0.4 miles (NRC, 2009b, p. 38)	0.6 miles (NRC, 2022c, pp. 3-72)	0.5 miles east-northeast (NRC, 2005b, p. 6)	0.6 miles (TRISO-X, 2022, pp. 4-62 to 4-70)	SMALL – Construction would be in existing industrial areas and temporary. Duration of construction noise would be temporary and limited to daytime working hours. Noise from operation would
	Noise Above Ambient Levels	No (NRC, 2009c, p. 42) 40 to 55 dBA daytime noise levels during operations at	No (NRC, 2009b, p. 38) sound levels ranged from 38.0 to 64.5 decibels	Complies with OSHA, BMPs, and applicable regulatory requirements in	Off-site noise mitigated by distance (NRC, 2005b, p. 12)	No (TRISO-X, 2022, pp. 4-62 to 4-70) 50.7 to 59.3 dBA at the adjacent receptors during	

Table 7-10. Summary of Impacts for Fuel Fabrication Facilities

Resource Area	*Impact Indicator*	*Framatome FFF Richland, WA (NRC, 2009c)*	*GNF-A FFF Wilmington, NC (NRC, 2009b)*	*Westinghouse FFF Columbia, SC (NRC, 2022c)*	*BWXT FFF Lynchburg, VA (NRC, 2005b)*	*TRISO-X FFF Oak Ridge, TN (TRISO-X, 2022)*	*New HALEU FFF*
		Framatome fenceline (NRC, 2009c, p. 29)		feet (NRC, 2022c, pp. 3-78).		operations TRISO-X (TRISO-X, 2022, pp. 4-64) (TRISO-X, 2022, pp. 4-64)	occur mostly inside buildings. Noise attenuated by distance.
	Impact	SMALL (NRC, 2009c, pp. 41, 42)	SMALL (NRC, 2009b, pp. 38, 39)	SMALL (NRC, 2022c, pp. 3-77, 3-78)	Not addressed	SMALL (TRISO-X, 2022, pp. 4-62 to 4-70)	
Waste Management	SNF	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	SMALL – Relatively small quantities of construction and operations wastes. Waste quantities from construction and operation generally independent of site.
	LLW	Northwest Compact and Energy Solutions Disposal (NRC, 2009c, p. 44)	2,197 m^3 for 2007 (NRC, 2009b, p. 9)	Average 24,000 ft^3/yr (NRC, 2022c, pp. 3-112)	Average 825.2 m^3/yr (NRC, 2005b, p. 13)	26,182 ft^3/yr (TRISO-X, 2022, pp. 2-31)	
	MLLW	Not addressed.	Yes (NRC, 2009b, p. 43)	Limited amount of mixed waste, 5 to 10 drums/year (NRC, 2022c, pp. 3-112)	0.3 m^3/yr (NRC, 2005b, p. 14)	352 ft^3/yr (TRISO-X, 2022, pp. 2-31)	
	Hazardous Waste	Yes (NRC, 2009c, p. 44)	1,170 MT for 2007 (NRC, 2009b, p. 9)	204,000 lb/yr (NRC, 2022c, pp. 3-112)	Yes (NRC, 2005b, p. 14)	Yes (TRISO-X, 2022, pp. 2-17)	
	Nonhazardous Waste	Possible reuse (NRC, 2009c, p. 45)	1,960 MT for 2007 (NRC, 2009b, p. 9)	393,000 lb/yr (NRC, 2022c, pp. 3-112)	30.6 m^3/yr (NRC, 2005b, p. 14)	Yes (TRISO-X, 2022, pp. 4-128)	
	Impact	SMALL (NRC, 2009c, pp. 44, 45)	SMALL (NRC, 2009b, pp. 9, 42, 43)	SMALL (NRC, 2022c, pp. 3-110 to 3-115)	SMALL (NRC, 2005b, pp. 13, 14)	SMALL (TRISO-X, 2022, pp. 2-17, 2-31, 4-126 to 4-128)	
Public and Occupational Health – Normal Operations	Occupational Risk	Max Lost-Time Incident Rate of 1.75 for 2005	Max DART Rate of 0.75 in 2006 (NRC, 2009b, p. 29)	Environmental programs improved (NRC,	Average incident rate of 7.3 (NRC, 2005b, p. 15)	0.02/yr (TRISO-X, 2022, pp. 4-103 to 4-125)	SMALL – During construction, exposure could result from fugitive dust containing

Table 7-10. Summary of Impacts for Fuel Fabrication Facilities

Resource Area	***Impact Indicator***	***Framatome FFF Richland, WA (NRC, 2009c)***	***GNF-A FFF Wilmington, NC (NRC, 2009b)***	***Westinghouse FFF Columbia, SC (NRC, 2022c)***	***BWXT FFF Lynchburg, VA (NRC, 2005b)***	***TRISO-X FFF Oak Ridge, TN (TRISO-X, 2022)***	***New HALEU FFF***
		(NRC, 2009c, p. 33)		2022c, pp. 3-101, 3-102)			radiological materials, direct radiation, and airborne particulates. Annual worker doses to workers estimated to be less than 100 mrem/yr based on uranium fuel cycle facility data.
	Construction Radiological Impacts	Not applicable	Individual worker dose of 10.5 mrem/yr (NRC, 2012b)	Not applicable	Not applicable	Not addressed	
	Operations Worker Dose – Average & Total	Max TEDE 1.7 rem in 2006 (NRC, 2009c, p. 32) 2020 average worker dose of 65 mrem	Max TEDE of 560 mrem in 2005 (NRC, 2009b, p. 29) 2020 average worker dose of 85 mrem	TEDE ranged between 197 mrem and 327 mrem (NRC, 2022c, pp. 3-107) 2020 average worker dose of 226 mrem	Highest dose of 2,231 mrem/yr (NRC, 2005b, p. 16) 2020 average worker dose of 50 mrem	Yes (TRISO-X, 2022, pp. 4-103 to 4-125)	
	Operations Public Dose – MEI & Total	Dose to public of 0.03 to 0.4 mrem, dose to MEI of 1.64×10^{-4} to 1.2×10^{-2} mrem/yr (NRC, 2009c, p. 44)	Dose to public ranged from 0.03 to 0.4 mrem/yr (NRC, 2009b, p. 28)	Highest radiation dose to MEI of 0.2 mrem/yr (NRC, 2022c, pp. 3-106)	Highest individual dose of 6.5×10^{-1} mrem (NRC, 2005b, p. 9)	7.44E-02 person-rem/yr (TRISO-X, 2022, pp. 4-110)	
	Chemical Risk	Monitored (NRC, 2009c, p. 12)	Yes (NRC, 2009b, p. 42)	Program to minimize the effects of releases (NRC, 2022c, pp. 3-106)	Industrial hygiene program addresses hazards (NRC, 2005b, p. 15)	Program to address hazards (TRISO-X, 2022, pp. 4-103 to 4-125)	
	Impact	SMALL (NRC, 2009c, pp. 43, 44)	SMALL (NRC, 2009b, pp. 27 to 29, 40 to 42)	SMALL (NRC, 2022c, pp. 3-100 to 3-108)	Not addressed	SMALL (TRISO-X, 2022, pp. 4-103 to 4-125)	
Public and Occupational	Radiological Accidents	Not provided	Not addressed due to security	Criticality – On-site dose of 13 rem, dose at	Not addressed	Criticality – 1.25 rem (TRISO-X, 2022, pp. 4-114)	SMALL to MODERATE – Criticality could be fatal to involved worker. Use

Table 7-10. Summary of Impacts for Fuel Fabrication Facilities

Resource Area	***Impact Indicator***	***Framatome FFF Richland, WA (NRC, 2009c)***	***GNF-A FFF Wilmington, NC (NRC, 2009b)***	***Westinghouse FFF Columbia, SC (NRC, 2022c)***	***BWXT FFF Lynchburg, VA (NRC, 2005b)***	***TRISO-X FFF Oak Ridge, TN (TRISO-X, 2022)***	***New HALEU FFF***
Health – Facility Accidents			(NRC, 2009b, p. 41)	nearest site boundary less than 7 rem (NRC, 2022c, pp. 3-118) Spill - <25 rem Fire - <3 rem			of critically safe components makes fatality highly unlikely. Fires and spill could result in radiological exposure. Chemical exposures could exceed guideline. Chances of accident occurrence reduced by application of IROFS.
	Chemical Accidents	Not addressed	Not addressed	Chemical exposure SMALL (NRC, 2022c, pp. 3-116 to 3-118)	Not addressed	MTS spill – 304 ppm exceeds AEGL-2 limit of 7.3 ppm for the public (TRISO-X, 2022, pp. 4-115)	
	Impact	SMALL (Inferred) – hazardous materials confined (NRC, 2009c, p. 40)	SMALL (Inferred) – accident consequences within limits (NRC, 2009b, pp. 40, 42)	SMALL (NRC, 2022c, pp. xiv, 2-31, 3-118)	Not addressed	SMALL (Inferred) (TRISO-X, 2022, pp. 4-112 to 4-118)	
Traffic	Construction Daily Traffic Volumes from Additional Worker Vehicles and Truck Shipments	Not applicable	Not applicable	Not applicable	Not applicable	268 vehicle trips/day from workers; 1,334 truck trips/day (first 6 months) and 24 truck trips/day (after first 6 months) (TRISO-X, 2022, pp. 4-15)	SMALL to MODERATE – Construction and operations related traffic volumes could result in increased roadway congestion, delays, and safety hazards. However, most traffic volumes would be expected to be within design capacity of the local roadways due to siting criteria.

Table 7-10. Summary of Impacts for Fuel Fabrication Facilities

Resource Area	***Impact Indicator***	***Framatome FFF Richland, WA (NRC, 2009c)***	***GNF-A FFF Wilmington, NC (NRC, 2009b)***	***Westinghouse FFF Columbia, SC (NRC, 2022c)***	***BWXT FFF Lynchburg, VA (NRC, 2005b)***	***TRISO-X FFF Oak Ridge, TN (TRISO-X, 2022)***	***New HALEU FFF***
	Operations Daily Traffic Volumes from Additional Worker Vehicles and Truck Shipments	No substantial increase in traffic volumes (NRC, 2009c, p. 35) (NRC, 2009c, p. 35). (Existing: 1,400 vehicle trips/day from workers based on 700 operations workers.)	Increase in truck and commuting worker traffic volumes result in less than significant levels (NRC, 2009b, p. 30). (Existing: 4,200 vehicle trips/day from workers based on 2,100 operations workers.) Number of truck shipments not available (NRC, 2009b, p. 31).	No increase in workforce; no significant increase in truck shipments (NRC, 2022c, pp. 3-110). (Existing: 2,276 vehicle trips/day from workers based on 1,138 operations workers.) Number of truck shipments not available (NRC, 2022c, pp. 3-110).	No changes in workforce; no changes in truck shipments (NRC, 2005b, pp. 7, 16) (Existing: 4,800 vehicle trips/day from workers based on 2,400 operations workers.)	1,640 vehicle trips/day from workers (TRISO-X, 2022, pp. 4-15). 2 truck trips/per day (TRISO-X, 2022, pp. 4-15).	
	Impact	SMALL (NRC, 2009c, pp. 34, 36)	SMALL to MODERATE (NRC, 2009b, pp. 30 - 32)	SMALL (NRC, 2022c, pp. 3-108 to 3-110)	No impacts	SMALL (TRISO-X, 2022, pp. 4-14 to 4-22)	
Socioeconomics	Peak Construction Employment	Not applicable	Not applicable	Not applicable	Not applicable	134 (TRISO-X, 2022, pp. 4-79)	SMALL to MODERATE – ROI is assumed to have available labor force to fill the majority of new jobs. Economic impacts would depend on the size of the workforce and the number of workers coming from outside the ROI.
	Operations Employment	700 (NRC, 2009c, p. 36)	2,100 (NRC, 2009b, p. 15) pulled from transportation	1,138 (NRC, 2022c, pp. 3-94)	2,400 (NRC, 2005b, pp. 7, 16)	816 (TRISO-X, 2022, pp. 4-81)	
	ROI Labor Force	119,140 (Tri-Cities MSA, November 2007)	175,455 (3-county total, 2006) (NRC,	512,470 (NRC, 2022c, pp. 3-97) 2018 data	2,400 is 2% to 3% of regional labor force (NRC, 2005b, p. 16)	(TRISO-X, 2022, pp. 4-81) 331,692 civilian labor force 2019	

Table 7-10. Summary of Impacts for Fuel Fabrication Facilities

Resource Area	*Impact Indicator*	*Framatome FFF Richland, WA (NRC, 2009c)*	*GNF-A FFF Wilmington, NC (NRC, 2009b)*	*Westinghouse FFF Columbia, SC (NRC, 2022c)*	*BWXT FFF Lynchburg, VA (NRC, 2005b)*	*TRISO-X FFF Oak Ridge, TN (TRISO-X, 2022)*	*New HALEU FFF*
		(NRC, 2009c) p.19	2009b, p. 18) p. 18				Socioeconomic impacts on a host county or local community, especially if rural in nature with low population, could be greater (MODERATE), in terms of potential adverse impacts (e.g., housing, community services) and those considered beneficial (e.g., increased income, spending and tax revenues).
	Impact	SMALL – sufficient socioeconomic infrastructure to support continued operation (NRC, 2009c, pp. 36, 37).	SMALL – no major changes in workforce associated with license renewal (NRC, 2009b, pp. 32, 33).	SMALL; no changes expected to baseline socioeconomic conditions from continued facility operation Beneficial SMALL (NRC, 2022c, pp. 3-93 to 3-100)	Not addressed; because no new work activities are proposed, the proposed action to renew License SNM-42 would not have a significant socioeconomic impact on the region. (NRC, 2005b, p. 16).	SMALL; SMALL to MODERATE beneficial economic impacts in ROI (TRISO-X, 2022, pp. 4-79 to 4-96)	
Environmental Justice	Minority and Low-Income Population in ROI	Not addressed	Minority population ranges from 14.6% to 22%, 13.8% of population below poverty level (NRC, 2009b, p. 17)	Minority and low-income populations (NRC, 2022c, pp. 3-121)	Minority population of 20.6% compared to 27.7% for state (NRC, 2005b, p. 6) 11.4% below poverty level compared to 9.6% for state (NRC, 2005b, p. 7)	Minority populations within 4 miles SMALL (TRISO-X, 2022, pp. 4-102)	SMALL – Construction and operation at existing fuel fabrication facility not anticipated to have disproportionate and adverse impacts on minority or low-income populations. Site-specific analysis may be conducted to make a final determination of environmental justice impacts.
	Impact	Not addressed	Not addressed	SMALL (NRC, 2022c, pp. 3-119 to 3-123)	Not addressed	SMALL (TRISO-X, 2022, pp. 4-99 to 4-102)	

Key: % = percent; AEGL = acute exposure guideline level; BLM = Bureau of Land Management; BMP = best management practice; BWXT = BWX Technologies, Inc.; DART = Days Away Restricted Transferred; dBA = A-weighted decibels; FFF = fuel fabrication facilities; ft^3 = cubic feet; gal/yr = gallons per year; GNF-A = Global Nuclear Fuel – Americas; HALEU = high-assay low-enriched uranium; HF = hydrogen fluoride; IROFS = items relied on for safety; lbs = pounds; LLW = low-level waste; m^3 = cubic meters; MEI = maximally exposed individual; mrem/yr = millirem per year; MSA = Metropolitan Statistical Area; MT = metric ton; MTS = methyltrichlorosilane; NAAQS = National Ambient

Table 7-10. Summary of Impacts for Fuel Fabrication Facilities

Resource Area	***Impact Indicator***	***Framatome FFF Richland, WA (NRC, 2009c)***	***GNF-A FFF Wilmington, NC (NRC, 2009b)***	***Westinghouse FFF Columbia, SC (NRC, 2022c)***	***BWXT FFF Lynchburg, VA (NRC, 2005b)***	***TRISO-X FFF Oak Ridge, TN (TRISO-X, 2022)***	***New HALEU FFF***

Air Quality Standards; NC = North Carolina; NO_x = nitrogen oxide; OSHA = Occupational Health and Safety Administration; ppm = parts per million; PM_{10} = 10 micrometers in diameter; ROI = region of influence; SC = South Carolina; SCF = standard cubic feet; SNM = special nuclear material; SO_2 = sulfur dioxide; T/yr = tons per year; TEDE = total effective dose equivalent; TN = Tennessee; VA = Virginia; VRM = Visual Resource Management; WA = Washington; yds = yards

8 Reactor Operations with HALEU

8.1 Description of the Activity

8.1.1 General Description

An advanced nuclear reactor (ANR) would have significant improvements compared to commercial light water nuclear reactors. Improvements associated with an ANR could include:

- Additional inherent safety features
- Significantly lower levelized cost of electricity
- Lower waste yields
- Greater fuel utilization
- Enhanced reliability
- Increased proliferation resistance
- Increased thermal efficiency
- Ability to integrate into electric and nonelectric applications

8.1.2 Description of the Process

Multiple technologies are under development that vary with respect to the fuel form used, neutron moderators employed, cooling processes, and other factors. Examples include small modular reactors, which generate between 20 megawatts electric (MWe) and 300 MWe, microreactors that generate less than 20 MWe, and larger reactors generating more than 300 MWe. A brief description of potential types of advanced reactors is provided below (McDowell & Goodman, 2021).

- High-temperature gas-cooled reactors (HTGRs) refer to graphite-moderated, typically helium-cooled systems that use tri-structural isotropic fuel micro particles. The particles are packed into a graphite matrix to form either spherical or cylindrical fuel elements. The pebble bed version of the HTGR uses spherical billiard ball-sized fuel elements that flow continuously through the reactor. The prismatic version of the HTGR uses the cylindrical fuel compacts in hexagonal blocks in a fixed geometry. HTGRs may be used for electricity production and/or process heat applications.
- Fluoride salt-cooled high-temperature reactors refer to a hybrid design that uses pebble fuel elements (like pebble bed HTGRs) and a fluoride salt coolant (like salt-cooled molten salt reactors [MSRs]). Some fixed-fuel fluoride salt-cooled high-temperature reactor designs (like prismatic HTGRs) have been proposed, but none is currently under commercial consideration.
- MSRs come in several varieties. Some designs use molten fluoride salt, while others use chloride salts as the coolant. Some designs have stationary fuel rods or plates, while others have moving fuel pebbles or fissile material dissolved within the flowing coolant. In addition, some MSRs use a fast neutron spectrum, while others use a thermal spectrum.
- Liquid metal-cooled reactors are an advanced type of nuclear reactor in which the primary coolant is a liquid metal. Liquid metal-cooled reactors are classified based on the liquid metal coolant used, such as sodium, lead-bismuth eutectic alloy, and lead-bismuth.

- Heat pipe reactors typically consist of a solid block core with the fuel in holes inside the solid block. Heat pipes are built into the block in a lattice configuration and remove the heat from the block as the liquid in the heat pipe is vaporized.
- Integral pressurized water reactors are an advancement upon historical pressurized water reactor designs that use coolant and fuels similar to existing light water reactors, but that have the primary coolant circuit components placed within the reactor pressure vessel, thereby eliminating the need for primary circuit pipework with the intention of enhancing safety and reliability.

8.1.3 Potential Facilities

Potential reactors using high-assay low-enriched uranium (HALEU) fuel are shown in Figure 8-1. The status of several potential reactors is shown in Table 8-1.

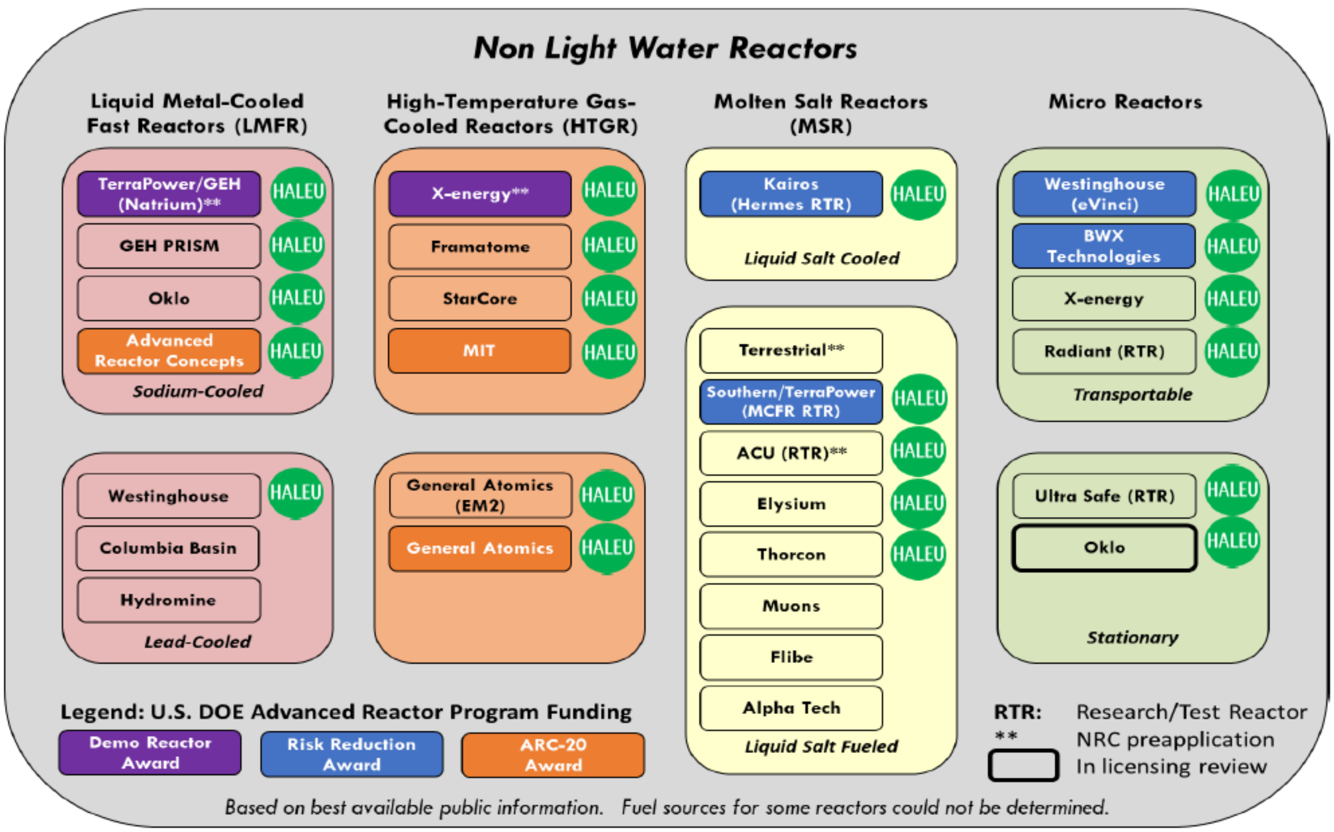


Figure 8-1. Most Advanced Reactors Require HALEU

Source: (Centrus Energy Corp, 2022)

An ANR site could be anywhere in the United States that meets the U.S. Nuclear Regulatory Commission (NRC) reactor siting criteria in Title 10 of the Code of Federal Regulations Part 100. The affected environment reflects the existing condition of environmental resources, as influenced by natural physical conditions and by past human activities such as agriculture, forestry, mining, urbanization, and industrial and non-industrial development. The site might be situated at an existing nuclear power plant location or at sites not previously used for nuclear power generation. Reactors might be located at sites that have a history of industrial use or other development, or at greenfield sites that have not been previously developed other than for agricultural, forestry, or conservation purposes. Reactors might be located on government-owned or managed installations such as military bases or national laboratories, or they might be located on privately owned sites.

Table 8-1. Status of Several Potential Advanced Nuclear Reactors

Reactor Type	*Power Level*	*Developer*	*Funding*	*NRC Licensing Status*	*Planned Startup Date*
Sodium-Cooled Fast Reactors					
Natrium	840 MWth/345 MWe	TerraPower-GE Hitachi	50–50 cost share with ARDP	Pre-application	2025–2027
Aurora Powerhouse [(a)]	4 MWth/1.5 MWe	Oklo, Inc.	Mostly private; some DOE subsidy	Combined operating license accepted for technical review June 2020	2024
High-Temperature Gas-Cooled Reactors					
Xe-100	4 × 200 MWth (76–80 MWe)	X-Energy	50–50 cost share with ARDP	Pre-application	2025–2027
Molten Salt Reactors					
Molten salt research reactor	1 MWth	ACU/NEXT Research Alliance	Natura Resources	Safety review in progress	2025
Hermes reduced-scale test reactor [(b)]	Full-scale Kairos reactor 320 MWth/140 MWe; reduced scale > 50 MWth	Kairos Power	80% ARDP; 20% private	Pre-application	2027

Sources: (Patel, 2020; Lyman, 2021; Kilmer, 2022; NRC, 2023c)

Key: % = percent; > = greater than; ACU = Abilene Christian University; ARDP: DOE Advanced Reactor Demonstration Program; GE = General Electric; MWe: megawatts of electricity; MWth: megawatts of thermal energy; NEXT = Nuclear Energy eXperimental Testing; NRC = U.S. Nuclear Regulatory Commission

Notes:

a The Aurora is potassium cooled, with liquid sodium bonding contained in the fuel rods.

b The Hermes is not molten salt–fueled but uses TRISO fuel and a molten-salt coolant.

8.1.4 Existing NEPA Documentation

Any of the advanced reactor designs might fit within the Plant Parameter Envelope (PPE) and Site Parameter Envelope (SPE) described in the *Generic Environmental Impact Statement for Advanced Nuclear Reactors - Draft Report for Comment* (NRC, 2021e)[54] (referred to as the "ANR GEIS"). The ANR GEIS can provide partial National Environmental Policy Act (NEPA) coverage for reactors that fall within the range of parameters analyzed (allows applicant for license to refer to the ANR GEIS without further analysis if parameters are met). Most advanced reactors would probably fit within the PPE and SPE developed in the ANR GEIS. The ANR GEIS shows that environmental consequences for an ANR are expected to range from SMALL to MODERATE. Reactor-specific analyses would provide NEPA coverage for issues not covered by the ANR GEIS analyses.

[54] The *Generic Environmental Impact Statement for Advanced Nuclear Reactors - Draft Report for Comment* (NRC, 2021e) is an internal NRC review draft, but represents the best available information and therefore was used in preparing the HALEU Environmental Impact Statement (EIS).

8.2 Approach to NEPA Analyses

The purpose and need for the ANR GEIS is to present impact analyses for the environmental issues common to ANRs that can be addressed generically and eliminate reproducing the same analyses each time a licensing application is submitted. Use of the ANR GEIS allows future environmental review efforts to focus on issues that can be resolved only once a site is identified. This ANR GEIS is intended to improve the efficiency of licensing ANRs by (1) identifying the types of potential environmental impacts of building, operating, and decommissioning an ANR, (2) assessing impacts that are expected to be generic (the same or similar) for many or most ANRs, and (3) defining the environmental issues that will need to be addressed in project-specific supplemental EISs addressing specific projects.

8.3 Affected Environment and Environmental Consequences

The ANR GEIS evaluates the potential environmental impacts of 121 issues relevant to constructing, operating, and decommissioning an ANR. It identifies 100 issues as Category 1 issues. Category 1 issues are those that the NRC staff has preliminarily determined that a generic conclusion regarding the potential environmental impacts of issuing a permit or license for an ANR can be reached, provided that the project is bounded by relevant PPE and SPE values and assumptions. Additionally, Category 1 issues are those that the NRC staff has preliminarily determined will result in no more than a SMALL adverse impact or significance level (in relation to a SMALL, MODERATE, or LARGE impact or significance level scale) or will have a beneficial impact. The ANR GEIS identifies 19 issues as Category 2 issues, which are those that the NRC staff has preliminarily determined cannot be resolved generically and for which both the applicant, in its environmental report, and the NRC staff, in its Draft Supplemental Environmental Impact Statement, must analyze in detail. Finally, there are two issues that are designated as “N/A” (i.e., impacts are uncertain), which are neither Category 1 nor Category 2.

In general, a license application for an ANR can refer to the generic analysis in the ANR GEIS for any Category 1 issue without further analysis if it demonstrates that it meets or is bounded by the relevant values and assumptions in the PPE and SPE and there is no new and significant information to change the conclusions in the ANR GEIS. If the relevant parameters and assumptions for a Category 1 issue are not met, the applicant would have to provide the requisite information and analysis necessary for the NRC staff to perform a site-specific analysis. Applicants addressing Category 2 issues would have to provide all of the information typically needed to perform a project-specific analysis.

The ANR GEIS considers assumptions, including mitigation measures, in the analysis of each environmental issue. The environmental issues are summarized in Table 8-2, using the same text as Table 4-1 of the ANR GEIS. The generic conclusion for a Category 1 issue may rely on one or more of the values and assumptions for a parameter that is considered in the resource-specific evaluation section in Chapter 3 of the ANR GEIS. Characteristics associated with microreactor and small- to medium-sized ANR technologies and resource needs are presented in Table 8-3 and Table 8-4. These tables are based on Tables E.1 and E.2 of *Advanced Nuclear Reactor Plant Parameter Envelope and Guidance* from the National Reactor Innovation Center (McDowell & Goodman, 2021).

Table 8-2. Summary of Findings and Mitigation

Issue	*ANR GEIS Section*	*Category*	*Finding*	*Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions*
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
Land Use				
Construction				
On-Site Land Use	3.1.2.1.1	1	SMALL	• The proposed project, including any associated land uses, complies with applicable NRC siting regulations such as Title 10 of the Code of Federal Regulations (10 CFR 100). • The site size is 100 acres (40.5 hectare [ha]) or less. • The permanent footprint of disturbance includes 30 acres (12 ha) or less of vegetated lands, and the temporary footprint of disturbance includes no more than an additional 20 acres (8.1 ha) or less of vegetated lands. • The proposed project complies with the site's zoning and is consistent with any relevant land use plans or comprehensive plans. • The site would not be situated closer than 0.5 miles (0.8 km) to existing residential areas or 1 mi (1.6 kilometers [km]) to sensitive land uses such as Federal, state, or local parks; wildlife refuges; conservation lands; Wild and Scenic Rivers; or Natural Heritage Rivers. • The site does not have a history of past industrial use capable of leaving a legacy of contamination requiring cleanup to protect human health and the environment. • The total wetland loss from use of the site, including use of any off-site ROWs, would be no more than 0.5 acres (0.2 ha). • BMPs for erosion, sediment control, and stormwater management would be used. • Compliance with any mitigation measures established through zoning ordinances, local building permits, site use permits, or other land use authorizations.
Off-Site Land Use	3.1.2.1.2	1	SMALL	• New off-site ROWs for transmission lines, pipelines, or access roads would be no more than 100 feet (30.5 meters [m]) in width and total no more than 1 mile (1.6 km) in length. • No new off-site ROWs would be situated closer than 0.5 miles (0.8 km) to existing residential areas or sensitive land uses such as Federal, state, or local parks; wildlife refuges; conservation lands; Wild and Scenic Rivers; or Natural Heritage Rivers. • No existing ROWs in residential areas would be used or widened to accommodate project features. • No ROW has a history of past industrial use capable of leaving a legacy of contamination requiring cleanup to protect human health and the environment. • The total wetland loss from use of the entire project, including use of the site and any off-site ROWs, would be no more than 0.5 acres (0.2 ha). • BMPs for erosion, sediment control, and stormwater management would be used.

Table 8-2. Summary of Findings and Mitigation

Issue	*ANR GEIS Section*	*Category*	*Finding*	*Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions*
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
				• Compliance with any mitigation measures established through zoning ordinances, local building permits, site use permits, or other land use authorizations.
Impacts on Prime and Unique Farmland	3.1.2.1.3	1	SMALL	• The site size is 100 acres (40.5 ha) or less. • The site does not contain any prime or unique farmland or other farmland of statewide or local importance; or the site does not abut any agricultural land and is not situated in a predominantly agricultural landscape.
Coastal Zone and Compliance with the Coastal Zone Management Act (16 U.S.C. 1451 et seq.)	3.1.2.1.4	1	SMALL	• The site is not situated in any designated coastal zone, or the applicant can demonstrate that the affected state(s) have or will issue a consistency determination or other indication that the project complies with the Coastal Zone Management Act (CZMA) of 1972.
Operation				
On-Site Land Use	3.1.2.2.1	1	SMALL	• The proposed project, including any associated land uses, complies with applicable NRC siting regulations such as 10 CFR 100. • The site size is 100 acres (40.5 ha) or less. • If needed, cooling towers would be mechanical draft, not natural draft; less than 100 feet (30.5 m) in height; and equipped with drift eliminators. • Any makeup water for the cooling towers would be fresh water (less than 1 [ppt] salinity). • BMPs for erosion, sediment control, and stormwater management would be used.
Off-Site Land Use	3.1.2.2.2	1	SMALL	• New off-site ROWs for transmission lines, pipelines, or access roads would be no more than 100 feet (30.5 m) in width and total no more than 1 mile (1.6 km) in length. • BMPs for erosion, sediment control, and stormwater management would be used (wherever land is disturbed during the course of ROW management).
Visual Resources				
Construction				
Visual Impacts in Site and Vicinity	3.2.2.1.1	1	SMALL	• The site size is 100 acres (40.5 ha) or less. • The site would not be situated closer than 0.5 miles (0.8 km) to existing residential areas or 1 mile (1.6 km) to sensitive land uses such as Federal, state, or local parks; wildlife refuges; conservation lands; Wild and Scenic Rivers; or Natural Heritage Rivers. • The maximum proposed building and structure height is no more than 50 feet (15.2 m), except that the maximum height is 200 feet (61 m) for proposed meteorological towers

Table 8-2. Summary of Findings and Mitigation

Issue	*ANR GEIS Section*	*Category*	*Finding*	*Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions*
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
				and 100 feet (30.5 m) for transmission line poles/towers and mechanical draft cooling towers. • The proposed project structures would not be visible from Federal or state parks or wilderness areas designated as Class 1 under Section 162 of the Clean Air Act (CAA) (42 U.S.C. 7472); or as a Wild and Scenic River, a Natural Heritage River, or a river of similar state designation.
Visual Impacts from Transmission Lines	3.2.2.1.2	1	SMALL	• New off-site ROWs for transmission lines, pipelines, or access roads would be no more than 100 feet (30.5 m) in width and total no more than 1 mile (1.6 km) in length. • No transmission line structures (poles or towers) would be over 100 feet (30.5 m) in height. • The new off-site ROWs would not be situated closer than 1 mile (1.6 km) to existing residential areas or sensitive land uses such as Federal, state, or local parks; wildlife refuges; conservation lands; Wild and Scenic Rivers; or Natural Heritage Rivers. • Any proposed new structures on off-site ROWs would not be visible from Federal or state parks or wilderness areas designated as Class 1 under Section 162 of the CAA (42 U.S.C. 7472); or as a Wild and Scenic River, a Natural Heritage River, or a river of similar state designation.
Operation				
Visual Impacts During Operations	3.2.2.2.1	1	SMALL	• The site would not be situated closer than 1 mile (1.6 km) to existing residential areas or sensitive land uses such as Federal, state, or local parks; wildlife refuges; conservation lands; Wild and Scenic Rivers; or Natural Heritage Rivers. • The maximum proposed building and structure height would be no more than 50 feet (15.2 m), except for proposed meteorological towers the maximum height would be 200 feet (61 m), and 100 feet (30.5 m) for proposed transmission line poles/towers and proposed mechanical draft cooling towers. • The proposed project structures would not be visible from Federal or state parks or wilderness areas designated as Class 1 under Section 162 of the CAA (42 U.S.C. 7472); or as a Wild and Scenic River, a Natural Heritage River, or a river of similar State designation. • If needed, cooling towers would be mechanical draft, not natural draft; less than 100 feet (30.5 m) in height; and equipped with drift eliminators. • Any makeup water for the cooling towers would be fresh water (less than 1 ppt salinity).

Table 8-2. Summary of Findings and Mitigation

Issue	*ANR GEIS Section*	*Category*	*Finding*	*Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions*
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
Meteorology and Air Quality				
Construction				
Emissions of Criteria Pollutants and Dust During Construction	3.3.2.1.1	1	SMALL	• The site size is 100 acres (40.5 ha) or less. • The permanent footprint of disturbance is 30 acres (12 ha) or less of vegetated lands and the temporary footprint of disturbance is an additional 20 acres (8.1 ha) or less of vegetated land. • New off-site ROWs for transmission lines, pipelines, or access roads would be no longer than 1 mi (1.6 km) and have a maximum ROW width of 100 feet (30.5 m). • Criteria pollutants emitted from vehicles and standby power equipment during construction are less than CAA General Conformity Rule *de minimis* levels set by the U.S. Environmental Protection Agency (EPA) if the site is located in a nonattainment or maintenance area, or the site is located in an attainment area. • The site is not located within 1 mile (1.6 km) of a mandatory Class I Federal area where visibility is an important value. • The LOS determination for affected roadways does not change. • Mitigation necessary to rely on the generic analysis includes implementation of BMPs for dust control. • Compliance with air permits under state and Federal laws that address the impact of air emissions during construction.
Greenhouse Gas Emissions During Construction	3.3.2.1.2	1	SMALL	• GHG emitted by equipment and vehicles during the 97-year ANR GHG lifecycle period would be equal to or less than 2,534,000 MT of carbon dioxide equivalent (CO_2e). Appendix H (of the ANR GEIS) contains the staff's methodology for developing this value, which includes emissions from building, operating, and decommissioning. As long as this total value is met, the impacts for the lifecycle of the project and the individual phases of the project are determined to be SMALL.
Operation				
Emissions of Criteria and Hazardous Air Pollutants During Operation	3.3.2.2.1	1	SMALL	• Criteria pollutants emitted from vehicles and standby [sic] power [sic] equipment during operations are less than CAA General Conformity Rule *de minimis* levels set by EPA if located in a nonattainment or maintenance area. • The site is not located within 1 mile (1.6 km) of a mandatory Class I Federal area where visibility is an important value.

Table 8-2. Summary of Findings and Mitigation

Issue	ANR GEIS Section	Category	Finding	Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
				• The LOS determination for affected roadways does not change. • The generic analysis can be relied on without applying any mitigation measures. • Compliance with air permits under state and Federal laws that address the impact of air emissions. • Hazardous air pollutant emissions will be within regulatory limits.
Greenhouse Gas Emissions During Operation	3.3.2.2.2	1	SMALL	• GHGs emitted by equipment and vehicles during the 97-year ANR GHG lifecycle period would be equal to or less than 2,534,000 MT of CO_2e. Appendix H (of the ANR GEIS) contains the staff's methodology for developing this value, which includes emissions from building, operating, and decommissioning. As long as this total value is met, the impacts for the lifecycle of the project and the individual phases of the project are determined to be SMALL.
Cooling-System Emissions	3.3.2.2.3	1	SMALL	• If needed, cooling towers would be mechanical draft, not natural draft. • Cooling towers would be equipped with drift eliminators. • The site is not located within 1 mile (1.6 km) of a mandatory Class I Federal area where visibility is an important value. • Mechanical draft cooling towers would be less than 100 feet (30.5 m) tall. • Makeup water would be fresh (with a salinity less than 1 ppt). • Operation of cooling towers is assumed to be subject to state permitting requirements. • HAP emissions would be within regulatory limits. • No existing residential areas within 0.5 miles (0.8 km) of the site.
Emissions of Ozone and Nitrogen Oxides During Transmission Line Operation	3.3.2.2.4	1	SMALL	• The transmission line voltage would be no higher than 1,200 kV.
Water Resources				
Construction				
Surface Water Use Conflicts During Construction	3.4.2.1.1	1	SMALL	Total Plant Water Demand: • Less than or equal to a daily average of 6,000 gpm (0.379 m^3/s). If water is obtained from a flowing water body, then the following Plant Parameter Envelope/Site Parameter Envelope (PPE/SPE) parameter and the associated assumptions also apply:

Table 8-2. Summary of Findings and Mitigation

Issue	ANR GEIS Section	Category	Finding	Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
				• Average plant water withdrawals do not reduce discharge from the flowing water body by more than 3% of the 95% exceedance daily flow and do not prevent the maintenance of applicable instream flow requirements. • The 95% exceedance flow accounts for existing and planned future withdrawals. • Water availability is demonstrated by the ability to obtain a withdrawal permit issued by state, regional, or Tribal governing authorities. • Water rights for the withdrawal amount are obtainable, if needed. If water is obtained from a non-flowing water body, then the following PPE/SPE values and assumptions also apply: • Water availability of the Great Lakes, the Gulf of Mexico, oceans, estuaries, and intertidal zones exceeds the amount of water required by the plant. • Water availability is demonstrated by the ability to obtain a withdrawal permit issued by state, regional, or Tribal governing authorities. • Water rights for the withdrawal amount are obtainable, if needed. • The CZMA consistency determination is obtainable, if applicable, for the non-flowing water body.
Groundwater Use Conflicts due to Excavation Dewatering	3.4.2.1.2	1	SMALL	• The long-term dewatering withdrawal rate is less than or equal to 50 gpm (0.003 m^3/s) (the initial rate may be larger). • Dewatering results in negligible groundwater level drawdown at the site boundary.
Groundwater Use Conflicts due to Construction-Related Groundwater Withdrawals	3.4.2.1.3	1	SMALL	• Groundwater withdrawal for all plant uses (excluding dewatering) is less than or equal to 50 gpm (0.003 m^3/s). • Withdrawal results in no more than 1 foot (0.3 m) of groundwater level drawdown at the site boundary. • Withdrawals are not derived from an EPA-designated SSA, or from any aquifer designated by a state, Tribe, or regional authority to have special protections to limit drawdown. • Withdrawals meet any applicable state or local permit requirements.
Water Quality Degradation due to Construction-Related Discharges	3.4.2.1.4	1	SMALL	• The permanent footprint of disturbance includes 30 acres (12 ha) or less of vegetated lands, and the temporary footprint of disturbance includes no more than an additional 20 acres (8.1 ha) or less of vegetated lands. • Adherence to requirements in National Pollutant Discharge Elimination System (NPDES) permits issued by EPA or state permitting program, and any other applicable permits.

Table 8-2. Summary of Findings and Mitigation

Issue	*ANR GEIS Section*	*Category*	*Finding*	*Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions*
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
				• The long-term groundwater dewatering withdrawal rate is less than or equal to 50 gpm (0.003 m^3/s). • Dewatering discharge has minimal effects on the quality of the receiving water body (e.g., as demonstrated by conformance with NPDES permit requirements). • There are no planned discharges to the subsurface (by infiltration or injection), including stormwater discharge.
Water Quality Degradation due to Inadvertent Spills During Construction	3.4.2.1.5	1	SMALL	• The site size is 100 acres (40.5 ha) or less. • The permanent footprint of disturbance includes 30 acres (12 ha) or less of vegetated lands, and the temporary footprint of disturbance includes no more than an additional 20 acres (8.1 ha) or less of vegetated lands. • Applicable requirements and guidance on spill prevention and control are followed, including relevant BMPs and Integrated Pollution Prevention Plans.
Water Quality Degradation due to Groundwater Withdrawal	3.4.2.1.6	1	SMALL	Groundwater Withdrawal for Excavation or Foundation Dewatering • The long-term dewatering withdrawal rate is less than or equal to 50 gpm (0.003 m^3/s) (the initial rate may be larger). • Dewatering results in negligible groundwater level drawdown at the site boundary. Groundwater Withdrawal for Plant Uses • Groundwater withdrawal for all plant uses (excluding dewatering) is less than or equal to 50 gpm (0.003 m^3/s). • Withdrawal results in no more than 1 foot (0.3 m) of groundwater level drawdown at the site boundary.
Water Quality Degradation due to Offshore or In-Water Construction Activities	3.4.2.1.7	1	SMALL	• Withdrawals are not derived from an EPA-designated SSA, or from any aquifer designated by a state, Tribe, or regional authority to have special protections to limit drawdown. • Withdrawals meet any applicable state or local permit requirements. • In-water structures (including intake and discharge structures) are constructed in compliance with provisions of the Clean Water Act (CWA) Section 404 (33 U.S.C. 1344) and Section 10 of the Rivers and Harbors Appropriation Act of 1899 (33 U.S.C. 401 et seq.). • Adverse effects of building activities controlled and localized using BMPs such as installation of turbidity curtains or installation of cofferdams.

Table 8-2. Summary of Findings and Mitigation

Issue	*ANR GEIS Section*	*Category*	*Finding*	*Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions*
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
				• Construction duration would be fewer than 7 years.
Water Use Conflict due to Plant Municipal Water Demand	3.4.2.1.8	1	SMALL	• The amount available from municipal water systems exceeds the amount of municipal water required by the plant (gpm). • Municipal Water Availability accounts for all existing and planned future uses. • An agreement or permit for the usage amount can be obtained from the municipality.
Degradation of Water Quality from Plant Effluent Discharges to Municipal Systems	3.4.2.1.9	1	SMALL	• Municipal Systems' Available Capacity to Receive and Treat Plant Effluent accounts for all existing and reasonably foreseeable future discharges. • Agreement to discharge to a municipal treatment system is obtainable.
Operation				
Surface Water Use Conflicts During Operation due to Water Withdrawal from Flowing Waterbodies	3.4.2.2.1	1	SMALL	• Total plant water demand is less than or equal to a daily average of 6,000 gpm (0.379 m^3/s). • Average plant water withdrawals do not reduce discharge from the flowing water body by more than 3% of the 95% exceedance daily flow and do not prevent the maintenance of applicable instream flow requirements. • The 95% exceedance flow accounts for existing and planned future withdrawals. • Water availability is demonstrated by the ability to obtain a withdrawal permit issued by state, regional, or Tribal governing authorities. • Water rights for the withdrawal amount are obtainable, if needed.
Surface Water Use Conflicts During Operation due to Water Withdrawal from Non-Flowing Waterbodies	3.4.2.2.2	1	SMALL	• Total plant water demand is less than or equal to a daily average of 6,000 gpm (0.379 m^3/s). • Water availability of the Great Lakes, the Gulf of Mexico, oceans, estuaries, and intertidal zones exceeds the amount of water required by the plant. • Water availability is demonstrated by the ability to obtain a withdrawal permit issued by state, regional, or Tribal governing authorities. • Water rights for the withdrawal amount are obtainable, if needed. • CZMA (16 U.S.C. 1451 et seq.) consistency determination is obtainable, if applicable.
Groundwater Use Conflicts due to Building Foundation Dewatering	3.4.2.2.3	1	SMALL	• The long-term dewatering withdrawal rate is less than or equal to 50 gpm (0.003 m^3/s) (the initial rate may be larger). • Dewatering results in negligible groundwater level drawdown at the site boundary.
Groundwater Use Conflicts due to	3.4.2.2.4	1	SMALL	• Groundwater withdrawal for all plant uses (excluding dewatering) is less than or equal to 50 gpm (0.003 m^3/s).

Table 8-2. Summary of Findings and Mitigation

Issue	*ANR GEIS Section*	*Category*	*Finding*	*Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions*
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
Groundwater Withdrawals for Plant Uses				• Withdrawal results in no more than 1 foot (0.3 m) of groundwater level drawdown at the site boundary. • Withdrawals are not derived from an EPA-designated SSA, or from any aquifer designated by a state, Tribe, or regional authority to have special protections to limit drawdown. • Withdrawals meet any applicable state or local permit requirements.
Surface Water Quality Degradation due to Physical Effects from Operation of Intake and Discharge Structures	3.4.2.2.5	1	SMALL	• Total plant water demand is less than or equal to a daily average of 6,000 gpm (0.379 m^3/s). • Adhere to best available technology requirements of CWA 316(b)(33 U.S.C. 1326). • Operated in compliance with CWA Section 316 (b) and 40 CFR 125.83, including compliance with monitoring and recordkeeping requirements in 40 CFR 125.87 and 40 CFR 125.88, respectively (40 CFR 125). • Best available technologies are employed in the design and operation of intake and discharge structures to minimize alterations due to scouring, sediment transport, increased turbidity, and erosion. • Adherence to requirements in NPDES permits issued by EPA or a given state. • If water is obtained from a flowing water body, then the following PPE/SPE value also applies: – The average rate of plant withdrawal does not exceed 3% of the 95% exceedance daily flow for the water body. • If water is obtained from a non-flowing water body, then the following PPE/SPE values and assumptions also apply: – Water availability of the Great Lakes, the Gulf of Mexico, oceans, estuaries, and intertidal zones exceeds the amount of water required by the plant.
Surface Water Quality Degradation due to Changes in Salinity Gradients Resulting from Withdrawals	3.4.2.2.6	1	SMALL	• Total plant water demand is less than or equal to a daily average of 6,000 gpm (0.379 m^3/s). • If water is obtained from a flowing water body, then the following PPE/SPE values and assumptions also apply: – Average plant water withdrawals do not reduce discharge from the flowing water body by more than 3%of the 95% exceedance daily flow and do not prevent the maintenance of applicable instream flow requirements. – The 95% exceedance flow accounts for existing and planned future withdrawals.

Table 8-2. Summary of Findings and Mitigation

Issue	ANR GEIS Section	Category	Finding	Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
				– Water availability is demonstrated by the ability to obtain a withdrawal permit issued by state, regional, or Tribal governing authorities. – Water rights for the withdrawal amount are obtainable, if needed. – If withdrawals are from an estuary or intertidal zone, then changes to salinity gradients are within the normal tidal or seasonal movements that characterize the water body. • If water is obtained from a non-flowing water body, then the following PPE/SPE values and assumptions also apply: – Water availability of the Great Lakes, the Gulf of Mexico, oceans, estuaries, and intertidal zones exceeds the amount of water required by the plant. – Water availability is demonstrated by the ability to obtain a withdrawal permit issued by state, regional, or Tribal governing authorities. – Water rights for the withdrawal amount are obtainable, if needed. – If withdrawals are from an estuary or intertidal zone, then changes to salinity gradients are within the normal tidal or seasonal movements that characterize the water body.
Surface Water Quality Degradation due to Chemical and Thermal Discharges	3.4.2.2.7	2	Undetermined	• The staff determined that a generic analysis to determine operational impacts on surface water quality due to chemical and thermal discharges was not possible because (1) some states may impose effluent constituent limitations more stringent that those required by EPA, (2) limitations imposed on effluent constituents may vary among states, and (3) the establishment of a mixing zone may be required. Because all of these issues related to degradation of surface water quality from chemical and thermal discharges require consideration of project-specific information, a project-specific assessment should be performed in the SEIS.
Groundwater Quality Degradation due to Plant Discharges	3.4.2.2.8	1	SMALL	• The plant is outside the recharge area for any EPA-designated SSA, or any aquifer designated to have special protections by a state, Tribal, or regional authority. • The plant is outside the wellhead protection area or designated contributing area for any public water-supply well. • There are no planned discharges to the subsurface (by infiltration or injection).
Water Quality Degradation due to Inadvertent Spills and Leaks During Operation	3.4.2.2.9	1	SMALL	• Applicable requirements and guidance on spill prevention and control are followed, including relevant BMPs and Integrated Pollution Prevention Plans. • There are no planned discharges to the subsurface (by infiltration or injection), including stormwater discharge.

Table 8-2. Summary of Findings and Mitigation

Issue	ANR GEIS Section	Category	Finding	Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
				• A groundwater protection program conforming to NEI 07-07 (NEI, 2019) is established and followed. • The site size is 100 acres (40.5 ha) or less. • Use of BMPs for soil erosion, sediment control, and stormwater management. • Adherence to requirements in NPDES permits issued by EPA or a given state, and any other applicable permits.
Water Quality Degradation due to Groundwater Withdrawals	3.4.2.2.10	1	SMALL	• The long-term dewatering withdrawal rate is less than or equal to 50 gpm (0.003 m^3/s) (the initial rate may be larger). • Dewatering results in negligible groundwater level drawdown at the site boundary. • Groundwater withdrawal for all plant uses (excluding dewatering) is less than or equal to 50 gpm (0.003 m^3/s). • Withdrawal results in no more than 1 foot (0.3 m) of groundwater level drawdown at the site boundary. • Withdrawals are not derived from an EPA-designated SSA, or from any aquifer designated by a state, Tribe, or regional authority to have special protections to limit drawdown. • Withdrawals meet any applicable state or local permit requirements.
Water Use Conflict from Plant Municipal Water Demand	3.4.2.2.11	1	SMALL	• Usage amount is within the existing capacity of the system(s), accounting for all existing and planned future uses. • An agreement or permit for the usage amount can be obtained from the municipality.
Degradation of Water Quality from Plant Effluent Discharges to Municipal Systems	3.4.2.2.12	1	SMALL	• Municipal Systems' Available Capacity to Receive and Treat Plant Effluent accounts for all existing and reasonably foreseeable future discharges. • Agreement to discharge to a municipal treatment system is obtainable.
Terrestrial Ecology				
Construction				
Permanent and Temporary Loss, Conversion, Fragmentation, and Degradation of Habitats	3.5.2.1.1	1	SMALL	• The permanent footprint of disturbance would include 30 acres (12 ha) or less of vegetated lands, and the temporary footprint of disturbance would include no more than an additional 20 acres (8.1 ha) or less of vegetated lands. • Temporarily disturbed lands would be revegetated using regionally indigenous vegetation once the lands are no longer needed to support building activities.

Table 8-2. Summary of Findings and Mitigation

Issue	*ANR GEIS Section*	*Category*	*Finding*	*Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions*
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
				• New off-site ROWs for transmission lines, pipelines, or access roads would be no more than 100 feet (30.5 m) in width and total no more than 1 mile (1.6 km) in length. • The footprint of disturbance (permanent and temporary) would contain no ecologically sensitive features such as floodplains, shorelines, riparian vegetation, late-successional vegetation, land specifically designated for conservation, or habitat known to be potentially suitable for one or more Federal or state threatened or endangered species. • Total wetland impacts from use of the site and any off-site ROWs would be no more than 0.5 acres (0.2 ha). • Applicants would demonstrate an effort to minimize fragmentation of terrestrial habitats by using existing ROWs, or widening existing ROWs, to the extent practicable. • BMPs would be used for erosion, sediment control, and stormwater management.
Permanent and Temporary Loss and Degradation of Wetlands	3.5.2.1.2	1	SMALL	• Applicant would provide a delineation of potentially impacted wetlands, including wetlands not under CWA jurisdiction. • Total wetland impacts from use of the site and any off-site ROWs would be no more than 0.5 acres (0.2 ha). • If activities regulated under the CWA are performed, those activities would receive approval under one or more nationwide permit (NWP) (33 CFR 330) or other general permits recognized by the USACE. • Temporary groundwater withdrawals for excavation or foundation dewatering would not exceed a long-term rate of 50 gpm (0.003 m^3/s). • Applicants would be able to demonstrate that the temporary groundwater withdrawals would not substantially alter the hydrology of wetlands connected to the same groundwater resource. • Any required state or local permits for wetland impacts would be obtained. • Any mitigation measures indicated in the NWPs or other permits would be implemented. • BMPs would be used for erosion, sediment control, and stormwater management.
Effects of Building Noise on Wildlife	3.5.2.1.3	1	SMALL	• Noise generation would not exceed 85 dBA 50 feet (15.2 m) from the source.
Effects of Vehicular Collisions on Wildlife	3.5.2.1.4	1	SMALL	• The site size would be 100 acres (40.5 ha) or less. • The permanent footprint of disturbance would include 30 acres (12 ha) or less of vegetated lands, and the temporary footprint of disturbance would include no more than an additional 20 acres (8.1 ha) or less of vegetated lands.

Table 8-2. Summary of Findings and Mitigation

Issue	*ANR GEIS Section*	*Category*	*Finding*	*Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions*
Note: For Category 2 issues, the impacts are stated as “Undetermined” because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
				• There would be no decreases in the LOS designation for affected roadways. • The licensee would communicate with Federal and state wildlife agencies and implement mitigation actions recommended by those agencies to reduce potential for vehicular injury to wildlife.
Bird Collisions and Injury from Structures and Transmission Lines	3.5.2.1.5	1	SMALL	• The site size would be 100 acres (40.5 ha) or less. • New off-site ROWs for transmission lines, pipelines, or access roads would be no more than 100 feet (30.5 m) in width and total no more than 1 mi (1.6 km) in length. • No transmission line structures (poles or towers) would be more than 100 feet (30.5 m) in height. • Licensees would implement common mitigation measures such as those provided by the American Bird Conservancy (ABC, 2015) for buildings, by the U.S. Fish and Wildlife Service (USFWS) for towers (USFWS, 2013) and by the Avian Power Line Interaction Committee (APLIC) for transmission lines (APLIC, 2012).
Important Species and Habitats – Resources Regulated under the Endangered Species Act of 1973 (ESA; 16 U.S.C. 1531 et seq.)	3.5.2.1.6.1	2	Undetermined	• The NRC staff is unable to determine the significance of potential impacts without consideration of project-specific factors, including the specific species and habitats affected and the types of ecological changes potentially resulting from each specific licensing action.
Important Species and Habitats – Other Important Species and Habitats	3.5.2.1.6.2	1	SMALL	• Applicants would communicate with state natural resource or conservation agencies regarding wildlife and plants and implement mitigation recommendations of those agencies.
Operation				
Permanent and Temporary Loss or Disturbance of Habitats	3.5.2.2.1	1	SMALL	• Temporarily disturbed lands would be revegetated using regionally indigenous vegetation once the lands are no longer needed to support building activities. • The total wetland loss from site disturbance over the operational life of the plant would be no more than 0.5 acres (0.2 ha). • Any state or local permits for wetland impacts would be obtained. • Any mitigation measures indicated in the NWPs or other wetland permits would be implemented. • BMPs would be used for erosion, sediment control, and stormwater management.

Table 8-2. Summary of Findings and Mitigation

Issue	ANR GEIS Section	Category	Finding	Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
Effects of Operational Noise on Wildlife	3.5.2.2.2	1	SMALL	• Noise generation would not exceed 85 dBA 50 feet (15.2 m) from the source. • There would be no decreases in the LOS designation for affected roadways. • The licensee would communicate with Federal and state wildlife agencies and implement mitigation actions recommended by those agencies to reduce potential for vehicular injury to wildlife.
Effects of Vehicular Collisions on Wildlife	3.5.2.2.2	1	SMALL	• Noise generation would not exceed 85 dBA 50 feet (15.2 m) from the source. • There would be no decreases in the LOS designation for affected roadways. • The licensee would communicate with Federal and state wildlife agencies and implement mitigation actions recommended by those agencies to reduce potential for vehicular injury to wildlife.
Exposure of Terrestrial Organisms to Radionuclides	3.5.2.2.3	1	SMALL	• Applicants would demonstrate in their application that any radiological nonhuman biota doses would be below International Atomic Energy Agency (IAEA, 1992) and National Council on Radiation Protection and Measurements (NCRP, 1991) guidelines.
Cooling-Tower Operational Impacts on Vegetation	3.5.2.2.4	1	SMALL	• If needed, cooling towers would be mechanical draft, not natural draft; less than 100 feet (30.5 m) in height; and equipped with drift eliminators. • Any makeup water for the cooling towers would be fresh water (less than 1 ppt salinity).
Bird Collisions and Injury from Structures and Transmission Lines	3.5.2.2.5	1	SMALL	• The site size would be 100 acres (40.5 ha) or less. • New off-site ROWs for transmission lines, pipelines, or access roads would be no more than 100 feet (30.5 m) in width and total no more than 1 mile (1.6 km) in length. • No transmission line structures (poles or towers) would be more than 100 feet (30.5 m) in height. • Licensees would implement common mitigation measures such as those provided by the American Bird Conservancy (ABC, 2015) for buildings, by USFWS (USFWS, 2013) for towers, and by APLIC for transmission lines (APLIC, 2012).
Bird Electrocutions from Transmission Lines	3.5.2.2.6	1	SMALL	• New off-site ROWs for transmission lines, pipelines, or access roads would be no more than 100 feet (30.5 m) in width and total no more than 1 mile (1.6 km) in length. • Common mitigation measures, such as those recommended by APLIC (2006), would be implemented.
Water Use Conflicts with Terrestrial Resources	3.5.2.2.7	1	SMALL	• Total plant water demand would be less than or equal to a daily average of 6,000 gpm (0.379 m^3/s).

Table 8-2. Summary of Findings and Mitigation

Issue	ANR GEIS Section	Category	Finding	Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
				• If water is withdrawn from flowing water bodies, average plant water withdrawals would not reduce flow by more than 3% of the 95% exceedance daily flow and would not prevent maintenance of applicable instream flow requirements. • Any water withdrawals would be in compliance with any EPA or state permitting requirements. • Applicants would be able to demonstrate that hydroperiod changes are within historical or seasonal fluctuations.
Effects of Transmission Line ROW Management on Terrestrial Resources	3.5.2.2.8	1	SMALL	• Vegetation in transmission line ROWs would be managed following a plan consisting of integrated vegetation management practices. • All ROW maintenance work would be performed in compliance with all applicable laws and regulations. • Herbicides would be applied by licensed applicators, and only if in compliance with applicable manufacturer label instructions.
Effects of Electromagnetic Fields on Flora and Fauna	3.5.2.2.9	1	SMALL	• Based on the literature review in the License Renewal GEIS (NRC, 2013a), the staff determined that this is a Category 1 issue and impacts would be SMALL regardless of the length, location, or size of the transmission lines. The staff did not recommend any mitigation in the License Renewal GEIS (NRC 2013); hence, none is needed here. The staff did not rely on any PPE and SPE values or assumptions in reaching this conclusion.
Important Species and Habitats – Resources Regulated under the ESA of 1973	3.5.2.2.10.1	2	Undetermined	• The NRC staff is unable to determine the significance of potential impacts without consideration of project-specific factors, including the specific species and habitats affected and the types of ecological changes potentially resulting from each specific licensing action.
Important Species and Habitats – Other Important Species and Habitats	3.5.2.2.10.2	1	SMALL	• Applicants would communicate with state natural resource or conservation agencies regarding wildlife and plants and implement mitigation recommendations of those agencies.
Aquatic Ecology				
Construction				
Runoff and Sedimentation from Construction Areas	3.6.2.1.1	1	SMALL	• BMPs would be used for erosion and sediment control. • Temporarily disturbed lands would be revegetated using regionally indigenous vegetation once the lands are no longer needed to support building activities.

Table 8-2. Summary of Findings and Mitigation

Issue	*ANR GEIS Section*	*Category*	*Finding*	*Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions*
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
Dredging and Filling Aquatic Habitats to Build Intake and Discharge Structures	3.6.2.1.2	1	SMALL	• Applicant would obtain approval, if required, under NWP 7 in 33 CFR 330. • Applicant would implement any mitigation required under NWP 7 in 33 CFR 330. • Applicant would minimize any temporarily disturbed shoreline and riparian lands needed to build the intake and discharge structures and restore those areas with regionally indigenous vegetation suited to those landscape settings once the disturbances are no longer needed. • BMPs would be used for erosion and sediment control.
Building Transmission Lines, Pipelines, and Access Roads across Surface Waterbodies	3.6.2.1.3	1	SMALL	• If activities regulated under the CWA are performed, they would receive approval under one or more NWPs (33 CFR 330) or other general permits recognized by USACE. • Pipelines would be extended under (or over) surface through directional drilling without physically disturbing shorelines or bottom substrate. • Access roads would span streams and other surface waterbodies with a bridge or ford, and any fords would include placement and maintenance of matting to minimize physical disturbance of shorelines and bottom substrates. • No access roads would be extended across stream channels over 10 feet (3 m) in width (at ordinary high water). • Any bridges or fords would be removed once no longer needed, and any exposed soils or substrate would be revegetated using regionally indigenous vegetation appropriate to the landscape setting. • Any mitigation measures indicated in the NWPs or other permits would be implemented. • BMPs would be used for erosion and sediment control.
Important Species and Habitats – Resources Regulated under the ESA and Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.)	3.6.2.1.4.1	2	Undetermined	• The NRC staff is unable to determine the significance of potential impacts without consideration of project-specific factors, including the specific species and habitats affected and the types of ecological changes potentially resulting from each specific licensing action. Furthermore, the ESA and Magnuson-Stevens Fishery Conservation and Management Act require consultations for each licensing action that may affect regulated resources.
Important Species and Habitats – Other Important Species and Habitats	3.6.2.1.4.2	1	SMALL	• Applicants would communicate with state natural resource or conservation agencies regarding aquatic fish, wildlife, and plants and implement mitigation recommendations of those agencies.

Table 8-2. Summary of Findings and Mitigation

Issue	ANR GEIS Section	Category	Finding	Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
Operation				
Stormwater Runoff	3.6.2.2.1	1	SMALL	• Preparation, approval by applicable regulatory agencies, and implementation of a stormwater management plan. • Obtaining and compliance with any required permits for the storage and use of hazardous materials issued by Federal and state agencies under the Resource Conservation and Recovery Act (RCRA). • BMPs would be used for stormwater management.
Exposure of Aquatic Organisms to Radionuclides	3.6.2.2.2	1	SMALL	• Applicants would demonstrate in their application that any radiological nonhuman biota doses would be below IAEA (1992) and NCRP (1991) guidelines.
Effects of Refurbishment on Aquatic Biota	3.6.2.2.3	1	SMALL	• BMPs would be used for erosion, sediment control, and stormwater management. • Exposed soils would be restored as soon as possible with regionally indigenous vegetation.
Effects of Maintenance Dredging on Aquatic Biota	3.6.2.2.4	1	SMALL	• If activities regulated under the CWA are performed, those activities would receive approval under one or more NWPs (33 CFR 330), or other general permits recognized by USACE. • Any mitigation measures indicated in the NWPs or other permits would be implemented. • BMPs would be used for erosion and sediment control.
Impacts of Transmission Line ROW Management on Aquatic Resources	3.6.2.2.5	1	SMALL	• Vegetation in transmission line ROWs would be managed following a plan consisting of integrated vegetation management practices. • All ROW maintenance work would be performed in compliance with all applicable laws and regulations. • Herbicides would be applied by licensed applicators, and only if in compliance with applicable manufacturer label instructions. • BMPs would be used for erosion and sediment control.
Impingement and Entrainment of Aquatic Organisms	3.6.2.2.6	1	SMALL	• Intakes would comply with regulatory requirements established by EPA in 40 CFR 125.84 to be protective of fish and shellfish. • Best available control technology would be employed in the design of intakes to minimize entrainment and impingement, such as use of screens and intake rates recognized to minimize effects.

Table 8-2. Summary of Findings and Mitigation

Issue	*ANR GEIS Section*	*Category*	*Finding*	*Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions*
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
Thermal Impacts on Aquatic Biota	3.6.2.2.7	2	Undetermined	• Staff would have to first review the discharge plume analysis (as described in ANR GEIS Section 3.4) and the aquatic biota potentially present before being able to reach a conclusion regarding the possible significance of impacts on that biota.
Other Effects of Cooling-Water Discharges on Aquatic Biota	3.6.2.2.8	2	Undetermined	• Staff would have to first review the discharge plume analysis (as described in ANR GEIS Section 3.4) and the aquatic biota potentially present before being able to reach a conclusion regarding the possible significance of impacts on that biota.
Water Use Conflicts with Aquatic Resources	3.6.2.2.9	1	SMALL	• If needed, cooling towers would be mechanical draft, not natural draft; less than 100 feet (30.5 m) in height; and equipped with drift eliminators. • Any makeup water for the cooling towers would be fresh water (less than 1 ppt salinity). • Total plant water demand would be less than or equal to a daily average of 6,000 gpm (0.379 m^3/s). • If water is withdrawn from flowing waterbodies, average plant water withdrawals would not reduce flow by more than 3% of the 95% exceedance daily flow and would not prevent maintenance of applicable instream flow requirements. • Any water withdrawals would be in compliance with any EPA or state permitting requirements. • Applicants would be able to demonstrate that hydroperiod changes are within historical or seasonal fluctuations.
Important Species and Habitats – Resources Regulated under the ESA and Magnuson-Stevens Fishery Conservation and Management Act	3.6.2.2.10.1	2	Undetermined	• The NRC staff is unable to determine the significance of potential impacts without consideration of project-specific factors, including the specific species and habitats affected and the types of ecological changes potentially resulting from each specific licensing action. Furthermore, the ESA and Magnuson-Stevens Fishery Conservation and Management Act require consultations for each licensing action that may affect regulated resources.
Important Species and Habitats – Other Important Species and Habitats	3.6.2.2.10.2	1	SMALL	• Applicants would communicate with state natural resource or conservation agencies regarding aquatic fish, wildlife, and plants and implement mitigation recommendations of those agencies.
Historic and Cultural Resources				
Construction				

Table 8-2. Summary of Findings and Mitigation

Issue	***ANR GEIS Section***	***Category***	***Finding***	***Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions***
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
Construction Impacts on Historic and Cultural Resources	3.7.2	2	Undetermined	• Impacts on historic and cultural resources are analyzed on a project-specific basis. The NRC will perform National Environmental Policy Act (NEPA) and National Historic Preservation Act (NHPA) Section 106 analysis, in accordance with 36 CFR 800, in its preparation of the SEIS. The NHPA Section 106 analysis includes consultation with the State and Tribal Historic Preservation Officers, American Indian Tribes, and other interested parties.
Operation				
Operation Impacts on Historic and Cultural Resources	3.7.2	2	Undetermined	• Impacts on historic and cultural resources are analyzed on a project-specific basis. The NRC will perform NEPA and NHPA Section 106 analysis, in accordance with 36 CFR 800, in its preparation of the SEIS. The NHPA Section 106 analysis includes consultation with the State and Tribal Historic Preservation Officers, American Indian Tribes, and other interested parties.
Environmental Hazards – Radiological Environment				
Construction				
Radiological Dose to Construction Workers	3.8.1.2.1	1	SMALL	• For protection against radiation, the applicant must meet the regulatory requirements of: – 10 CFR 20.1101, *Radiation Protection Programs* (10 CFR 20) if issued a license – 10 CFR 20.1201, Occupational dose limits for adults – 10 CFR 20.1301 Dose limits for individual members of the public – Appendix B of 10 CFR 20 Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage • Applicable NRC radiation protection regulations, such as: – 10 CFR 50.34a (10 CFR 50), Design objectives for equipment to control releases of radioactive material in effluents—nuclear power reactors – 10 CFR 50.36a Technical specifications on effluents from nuclear power reactors • Application contains sufficient technical information for the staff to complete the detailed technical safety review. • Application will be found to be in compliance by the staff with the above regulations through a radiation protection program and an effluent release monitoring program.
Operation				

Table 8-2. Summary of Findings and Mitigation

Issue	***ANR GEIS Section***	***Category***	***Finding***	***Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions***
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
Occupational Doses to Workers	3.8.1.2.2.1	1	SMALL	• For protection against radiation, the applicant must meet the regulatory requirements of: – 10 CFR 20.1101, *Radiation Protection Programs* (10 CFR 20-TN283) if issued a license – 10 CFR 20.1201, Occupational dose limits for adults – Appendix B of 10 CFR 20, Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage • Applicable radiation protection regulations, such as: – 10 CFR 50.34a (10 CFR 50), Design objectives for equipment to control releases of radioactive material in effluents—nuclear power reactors • 10 CFR 50.36a, Technical specifications on effluents from nuclear power reactors • Application contains sufficient technical information for the staff to complete the detailed technical safety review • Application will be found to be in compliance by the staff with the above regulations through a radiation protection program and an effluent release monitoring program.
Maximally Exposed Individual Annual Doses	3.8.1.2.2.2	1	SMALL	• For protection against radiation, the applicant must meet the regulatory requirements of: – 10 CFR 20.1101 (10 CFR 20), *Radiation Protection Programs* if issued a license – 10 CFR 20.1301, Dose limits for individual members of the public – Appendix B of 10 CFR 20, Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage • Applicable radiation protection regulations, such as: – 10 CFR 50.34a (10 CFR 50), Design objectives for equipment to control releases of radioactive material in effluents—nuclear power reactors – 10 CFR 50.36a, Technical specifications on effluents from nuclear power reactors • Application contains sufficient technical information for the staff to complete the detailed technical safety review • Application will be found to be in compliance by the staff with the above regulations through a radiation protection program and an effluent release monitoring program
Total Population Annual Doses	3.8.1.2.2.3	1	SMALL	• For protection against radiation, the applicant must meet the regulatory requirements of:

Table 8-2. Summary of Findings and Mitigation

Issue	*ANR GEIS Section*	*Category*	*Finding*	*Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions*
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
				– 10 CFR 20.1101, *Radiation Protection Programs* (10 CFR 20) if issued a license – 10 CFR 20.1301, Dose limits for individual members of the public – Appendix B of 10 CFR 20, Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage • Applicable radiation protection regulations, such as: – 10 CFR 50.34a, (10 CFR 50) Design objectives for equipment to control releases of radioactive material in effluents—nuclear power reactors – 10 CFR 50.36a, Technical specifications on effluents from nuclear power reactors • Application contains sufficient technical information for the staff to complete the detailed technical safety review • Application will be found to be in compliance by the staff with the above regulations through a radiation protection program and an effluent release monitoring program.
Nonhuman Biota Doses	3.8.1.2.2.4	1	SMALL	• Applicants would demonstrate in their application that any radiological nonhuman biota doses would be below IAEA (1992) and NCRP (1991) guidelines.
Environmental Hazards – Nonradiological Environment				
Construction				
Building Impacts of Chemical, Biological, and Physical Nonradiological Hazards	3.8.2.2.1.1	1	SMALL	• The applicant must adhere to all applicable Federal, state, local, or Tribal regulatory limits and permit conditions for chemical hazards, biological hazards, and physical hazards. • The applicant will follow nonradiological public and occupational health BMPs and mitigation measures, as appropriate.
Building Impacts of Electromagnetic Fields (EMFs)	3.8.2.2.1.2	N/A	Uncertain	• Studies of 60 Hz EMFs have not uncovered consistent evidence linking harmful effects with field exposures. Because the state of the science is currently inadequate, no generic conclusion on human health impacts is possible. If, in the future, the Commission finds that a general agreement has been reached by appropriate Federal health agencies that there are adverse health effects from EMFs, the Commission will require applicants to submit project-specific reviews of these health effects as part of their application. Until such time, applicants are not required to submit information about this issue.
Operation				

Table 8-2. Summary of Findings and Mitigation

Issue	***ANR GEIS Section***	***Category***	***Finding***	***Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions***
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
Operation Impacts of Chemical, Biological, and Physical Nonradiological Hazards	3.8.2.2.2.1	1	SMALL	• The applicant must adhere to all applicable Federal, state, local, or Tribal regulatory limits and permit conditions for chemical hazards, biological hazards, and physical hazards. • The applicant will follow nonradiological public and occupational health BMPs and mitigation measures, as appropriate.
Operation Impacts of EMFs	3.8.2.2.2.2	N/A	Uncertain	• Studies of 60 Hz EMFs have not uncovered consistent evidence linking harmful effects with field exposures. Because the state of the science is currently inadequate, no generic conclusion on human health impacts is possible. If, in the future, the Commission finds that a general agreement has been reached by appropriate Federal health agencies that there are adverse health effects from EMFs, the Commission will require applicants to submit project-specific reviews of these health effects as part of their application. Until such time, applicants are not required to submit information about this issue.
Noise				
Construction				
Construction-Related Noise	3.9.2.1	1	SMALL	• The noise level would be no more than 65 dBA at site boundary, unless a relevant state or local noise abatement law or ordinance sets a different threshold, which would then be the presumptive threshold for PPE purposes. • If an applicant cannot meet the 65 dBA threshold through mitigation, then the applicant must obtain a variance or exception with the relevant state or local regulator. • The project would implement BMPs, such as modeling, foliage planting, construction of noise buffers, and the timing of construction and/or operation activities.
Operation				
Operation-Related Noise	3.9.2.2	1	SMALL	• The noise level would be no more than 65 dBA at site boundary, unless a relevant state or local noise abatement law or ordinance sets a different threshold, which would then be the presumptive threshold for PPE purposes. • If an applicant cannot meet the 65 dBA threshold through mitigation, then the applicant must obtain a variance or exception with the relevant state or local regulator. • The project would implement BMPs, such as modeling, foliage planting, construction of noise buffers, and the timing of construction and/or operation activities.
Waste Management – Radiological Environment				
Operation				

Table 8-2. Summary of Findings and Mitigation

Issue	ANR GEIS Section	Category	Finding	Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
Low-Level Radioactive Waste (LLW)	3.10.1.2.1	1	SMALL	• Applicants must meet the regulatory requirements of 10 CFR 20 (e.g., 20.1406 and Subpart K), 10 CFR 61 10 CFR 71 and 10 CFR 72. • Quantities of low-level radioactive waste (LLW) generated at an ANR would be less than the quantities of LLW generated at existing nuclear power plants, which generate an average of 21,200 ft^3 (600 m^3) and 2,000 Ci (7.4×10^{13} Bq) per year for boiling water reactors and half that amount for pressurized water reactors (NRC, 2013a).
On-Site Spent Nuclear Fuel Management	3.10.1.2.2	1	SMALL	• Compliance with 10 CFR 72
Mixed Waste	3.10.1.2.3	1	SMALL	• RCRA Small-Quantity Generator (EPA, 2020) for Mixed Waste.
Waste Management – Nonradiological Environment				
Construction				
Construction Nonradiological Waste	3.10.2.2.1	1	SMALL	• The applicant must meet all the applicable permit conditions, regulations, and BMPs related to solid, liquid, and gaseous waste management. • For hazardous waste generation, applicants must meet conformity with hazard waste quantity generation levels in accordance with RCRA. • For sanitary waste, applicants must dispose of sanitary waste in a permitted process. • For mitigation measures, the applicant would perform mitigation measures to the extent practicable, such as recycling, process improvements, or the use of a less hazardous substance.
Operation				
Operation Nonradiological Waste	3.10.2.2.2	1	SMALL	• The applicant must meet all the applicable permit conditions, regulations, and BMPs related to solid, liquid, and gaseous waste management. • For hazardous waste generation, applicants must meet conformity with hazard waste quantity generation levels in accordance with RCRA. • For sanitary waste, applicants must dispose of sanitary waste in a permitted process. • For mitigation measures, the applicant would perform mitigation measures to the extent practicable, such as recycling, process improvements, or the use of a less hazardous substance.
Postulated Accidents				
Operation				

Table 8-2. Summary of Findings and Mitigation

Issue	***ANR GEIS Section***	***Category***	***Finding***	***Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions***
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
Design Basis Accidents Involving Radiological Releases	3.11.2.1	1	SMALL	• For the exclusion area boundary, the maximum total effective dose equivalent (TEDE) for any 2-hour period during the radioactivity release should be calculated. • For the low-population zone, the TEDE should be calculated for the duration of the accident release (i.e., 30 days, or other duration as justified). • The above calculations should demonstrate that the design basis accident doses satisfy the dose criteria given in regulations related to the application (e.g., 10 CFR 50.34(a)(1), 10 CFR 52.17(a)(1), and 10 CFR 52.79(a)(1) [10 CFR 52]), standard review plans (e.g., standard review plan [SRP] criteria, Table 1 in SRP Section 15.0.3 of NUREG-0800 (NRC, 2007/2019), and Regulatory Guides (RGs), e.g., RG 1.183 (NRC, 2000b)) as applicable.
Accidents Involving Releases of Hazardous Chemicals	3.11.2.2	1	SMALL	• ANR inventory of a regulated substance is less than its Threshold Quantity. Threshold Quantities are found in 40 CFR 68.130, Tables 1–4; and • ANR inventory of an extremely hazardous substance is less than its Threshold Planning Quantity. Threshold Planning Quantities are found in 40 CFR 355, Appendices A and B.
Severe Accidents	3.11.2.3	2	Undetermined	• Based on the analysis in the Final Safety Analysis Report/Preliminary Safety Analysis Report regarding severe accidents, if an ANR design has severe accident progressions with radiological or hazardous chemical releases, then an environmental risk evaluation must be performed.
Severe Accident Mitigation Design Alternatives	3.11.2.4	1	SMALL	• If a cost-screening analysis determines that the maximum benefit for avoiding an accident is so small that a severe accident mitigation design alternative analysis is not justified based on a minimum cost to design an appropriate severe accident mitigation design alternative.
Acts of Terrorism	3.11.2.5	1	SMALL	• The environmental impacts of acts of terrorism and sabotage only need to be addressed if an ANR facility is subject to the jurisdiction of the U.S. Court of Appeals for the Ninth Circuit.
Socioeconomics				
Construction				
Community Services and Infrastructure	3.12.1.1.1	1	SMALL	• The housing vacancy rate in the affected economic region does not change by more than 5%, or at least 5% of the housing stock remains available after accounting for in-migrating construction workers. • Student-teacher ratios in the affected economic region do not exceed locally mandated levels after including the school-age children of the in-migrating worker families.

Table 8-2. Summary of Findings and Mitigation

Issue	*ANR GEIS Section*	*Category*	*Finding*	*Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions*
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
Transportation Systems and Traffic	3.12.1.1.2	1	SMALL	• The LOS determination for affected roadways does not change. Mitigation measures may include implementation of traffic flow management, management of shift-change timing, and encouragement of ridesharing and use of public transportation options, such that LOS values can be maintained with the increased volumes.
Economic Impacts	3.12.1.1.3	1	Beneficial	• The economic impacts of construction and operation of an ANR are expected to be beneficial; therefore, this is a Category 1 issue. If, during the project-specific environmental review, the NRC staff determines a detailed analysis of economic costs and benefits is needed for analysis of the range of alternatives considered or relevant to mitigation, the staff may require further information from the applicant.
Tax Revenue Impacts	3.12.1.1.4	1	Beneficial	• The tax revenue impacts of construction and operation of an ANR are expected to be beneficial; therefore, this is a Category 1 issue. If, during the project-specific environmental review, the NRC staff determines a detailed analysis of tax revenue costs and benefits is needed for analysis of the range of alternatives considered or relevant to mitigation, the staff may require further information from the applicant.
Operation				
Community Services and Infrastructure	3.12.1.2.1	1	SMALL	• The housing vacancy rate in the affected economic region does not change by more than 5%, or at least 5% of the housing stock remains available after accounting for in-migrating construction workers. • Student: teacher ratios in the affected economic region do not exceed locally mandated levels after including the school-age children of the in-migrating worker families.
Transportation Systems and Traffic	3.12.1.2.2	1	SMALL	• The LOS determination for affected roadways does not change. Mitigation measures may include implementation of traffic flow management, management of shift-change timing, and encouragement of ridesharing and use of public transportation options, such that LOS values can be maintained with the increased volumes.
Economic Impacts	3.12.1.2.3	1	Beneficial	• The economic impacts of construction and operation of an ANR are expected to be beneficial; therefore, this is a Category 1 issue. If, during the project-specific environmental review, the NRC staff determines a detailed analysis of economic costs and benefits is needed for analysis of the range of alternatives considered or relevant to mitigation, the staff may require further information from the applicant.
Tax Revenue Impacts	3.12.1.2.4	1	Beneficial	• The tax revenue impacts of construction and operation of an ANR are expected to be beneficial; therefore, this is a Category 1 issue. If, during the project-specific environmental review, the NRC staff determines a detailed analysis of tax revenue costs

Table 8-2. Summary of Findings and Mitigation

Issue	ANR GEIS Section	Category	Finding	Plant Parameter Envelope/Site Parameter Envelope Values and Assumptions
Note: For Category 2 issues, the impacts are stated as "Undetermined" because the NRC staff cannot reach a generic conclusion regarding the impacts for these issues.				
				and benefits is needed for analysis of the range of alternatives considered or relevant to mitigation, the staff may require further information from the applicant.
Environmental Justice				
Construction				
Construction Environmental Justice Impacts	3.13.2.1	2	Undetermined	• Project-specific analysis would be necessary, including analysis of the presence and size of specific minority or low-income populations, impact pathways derived from the plant design, layout, or site characteristics, or other community characteristics affecting specific minority or low-income populations. In performing its environmental justice analysis, the NRC staff will be guided by the NRC's "Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions," which was published in the *Federal Register* on August 24, 2004 (69 FR 52040).
Operation				
Operation Environmental Justice Impacts	3.13.2.1	2	Undetermined	• Project-specific analysis would be necessary, including analysis of the presence and size of specific minority or low-income populations, impact pathways derived from the plant design, layout, or site characteristics, or other community characteristics affecting specific minority or low-income populations. In performing its environmental justice analysis, the NRC staff will be guided by the NRC's "Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions," which was published in the *Federal Register* on August 24, 2004 (69 FR 52040).

Key: ANR = advanced nuclear reactor; APLIC = Avian Power Line Interaction Committee; BMP= best management practice; Bq = becquerel; CAA = Clean Air Act; CFR = Code of Federal Regulations; CO_2e = carbon dioxide equivalent; CWA = Clean Water Act; CZMA = Coastal Zone Management Act; dBA = decibel levels are "A" weighted; EMFs = electromagnetic fields; EPA = U.S. Environmental Protection Agency; GHG = greenhouse gas; gpm = gallons per minute; HAP = hazardous air pollutant; ha = hectares; km = kilometers; kV = kilovolt; LLW = low-level radioactive waste; LOS = level of service; m^3 = cubic meters; MT = metric tons; NEPA = National Environmental Policy Act; NHPA = National Historic Preservation Act; NPDES = National Pollutant Discharge Elimination System; NRC = U.S. Nuclear Regulatory Commission; NWP = nationwide permit; PPE/SPE = Plant Parameter Envelope/Site Parameter Envelope; ppt = parts per thousand; ROWs = rights-of-way; RCRA = Resource Conservation and Recovery Act; SEIS = Supplemental Environmental Impact Statement; SRP = standard review plan; SSA = Sole Source aquifer; USACE = U.S. Army Corps of Engineers; USFWS = U.S. Fish and Wildlife Service

Note:

[a] Fuel fabrication impacts for metal fuel and liquid-fueled molten salt are not included in the staff's generic analysis.

Table 8-3. Microreactor PPE Data Sources and Methodology [(a)]

Parameter	*Information Sources*				*Microreactor Bounding Value*	*Source/Rationale*
	NRC ANR GEIS Value	*Internal Research Value*	*Vendor Bounding Value*	*Regulatory Limit Value*		
Plant Design						
What is your design type?	None provided	HTGR, MSR, LMR, heat pipe, and nuclear battery	HTGR, MSR, LMR, and nuclear battery	Not applicable	**Not Applicable for bounding parameters**	Plant type itself is not relevant to the environmental analysis; parameters therein that have an environmental interface are considered.
How many units do you plan to install?	None provided	Not evaluated	1	Not applicable	**1**	While the PPE considers installation of one unit, multiple units may be proposed, for instance to demonstrate the capability of following increases in electricity demand over time. This would have potential impacts on the extent and timing of resource analyses, including cumulative impacts.
What is the output of your design (per unit)?	60 MWt/20MWe	13 MWe	50 MWt 17 MWe	Not applicable	**60 MWt**	Value is bounded by a larger microreactor that maximizes the difference between thermal and electrical output and will generally lead to greater resource needs, such as cooling water. Therefore, NRC's proposed microreactor limit was selected as the bounding value.
Is your reactor designed to be mobile?	None provided	Not evaluated	No	Not applicable	**No**	While the PPE representative value indicates that the reactor is not mobile, some designs may include mobile reactors. If so, there would be additional transportation and workforce related issues that would have to be considered.
If the reactor is designed to be transportable, what are the total number of shipments and weight of reactor, fuel, and its packaging?	None provided	Not evaluated	15 shipments, including the reactor, fuel, and core assembly	Not applicable	**30 shipments, including the reactor, fuel, and core assembly**	The largest value among the microreactor vendor responses, scaled to a 60 MWt reactor.
Describe your power conversion system.	None provided	Not evaluated	Varied; including		**N/A**	Power conversion does not itself have an environmental nexus.

Table 8-3. Microreactor PPE Data Sources and Methodology [(a)]

Parameter	*Information Sources*				*Microreactor Bounding Value*	*Source/Rationale*
	NRC ANR GEIS Value	*Internal Research Value*	*Vendor Bounding Value*	*Regulatory Limit Value*		
			Rankine Cycle, Brayton Cycle, and Air cooled DOWTHERM™ heat transfer fluid			
Will off-site power sources be required to maintain functioning of structures, systems, and components important to safety following loss of on-site AC power? If so, what transmission voltage would be required from off-site power sources?	Required. Off-site ROW 1,000 ft × 100 ft (new) or within or adjacent to existing ROW	Required, assuming compliance with General Design Criteria 17	None provided	General Design Criteria 17	**Required. Off-site ROW 1,000 ft × 100 ft (new) or within or adjacent to existing ROW**	The requirement for access to the existing on-site INL transmission system would bound all designs. Both substation and transmission interconnections are assumed to be required. Length and breadth of transmission line right-of-way and size of the switchyard will depend on final site location.
What support facilities (fuel storage and handling, waste treatment, etc.) are necessary for your plant design?	None provided	Fuel storage and handling; waste treatment; reactor pre-heating and metal melting; control building; power conversion	Varied	Not applicable	**Fuel storage and handling; waste treatment; reactor pre-heating and metal melting; control building; power conversion**	Representative support facilities as informed by SME analysis and review of publicly available information on microreactors, small- to medium-sized advanced reactors, and vendor responses. The existence of these structures themselves does not have an environmental nexus; however, the land use requirements and resource needs associated with these facilities will have an environmental nexus and should be considered.
Plant Structure and Footprint						
What is the tallest structure and what is the maximum structure height (structure, ft)?	50 ft (structure) None provided (stack)	28 ft structure 45 ft stack height	28 ft structure 45 ft stack	Not applicable	**28 ft structure 50 ft stack height**	Selected largest values from vendor responses and NRC ANR GEIS PPE to better bound potential visual, scenic, and land use impacts

Table 8-3. Microreactor PPE Data Sources and Methodology [(a)]

Parameter	Information Sources				Microreactor Bounding Value	Source/Rationale
	NRC ANR GEIS Value	Internal Research Value	Vendor Bounding Value	Regulatory Limit Value		
What is the stack height?						
What is the maximum depth of excavation?	50 ft	Not Evaluated	20 ft	Not applicable	**20 ft**	Selected largest value consistent with vendor responses. The NRC ANR GEIS value appears larger than necessary for the planned microreactor deployments.
What is the temporary disturbed acreage during construction, including parking and laydown?	50 ac	10 ac	8 ac	Not applicable	**18 ac**	Selected values that bound vendor responses, with slight rounding up to account for potential larger projects. The NRC ANR GEIS value appears larger than necessary for the planned microreactor deployments.
What is the permanent disturbed acreage, including parking lots, ponds, substations, and other plant support facilities?	30 ac	8 ac	7 ac	Not applicable	**8 ac**	Selected values that bound vendor responses. The NRC ANR GEIS value appears larger than necessary for the planned microreactor deployments.
What is the maximum expected sound level due to construction activities, measured at 50 ft from the noise source?	None provided	101 dB at 50 ft	Question not asked	Not applicable	**101 dB at 50 ft**	Questionnaire did not include this parameter. SME estimate is from the Clinch River EIS PPE (NRC, 2019b).
Are there large quantities of any unique materials (perhaps items not normally used in general office or industrial buildings) that will be used in plant construction (e.g., graphite)? If so, what are these anticipated volumes?	None provided	Not evaluated	160 tons/15 m^3 lead; borated poly; graphite; sodium	Not applicable	**160 tons/15 m^3 lead; borated poly; graphite; sodium; 52.5 MT molten salt**	Responses did not pose any particular environmental challenges. Any particular unique materials are necessarily specific to a given design proposed for deployment. For purposes of impact analysis, the SME estimate of unique materials should bound applicable resource impacts

Table 8-3. Microreactor PPE Data Sources and Methodology [(a)]

Parameter	***Information Sources***				***Microreactor Bounding Value***	***Source/Rationale***
	NRC ANR GEIS Value	***Internal Research Value***	***Vendor Bounding Value***	***Regulatory Limit Value***		
Operational Parameters						
What is the operational life for which the plant is designed? How long do you intend to operate the reactor prototype?	80 yr 2 to 20 yr operating cycle length	Not evaluated	30 yr 10 yr	Not applicable	**30 yr** **10 yr**	Selected longest vendor response value. Prototype deployment at INL would likely be shorter than the 80-yr operational period chosen by NRC for a commercial reactor.
Do you anticipate installing additional modules incrementally over time?	None provided	Not evaluated	No	Not applicable	**No**	While the PPE assumes that additional modules would not be added over time, particularly for demonstration projects, it is possible that multiple modules could be proposed for certain microreactor applications. This would have additive implications as well as potential cumulative impacts.
What is the reactor heat transfer material (coolant)? How much is required initially/annually?	Water	52.5 MT molten salt initial loading 150 MT lead initial loading	Liquid lead 73 tons Initially 0 tons Annually	Not applicable	**52.5 MT molten salt initial loading** **150 MT lead initial loading**	Molten salt value obtained by scaling Molten Salt Reactor Experiment (MSRE) (8 MWt) coolant quantity to 60 MWt (ORNL, 2015) Lead value obtained by scaling and rounding vendor response (30 MWt) to 60 MWt
What is the anticipated technology (or technologies) for the normal plant heat sink?	None provided	Mechanical draft cooling tower	Varied	Not applicable	**Mechanical draft cooling tower**	It is anticipated that mechanical draft cooling towers, in general, will have the most resource-intensive type of plant heat sink.
What are the maximum and average daily water use requirements for plant cooling and service water systems, including potable and sanitary water use (if required)?	1,000 gpm	335 gpm (average) For air-cooled reactors, 25 gpm	450 gpm (average)	Not applicable	**450 gpm (average)** For air-cooled reactors, 25 gpm	The bounding vendor value was chosen as the PPE value because it exceeds the SME calculated value. For air-cooled reactors, the PPE water use includes non-cooling uses, which were based upon scaling non-cooling-water use from the Clinch River EIS, and potable/sanitary use assumed to be 100 gpd per member of the vendor-provided or estimated operations workforce.

Table 8-3. Microreactor PPE Data Sources and Methodology [(a)]

Parameter	*Information Sources*				*Microreactor Bounding Value*	*Source/Rationale*
	NRC ANR GEIS Value	*Internal Research Value*	*Vendor Bounding Value*	*Regulatory Limit Value*		
What are the expected characteristics of plant water discharges (if any)?	600 gpm	102 gpm For air-cooled reactors, 25 gpm	400 gpm	Not applicable	**400 gpm** For air-cooled reactors, 25 gpm	The vendor value was chosen as the PPE value for consistency with the water demand estimate. For air-cooled reactors, the PPE discharge includes non-cooling system wastewater and potable/sanitary wastewater, assumed to be equivalent to the water use rate for these purposes.
Blowdown temperature and constituent concentrations	Within applicable Clean Water Act limits	Not evaluated	Not Evaluated	Within applicable Clean Water Act limits	**Within applicable Clean Water Act limits**	Questionnaire did not include this parameter. Discharges mainly from plant blowdown are regulated under a Clean Water Act permit.
What are the chemical and radionuclide constituents of the plant discharges, and maximum and expected concentrations/activities in the discharge (if available)?	Within applicable Clean Water Act limits	See Clinch River Table - Projected Blowdown Constituents and Concentrations (Table C.2).*	None Provided	DOE O 458.1 (DOE-STD-1196 and DOE-STD-1153) (or 10 CFR Part 20 Appendix B) for both liquid and gaseous effluents and 40 CFR Part 61 Subpart H for gaseous effluents	**See Clinch River Table - Projected Blowdown Constituents and Concentrations, Table C.2.***	Clinch River ER provided anticipated constituents and concentrations associated with blowdown, which would be assumed to be the dominant portion of liquid nonradioactive waste. Not all of these constituents would be relevant to each microreactor design, but these values represent a reasonable estimate for values that could be included in a surrogate plant.
What is the fuel source and size of auxiliary boilers, emergency power systems and standby power systems (if applicable) (fuel source, MW)?	None provided	Not evaluated	Diesel 50-150 kW Standby Power	Not applicable	**Two diesel 50–150 kW standby power generators**	The largest value from vendor responses was selected. Two generators are assumed for redundancy to power plant safety systems in the event of loss of off-site power.
Emissions from construction equipment and standby power	Criteria pollutants are less than Clean Air Act *de minimis* levels	Not evaluated	Not evaluated	Criteria pollutants are less than Clean	**Criteria pollutants are less than Clean**	Questionnaire did not include this parameter. Clean Air Act requires a conformity determination for maintenance

Table 8-3. Microreactor PPE Data Sources and Methodology [(a)]

Parameter	***Information Sources***				***Microreactor Bounding Value***	***Source/Rationale***
	NRC ANR GEIS Value	***Internal Research Value***	***Vendor Bounding Value***	***Regulatory Limit Value***		
equipment during operations				Air Act *de minimis* levels	**Air Act *de minimis* levels**	or nonattainment areas that exceed *de minimis* values. Not applicable to attainment areas, so this would be bounding for INL.
How much hazardous, radioactive, and mixed waste would be generated during operations, and where would it be dispositioned?	None provided	19 MT radioactive waste (fuel) 315 MT molten salt (mixed) Hazardous waste generation amount would be within the criteria of a small quantity generator	None provided	Small quantity generators produce more than 100 kilograms, but less than 1,000 kilograms of hazardous waste a month.	**19 MT radioactive waste (fuel)** **315 MT molten salt (mixed)**	Reference molten salt reactor consumes 1,930 kg of 19.7 percent enriched U and 3,290 kg of Th annually; scaled from reference reactor's power (500 MWt) to microreactor power (60 MWt). Assumes 30 yr demonstration. Initial loading of molten salt value taken by scaling MSRE (8 MWt) coolant quantity to 60 MWt (ORNL, 2015). Assuming MSRE initial loading of 52.5 MT of molten salt would be replenished every 5 yr, two loadings would be needed for the assumed 80 yr demonstration. The molten salt spent fuel and coolant would be classified as either high-level mixed waste or mixed transuranic waste (depending on the spent fuel processing). These waste volumes reflect waste that would be generated from within the reactor vessel. For estimates of total radioactive waste generation (excluding spent fuel) see estimates of the total number of shipments and volume of radioactive waste. RCRA requires waste management for hazardous waste and sets a volume amount of generations of no more than 1,000 kg a month. This volume could be used as a bounding value.
What is the stack exit velocity?	None provided	Not evaluated	10 ft/s	Not applicable	**10 ft/s**	The largest value from vendor responses was selected.

Table 8-3. Microreactor PPE Data Sources and Methodology [(a)]

Parameter	*Information Sources*				*Microreactor Bounding Value*	*Source/Rationale*
	NRC ANR GEIS Value	*Internal Research Value*	*Vendor Bounding Value*	*Regulatory Limit Value*		
What amount of noise would be generated 50 ft from the source and at the site boundary?	65 dBA at site boundary	Not evaluated	None provided	Not applicable	**65 dBA at site boundary**	The value from the NRC estimate in ANR GEIS was selected and it is consistent with NRC Environmental Standard Review Plans (NRC, 2013b).
Fuel						
What is the form of the fuel associated with your design?	None provided	Molten salt	Molten salt	Not applicable	**Molten salt**	Fuel types could include UO2, MOX, Metal (U, U alloys, Pu-containing alloys), TRISO, molten salt, uranium nitride, uranium carbide, QUADRISO, cermet, accident-tolerant fuel. Emission release mechanisms from molten salt are different from LWRs; expect that molten salt will have upper bounding impacts compared to other fuel technologies.
What is the annual average fuel requirement (metric tons) per module?	None provided	0.5 MT (5 MT initial fuel loading)	0.5 MT	Not applicable	**0.5 MT (5 MT initial fuel loading)**	The largest value from vendor responses was selected.
Where would fuel be obtained?	None provided	Not evaluated	Existing DOE supply	Not applicable	**Off-site commercial source**	Multiple vendors assumed that the fuel would come from an existing DOE supply at INL, while other vendors would source the fuel from off-site commercial sources. For purposes of developing a surrogate reactor, the PPE assumes that fuel would be obtained from off-site sources.
What is the total number of shipments and MTU for unirradiated fuel shipped to reactor or site?	None provided	10 shipments over the 30 yr life of the plant. 45 MTU total	1 shipment, 3 MTU	Not applicable	**10 shipments over the 30 yr life of the plant. 45 MTU total**	Unirradiated fuel shipments scaled to 60 MWt from surrogate SMR from Clinch River ESP (NRC, 2019c, pp. Table 6-4). MTU scaled to 1,000 MWt from Clinch River ESP (NRC, 2019c, pp. Table 6-10).
Total number of shipments and volume of radioactive waste	None provided	49 shipments over the 30 yr life of the plant. Volume	1 shipment, 14 m^3	Not applicable	**49 shipments over the 30 yr life of the plant. Volume of each shipment is**	Radioactive waste shipments and volume scaled to 60 MWt from surrogate SMR from Clinch River ESP (NRC, 2019c, pp. Table 6-14).

Table 8-3. Microreactor PPE Data Sources and Methodology [(a)]

Parameter	***Information Sources***				***Microreactor Bounding Value***	***Source/Rationale***
	NRC ANR GEIS Value	***Internal Research Value***	***Vendor Bounding Value***	***Regulatory Limit Value***		
shipments from reactor/site?		of each shipment is 2.34 m^3.			**2.34 m^3. Total volume = 113 m^3**	These values are used as a bounding measure of radioactive waste generation (excluding spent fuel) but do not account for differences in design or unique waste streams from advanced reactors.
What is the radionuclide inventory for irradiated fuel at time of shipment (Ci/MTU by radionuclide)?	None provided	See Fission Product Inventory (Appendix C.7)*	None provided	Not applicable	**Fission Product Inventory (Appendix C.7)***	See Appendix C.7* in *Advanced Nuclear Reactor Plant Parameter Envelope and Guidance* from the National Reactor Innovation Center (McDowell & Goodman, 2021).
How will the reactor, fresh fuel and other large components be transported to the site?	None provided	Truck	Truck or rail	Not applicable	**Truck**	Truck transportation is assumed based upon internal research value.
Is the reactor designed to be refueled? If so, at what frequency (year)? What MTU per refueling?	None provided	5 MTU [full core refueling]	Yes, online and continuous refueling	Not applicable	**Yes, 5 MTU (full core refueling), online and continuous refueling**	Assumed that the reactor would be refueled in order to develop a more robust bounding impact. Online and continuous refueling was assumed, which may increase impacts associated with radioactive and nonradioactive emissions.
What are the source terms for routine releases (if any) per module and design-basis accidents?	None provided	See Fission Product Inventory (Appendix C.7)*	None provided	Not applicable	**Fission Product Inventory (Appendix C.7)***	See Appendix C.7.* The analysis uses general cases, instead of specific designs, to calculate the radionuclide inventory.
Are there any unique fuel storage or cooling requirements associated with the fuel?	None provided	Not Evaluated	None	Not applicable	**None**	No unique fuel storage or cooling requirements identified by microreactor vendors.
How and where would spent fuel be dispositioned?	None provided	89 shipments of irradiated fuel over the 30 yr life of the plant.	On-site storage	Not applicable	**89 irradiated fuel shipments over 30 yr life of the plant. Off-site storage or disposal. Treatment,**	HALEU and all spent fuel used for the Oklo application would stay at the INL site post-demonstration (Oklo, 2020). Irradiated fuel shipments scaled to 60 MWt from surrogate SMR from Clinch River ESP (NRC, 2019c, pp. Table 6-10). The Clinch River ESP

Table 8-3. Microreactor PPE Data Sources and Methodology [(a)]

Parameter	***Information Sources***				***Microreactor Bounding Value***	***Source/Rationale***
	NRC ANR GEIS Value	***Internal Research Value***	***Vendor Bounding Value***	***Regulatory Limit Value***		
		On-site storage, or off-site storage or disposal			**storage, and disposal in accordance with applicable legal requirements.**	assumed that fuel would be dispositioned to Yucca Mountain. This assumption is not carried forward into this PPE, but the number of shipments is scaled as a bounding value.
Workforce						
How many workers will be on-site for construction?	150	150	None provided	Not applicable	**150**	The largest number of workers from NRC ANR GEIS (NRC, 2021e) was selected to bound impacts.
What is the anticipated construction period?	None provided	6 months	24 months	Not applicable	**24 months**	The largest value from the vendor responses was selected and is consistent with the SME estimate.
What is the number of total permanent staff to support operations?	50	27	None provided	Not applicable	**50**	The largest value from NRC ANR GEIS was selected to bound impacts.
What is the number of temporary staff during refueling (if planned)?	100	21	None provided	Not applicable	**100**	The largest value from the NRC ANR GEIS was selected to bound impacts.
What is the number of temporary staff during additional module installation (if planned)?	None provided	20	None provided	Not applicable	**N/A**	Assumed a single module for purposes of this PPE, thus no temporary staff are needed.
What are the distances from radiation sources to the nearest involved worker?	None provided	500 ft	500 ft	Not applicable	**500 ft**	Internal research estimate is consistent with vendor response.
Decommissioning						
Do you plan to decommission and remove the prototype from the INL site?	None provided	Not evaluated	Yes	Not applicable	**Yes**	It is assumed that the prototype would be decommissioned to bound impacts associated with land use, fuel, transportation, and workforce.
What is the number of temporary staff during decommissioning (if planned)?	None provided	150	None provided	Not applicable	**150**	It is assumed that the number of staff needed during decommissioning would be similar to those needed during construction.

Table 8-3. Microreactor PPE Data Sources and Methodology [(a)]

Parameter	***Information Sources***				***Microreactor Bounding Value***	***Source/Rationale***
	NRC ANR GEIS Value	***Internal Research Value***	***Vendor Bounding Value***	***Regulatory Limit Value***		
What is the number of months from start of decommissioning to completion (if planned)?	None provided	Not evaluated	18 months	Not applicable	**18 months**	Selected the largest value from vendor responses.
How much waste would be generated during decommissioning (if planned)?	None provided	Bounded by the waste streams evaluated in NUREG-0586	None provided	Not applicable	**Bounded by the waste streams evaluated in NUREG-0586**	The anticipated volumes of wastes evaluated in NUREG-0586 were based on industry decommissioning experience as of 2002. Appendix G of NUREG-0586, "Radiation Protection Considerations for Nuclear Power Facility Decommissioning" summarizes effluent releases for operating facilities and decommissioning facilities. Low-level waste volume estimates for decommissioning facilities are presented in Appendix K of NUREG-0586 (NRC, 2002c).

Sources: as provided in McDowell and Goodman (2021)

Key: AC = alternating current; ANR = advanced nuclear reactor; CFR = *Code of Federal Regulations*; DOE = U.S. Department of Energy; EIS = Environmental Impact Statement; ER = Environmental Report; ESP = early site permit; GDC = General Design Criteria; GEIS = Generic Environmental Impact Statement; HALEU = high-assay low-enriched uranium; HTGR = high-temperature gas-cooled reactor; INL = Idaho National Laboratory; LMR = liquid metal reactor; LWR = light water reactor; MSR = molten salt reactor; MSRE = Molten Salt Reactor Experiment; MTU = metric tons of uranium; NRC = U.S. Nuclear Regulatory Commission; PPE = Plant Parameter Envelope; RCRA = Resource Conservation and Recovery Act; ROW = right-of-way; SME = subject matter expert; SMR = small modular reactor

Note:

* Refers to a table, section, or appendix in *Advanced Nuclear Reactor Plant Parameter Envelope and Guidance* from the National Reactor Innovation Center (McDowell & Goodman, 2021).

Table 8-4. Small- to Medium-Sized Advanced Reactor PPE Data Sources and Methodology

Parameter	*Information Sources*					*Small- to Medium-Sized Advanced Reactor Bounding Value*	*Source/Rationale*
	NRC ANR GEIS Value [(a)]	*Internal Research Value*	*Vendor Bounding Value*	*Versatile Test Reactor Draft EIS Value*	*Regulatory Limit Value*		
Plant Design							
What is your design type?	None provided		HTGR, BWR, LMR	GE Hitachi PRISM design	Not applicable	**Not Applicable for bounding parameters**	Plant type itself is not relevant to the environmental analysis; parameters therein that have an environmental interface are considered.
How many units do you plan to install?	None provided	Not evaluated	1-4 units	1	Not applicable	**1**	While the PPE considers installation of one unit, multiple units may be proposed, for instance to demonstrate the capability of following increases in electricity demand over time. This would have potential impacts on the extent and timing of resource analyses, including cumulative impacts.
What is the output of your design (per unit)?	60 MWt/20MWe	Not evaluated	950 MWt	300 MWt	Not applicable	**1,000 MWt**	Based upon the largest vendor response, 1,000 MWt was selected as a bounding value to account for potentially larger plants.
Is your reactor designed to be mobile?	None provided	Not evaluated	No	No	Not applicable	**No**	Reactor is not assumed to be mobile.
If the reactor is designed to be transportable, what are the total number of shipments and weight of reactor,	None provided	Not evaluated	N/A	N/A	Not applicable	**N/A**	Reactor is not assumed to be transportable.

Table 8-4. Small- to Medium-Sized Advanced Reactor PPE Data Sources and Methodology

Parameter	***Information Sources***					***Small- to Medium-Sized Advanced Reactor Bounding Value***	***Source/Rationale***
	NRC ANR GEIS Value [(a)]	***Internal Research Value***	***Vendor Bounding Value***	***Versatile Test Reactor Draft EIS Value***	***Regulatory Limit Value***		
fuel, and its packaging?							
Describe your power conversion system.	None provided	Not evaluated	Rankine Cycle	N/A		**N/A**	Power conversion does not itself have an environmental nexus.
Will off-site power sources be required to maintain functioning of structures, systems, and components important to safety following loss of on-site AC power? If so, what transmission voltage would be required from off-site power sources?	Required. Off-site ROW 1,000 ft × 100 ft (new) or within or adjacent to existing ROW	Required, assuming compliance with General Design Criteria 17	Not required	Yes, two 230 kV transmission lines available	General Design Criteria 17	**Two 230 kV transmission lines required. Off-site ROW 1,000 ft × 100 ft (new) or within or adjacent to existing ROW**	GDC 17 requires two off-site sources of power. The requirement for access to the existing on-site INL transmission system would bound all designs. Both substation and transmission interconnections are assumed to be required. Length and breadth of transmission line right-of-way and size of the switchyard will depend on final site location.
What support facilities (fuel storage and handling, waste treatment, etc.) are necessary for your plant design?	None provided	Not evaluated	Cooling-water system; switchyard/ transformers; chemical/gas/ fuel storage, potable water supply; wastewater system, including retention basins and associated discharge equipment; liquid radwaste system; fire protection and emergency response buildings;	Feedstock preparation facility, fuel fabrication facility, experiment support areas, post-irradiation examination facility, spent fuel treatment facility, on-site spent fuel pad	Not applicable	**Multiple support facilities**	Vendor responses included representative facilities that may be required associated with any given design.

Table 8-4. Small- to Medium-Sized Advanced Reactor PPE Data Sources and Methodology

Parameter	Information Sources					Small- to Medium-Sized Advanced Reactor Bounding Value	Source/Rationale
	NRC ANR GEIS Value [(a)]	Internal Research Value	Vendor Bounding Value	Versatile Test Reactor Draft EIS Value	Regulatory Limit Value		
			Administration/Maintenance Building(s); Security Facility; Chemistry and Meteorology Facility; Radioactive Waste Storage Facility (Region/Country Dependent); various off-site facilities				
Plant Structure and Footprint							
What is the tallest structure and what is the maximum structure height (structure, ft)? What is the stack height?	50 ft (structure) None provided (stack)	Not evaluated	75 ft structure 87 ft stack height	90 ft (experiment support area) 190 ft (cooling chimneys)	Not applicable	**75 ft structure** **87 ft stack height**	Selected largest values from vendor responses to better bound potential visual, scenic, and land use impacts. Although the VTR is larger, above-ground PPE estimates are generally consistent; the height of the above-ground portion of the VTR stack is generally consistent with the vendor-provided estimates.
What is the maximum depth of excavation?	50 ft	Not evaluated	155 ft	93 ft	Not applicable	**155 ft**	Selected largest value consistent with vendor responses.
What is the temporary disturbed acreage during construction, including parking and laydown?	50 ac	60 ac	58 ac	100 ac	Not applicable	**100 ac**	Selected largest value consistent with vendor responses and the VTR estimated acreage.

Table 8-4. Small- to Medium-Sized Advanced Reactor PPE Data Sources and Methodology

Parameter	Information Sources					Small- to Medium-Sized Advanced Reactor Bounding Value	Source/Rationale
	NRC ANR GEIS Value [(a)]	Internal Research Value	Vendor Bounding Value	Versatile Test Reactor Draft EIS Value	Regulatory Limit Value		
What is the permanent disturbed acreage, including parking lots, ponds, substations, and other plant support facilities?	30 ac	50 ac	43 ac	25 ac	Not applicable	**50 ac**	Selected largest value consistent with vendor responses, rounded up to consider potential additional acreage needed for air-cooling.
What is the maximum expected sound level due to construction activities, measured at 50 ft from the noise source?	None provided	101 dB at 50 ft	Question not asked	Imperceptible at the INL site boundary and the closest receptor	Not applicable	**101 dB at 50 ft**	Questionnaire did not include this parameter. SME estimate is from the Clinch River EIS PPE (NRC, 2019c).
Are there large quantities of any unique materials (perhaps items not normally utilized in general office or industrial buildings) that will be utilized in plant construction (e.g., graphite)? If so, what are these anticipated volumes?	None provided	230 MT Graphite, 65 m^3 lead, 2,020 m^3 sodium	Graphite, 280 m^3 lead	No information provided	Not applicable	**280 m^3 lead**	Responses did not pose any particular environmental challenges. Any particular unique materials are necessarily specific to a given design proposed for deployment. For purposes of impact analysis, the SME estimate of unique materials should bound applicable resource impacts.
Operational Parameters							
What is the operational life for which the plant is designed? How long do you intend to	80 yr 2 to 20 yr operating cycle length	Not evaluated	80 yr 80 yr	60 yr	Not applicable	**80 yr** **80 yr**	Selected longest vendor response value. Prototype deployment at INL would likely be shorter than the 80-yr

Table 8-4. Small- to Medium-Sized Advanced Reactor PPE Data Sources and Methodology

Parameter	***Information Sources***					***Small- to Medium-Sized Advanced Reactor Bounding Value***	***Source/Rationale***
	NRC ANR GEIS Value [(a)]	***Internal Research Value***	***Vendor Bounding Value***	***Versatile Test Reactor Draft EIS Value***	***Regulatory Limit Value***		
operate the reactor prototype?							operational period chosen by NRC for a commercial reactor.
Do you anticipate installing additional modules incrementally over time?	None provided	Not evaluated	Yes	No	Not applicable	**Yes**	Vendor responses stated that multiple modules may be installed. This would have additive implications as well as potential cumulative impacts.
What is the reactor heat transfer material (coolant)? How much is required initially/annually?	Water	870 MT molten salt, 65 m^3 lead, 2,020 m^3 sodium	Liquid metal (e.g., sodium, lead, lead-bismuth); gas (e.g., helium); water	Sodium	Not applicable	**Various**	Molten salt value taken by scaling reference MSR (8 MWt) coolant quantity to 1,000 MWt (ORNL, 2015) Lead value taken by scaling reference LFR (280 MWt) coolant quantity to 1,000 MWt (Cinotti et al., 2010) Sodium value taken by scaling reference SFR (400 MWt) coolant quantity to 1,000 MWt (Cabell, 1980)
What is the anticipated technology (or technologies) for the normal plant heat sink?	None provided	Mechanical draft cooling tower	Mechanical draft cooling tower or air-cooled condenser	Air-cooled heat exchangers	Not applicable	**Mechanical draft cooling tower**	It is anticipated that mechanical draft cooling towers, in general, will have the most resource-intensive type of plant heat sink.
What are the maximum and average daily water use requirements for	1,000 gpm	5,850 gpm For air-cooled reactors, 415 gpm	7,500 gpm maximum; 4,200 gpm average	6.8 million gallons/yr/365 = about 18,000 gallons per day	Not applicable	**For water-cooled reactors, 5,850 gpm (maximum)** **5,850 gpm (average)**	Cooling-water use was estimated assuming the bounding reactor operates at 33 percent

Table 8-4. Small- to Medium-Sized Advanced Reactor PPE Data Sources and Methodology

Parameter	Information Sources					Small- to Medium-Sized Advanced Reactor Bounding Value	Source/Rationale
	NRC ANR GEIS Value [(a)]	Internal Research Value	Vendor Bounding Value	Versatile Test Reactor Draft EIS Value	Regulatory Limit Value		
plant cooling and service water systems, including potable and sanitary water use (if required)?						**For air-cooled reactors, 415 gpm**	thermal efficiency, which is considered a lower bound on the efficiency. The 7,500 gpm vendor value seems excessively high given the power output and efficiency of the reactor. This water use estimate would also bound those reactor designs that are only using process heat rather than electricity. For air-cooled reactors, the PPE water use includes non-cooling uses, which were based upon scaling non-cooling-water use from Clinch River EIS (NRC, 2019c), and potable/sanitary use assumed to be 100 gpd per member of the vendor-provided or estimated operations workforce.
What are the expected characteristics of plant water discharges (if any)?	600 gpm	1,775 gpm For air-cooled reactors, 415 gpm	Various, including no discharges anticipated	4.4 million gallons annually (about 8.4 gpm if continuous), including the volume required for personnel use and sanitation, fire protection water,	Not applicable	**1,775 gpm** **For air-cooled reactors, 415 gpm**	Discharge includes blowdown from the cooling towers with contributions from non-cooling systems and potable/sanity uses. The blowdown rate depends on the cycles of

Table 8-4. Small- to Medium-Sized Advanced Reactor PPE Data Sources and Methodology

Parameter	***Information Sources***					***Small- to Medium-Sized Advanced Reactor Bounding Value***	***Source/Rationale***
	NRC ANR GEIS Value [(a)]	***Internal Research Value***	***Vendor Bounding Value***	***Versatile Test Reactor Draft EIS Value***	***Regulatory Limit Value***		
				and demineralized water. No water required for reactor operation			concentration during tower operation, which was assumed to be four. Two cycles of concentration would result in a larger discharge rate, but four cycles of concentration was selected for the PPE because this maximizes nonradioactive concentrations in the discharge. Minimizing the liquid discharge rate is likely to be desirable at INL. For air-cooled reactors, the PPE discharge includes non-cooling system wastewater and potable/sanitary wastewater, assumed to be equivalent to the water use rate for these purposes.
Blowdown Temperature and Constituent Concentrations	Within applicable Clean Water Act limits	Not evaluated	Question not asked	No information provided	Within applicable Clean Water Act limits	**Within applicable Clean Water Act limits**	Questionnaire did not include this parameter. Discharges mainly from plant blowdown are regulated under a Clean Water Act permit.

Table 8-4. Small- to Medium-Sized Advanced Reactor PPE Data Sources and Methodology

Parameter	***Information Sources***					***Small- to Medium-Sized Advanced Reactor Bounding Value***	***Source/Rationale***
	NRC ANR GEIS Value (a)	***Internal Research Value***	***Vendor Bounding Value***	***Versatile Test Reactor Draft EIS Value***	***Regulatory Limit Value***		
What are the chemical and radionuclide constituents of the plant discharges, and maximum and expected concentrations/activities in the discharge (if available)?	Within applicable Clean Water Act limits	See Clinch River Table - Projected Blowdown Constituents and Concentrations (Table C.2)*	TBD	No information provided	DOE O 458.1 (DOE-STD-1196 and DOE-STD-1153) (or 10 CFR Part 20 Appendix B) for both liquid and gaseous effluents and 40 CFR Part 61 Subpart H for gaseous effluents	**See Clinch River Table - Projected Blowdown Constituents and Concentrations, Table C.2.***	Radionuclides in liquid discharge will be dependent on the specific reactor. Discharge can be assumed to be diluted to meet the 10 CFR Part 20 Appendix B, Table 2 limits at the point of discharge. Nonradioactive constituents of the liquid discharge will be determined by the source water used for cooling, by the cycles of concentration used in cooling-tower operation, and by additives used in plant processes. The Clinch River discharge was assumed to be representative with some consideration of the typical source water at INL. The microreactor PPE assumed four cycles of concentration, which would also be a reasonable bounding assumption for the small- to medium-sized advanced reactors.

Table 8-4. Small- to Medium-Sized Advanced Reactor PPE Data Sources and Methodology

Parameter	***Information Sources***					***Small- to Medium-Sized Advanced Reactor Bounding Value***	***Source/Rationale***
	NRC ANR GEIS Value [(a)]	***Internal Research Value***	***Vendor Bounding Value***	***Versatile Test Reactor Draft EIS Value***	***Regulatory Limit Value***		
What is the fuel source and size of auxiliary boilers, emergency power systems and standby power systems (if applicable) (fuel source, MW)?	None provided	50 MWt oil fired; 15 MWe Sentry turbine	4 MWe natural gas or diesel auxiliary boiler; 1 MWe standby power (gas, diesel, battery)	4.7 million ft^3 of propane per year	Not applicable	**50 MWt oil fired; 15 MWe Sentry turbine**	Selected based upon a review of publicly available documentation, including vendor websites and other literature.
Emissions from construction equipment and standby power equipment during operations	Criteria pollutants are less than Clean Air Act *de minimis* levels	Not Evaluated	Not asked	Well below EPA PSD permitting threshold of 250 tons per year for a criteria pollutant	Criteria pollutants are less than Clean Air Act *de minimis* levels	**Criteria pollutants are less than Clean Air Act *de minimis* levels**	Questionnaire did not include this parameter. Clean Air Act requires a conformity determination for maintenance or nonattainment areas that exceed *de minimis* values. Not applicable to attainment areas, so this would be bounding for INL.
How much hazardous, radioactive, and mixed waste would be generated during operations, and where would it be dispositioned?	None provided	836 MT radioactive waste (fuel) 13,920 MT molten salt (mixed)	Various	45 spent driver fuel assemblies per year, initially stored on-site 18,460 total shipments	Not applicable	**836 MT radioactive waste (fuel) 13,920 MT molten salt (mixed)**	Reference molten salt reactor consumes 1,930 kg of 19.7 percent enriched U and 3,290 kg of Th annually; scaled from reference reactor's nominal power (500 MWt) to 1,000 MWt. Assumes 30 yr demonstration. Initial loading of molten salt value taken by scaling reference MSR (8 MWt) coolant quantity to 1,000 MWt (ORNL,

Table 8-4. Small- to Medium-Sized Advanced Reactor PPE Data Sources and Methodology

Parameter	Information Sources					Small- to Medium-Sized Advanced Reactor Bounding Value	Source/Rationale
	NRC ANR GEIS Value [(a)]	Internal Research Value	Vendor Bounding Value	Versatile Test Reactor Draft EIS Value	Regulatory Limit Value		
							2015). Assuming initial loading of 870 MT of molten salt would be replenished every 5 yr, 16 loadings would be needed for assumed 80-yr demonstration. The molten salt spent fuel and coolant would be classified as either high-level mixed waste or mixed transuranic waste (depending on the spent fuel processing) Vendor responses indicate that fuel would come from existing INL feedstock. As a result, the PPE assumes that disposition would remain at INL. These waste volumes reflect waste that would be generated from within the reactor vessel. For estimates of total radioactive waste generation (excluding spent fuel), see estimates of the total number of shipments and volume of radioactive waste.

Table 8-4. Small- to Medium-Sized Advanced Reactor PPE Data Sources and Methodology

Parameter	Information Sources					Small- to Medium-Sized Advanced Reactor Bounding Value	Source/Rationale
	NRC ANR GEIS Value [(a)]	Internal Research Value	Vendor Bounding Value	Versatile Test Reactor Draft EIS Value	Regulatory Limit Value		
What is the stack exit velocity?	None provided	Not evaluated	58 ft/s	No information provided	Not applicable	**58 ft/s**	The largest value from vendor responses was selected.
What amount of noise would be generated 50 ft from the source and at the site boundary?	65 dBA at site boundary	Not evaluated	70 dBA at 50 ft from cooling tower; < 55 dBA at site boundary	Imperceptible at the INL site boundary and the closest receptor	Not applicable	**65 dBA at site boundary**	The value from the NRC estimate in ANR GEIS was selected and it is consistent with NRC Environmental Standard Review Plans (NRC, 2013a).
Fuel							
What is the form of the fuel associated with your design?	None provided	Molten salt	Various, including metal fuel, TRISO in graphite blocks or pebbles, uranium oxide.	Uranium-plutonium-zirconium alloy fuel (U-20Pu-10Zr)	Not applicable	**Molten Salt**	Molten salt, TRISO, Uranium Oxide, HALEU, U-Zr alloy. Emission release mechanisms from molten salt are different from LWRs; expect that molten salt will have upper bounding impacts compared to other fuel technologies.
What is the annual average fuel requirement (metric tons) per module?	None provided	8 MT	4.9 MT	1.8 MT annually (~1.3-1.4 MT uranium, ~0.4-0.54 MT plutonium, plus 10% Zr)		**8 MT**	The largest value from vendor responses was selected, scaled to 1,000 MWt.
Where would fuel be obtained?	None provided	Not evaluated	Various	U from within DOE complex and from commercial vendors, Pu from within the DOE complex. Fuel manufactured at either INL or SRS	Not applicable	**Off-site commercial source**	Multiple vendors assumed that the fuel would come from an existing DOE supply at INL, while other vendors would source the fuel from off-site commercial sources. For purposes of

Table 8-4. Small- to Medium-Sized Advanced Reactor PPE Data Sources and Methodology

Parameter	***Information Sources***					***Small- to Medium-Sized Advanced Reactor Bounding Value***	***Source/Rationale***
	NRC ANR GEIS Value [(a)]	***Internal Research Value***	***Vendor Bounding Value***	***Versatile Test Reactor Draft EIS Value***	***Regulatory Limit Value***		
							developing a surrogate reactor, the PPE assumes that fuel would be obtained from off-site sources.
What is the total number of shipments and MTU for unirradiated fuel shipped to reactor or site?	None provided	432 shipments over the 80 yr life of the plant. 1,972 MTU total.	255 fuel blocks per module/year; 10 shipments per module/year	460-550 kg Pu and 1.61-1.92 MTU per year needed for feedstock. 3 assemblies per shipment. 22 shipments for initial loading, then 15 shipments annually = 922 total unirradiated fuel shipments for 60 yr operational life	Not applicable	**432 shipments over the 80 yr life of the plant.** **1,972 MTU total.**	Unirradiated fuel shipments scaled to 1,000 MWt from surrogate SMR from Clinch River ESP (NRC, 2019c, pp. Table 6-4). MTU scaled to 1,000 MWt from Clinch River ESP (NRC, 2019c, pp. Table 6-10). VTR refueling will occur more frequently than for demonstration reactors considered in this PPE to support its research mission. While the VTR value would bound impacts, this value is not representative of the anticipated fueling cycle for anticipated advanced reactor designs.
Total number of shipments and volume of radioactive waste shipments from reactor/site?	None provided	2,160 shipments over the 80 yr life of the plant. Volume of each shipment is 2.34 m^3. Total volume = 4,981 m^3.	~4 Total Shipments, ~24 M^3	Up to 423 shipments annually = 25,380 shipments for 60 yr operational life	Not applicable	**2,160 shipments over the 80 yr life of the plant. Volume of each shipment is 2.34 m^3.** **Total volume= 4,981 m^3.**	Radioactive waste shipments and volume scaled to 1,000 MWt from surrogate SMR from Clinch River ESP (NRC, 2019c, pp. Table 6-14).

Table 8-4. Small- to Medium-Sized Advanced Reactor PPE Data Sources and Methodology

Parameter	***Information Sources***					***Small- to Medium-Sized Advanced Reactor Bounding Value***	***Source/Rationale***
	NRC ANR GEIS Value (a)	***Internal Research Value***	***Vendor Bounding Value***	***Versatile Test Reactor Draft EIS Value***	***Regulatory Limit Value***		
							These values are used as a bounding measure of radioactive waste generation (excluding spent fuel) but do not account for differences in design or unique waste streams from advanced reactors. Similar to the shipments of unirradiated fuel, the VTR parameter for radioactive waste shipments exceeds the PPE bounding parameter related to National Reactor Innovation Center prototypes, based upon a different research and mission goal. While the VTR value would bound impacts, this value is not representative of the anticipated radioactive waste shipments for anticipated advanced reactor designs.
What is the radionuclide inventory for irradiated fuel at time of shipment (Ci/MTU by radionuclide)?	None provided	See Fission Product Inventory (Appendix C.7)*	No information provided	No information provided	Not applicable	**Fission Product Inventory (Appendix C.7)***	See Appendix C.7*

Table 8-4. Small- to Medium-Sized Advanced Reactor PPE Data Sources and Methodology

Parameter	***Information Sources***					***Small- to Medium-Sized Advanced Reactor Bounding Value***	***Source/Rationale***
	NRC ANR GEIS Value [(a)]	***Internal Research Value***	***Vendor Bounding Value***	***Versatile Test Reactor Draft EIS Value***	***Regulatory Limit Value***		
How will the reactor, fresh fuel and other large components be transported to the site?	None provided		Truck or rail	Unirradiated fuel to be shipped via Secure Transportation Asset (STA; truck transport only)	Not applicable	**Truck**	Truck transportation is assumed for both microreactors and small- to medium-sized advanced reactors
Is the reactor designed to be refueled? If so, at what frequency (year)? What MTU per refueling?	None provided	Daily refueling of 10.6 kg enriched U and 18 kg Th; annual requirement 3.9 MT enriched U, 6.6 MT Th.	Various, depending on whether counting total amount of fuel or annual fuel consumption	Typically < 17 driver fuel assemblies (~1/4 of core) replaced per refueling/ three ~100-day operating cycles per year/~0.6 MT Th per refueling Up to 45 driver fuel assemblies per year/ ~1.8 MT Th	Not applicable	**Daily refueling of 10.6 kg enriched U and 18 kg Th; annual requirement 3.9 MT enriched U, 6.6 MT Th.**	Assumed that the reactor would be refueled in order to develop a more robust bounding impact. Online and continuous refueling assumed, which may increase impacts associated with radioactive and nonradioactive emissions. Continuous refueling quantity scaled from reference MSR (500 MWt) to 1,000 MWt.
What are the source terms for routine releases (if any) per module and design-basis accidents?	None provided	See Fission Product Inventory (Appendix C.7)*	TBD	No information provided	Not applicable	**Fission Product Inventory (Appendix C.7)***	See Appendix C.7.***** The analysis uses general cases, instead of specific designs, to calculate the radionuclide inventory.
Are there any unique fuel storage or cooling requirements associated with the fuel?	None provided	Sodium or lead pool depending on coolant type; separate storage area required for liquid metal reactors	TBD	Cool in-vessel for ~1 year, then wash off external sodium and transfer to cask on spent fuel pad to cool further. Fuel then chopped, consolidated,	Not applicable	**Sodium or lead pool depending on coolant type; separate storage area required with liquid metal reactors**	No unique fuel storage or cooling requirements identified by small- to medium-sized advanced reactor vendors. Fuel from liquid metal reactors will require

Table 8-4. Small- to Medium-Sized Advanced Reactor PPE Data Sources and Methodology

Parameter	***Information Sources***					***Small- to Medium-Sized Advanced Reactor Bounding Value***	***Source/Rationale***
	NRC ANR GEIS Value [(a)]	***Internal Research Value***	***Vendor Bounding Value***	***Versatile Test Reactor Draft EIS Value***	***Regulatory Limit Value***		
				sodium removed, and diluted (likely with scrap metal from driver fuel assembly). Mixture packaged in containers, placed in storage casks, and stored on spent fuel pad until shipped off-site			compatible pool/storage vessel.
How and where would spent fuel be dispositioned?	None provided	3,944 shipments of irradiated fuel over the 80 yr life of the plant. On-site storage, or off-site storage or disposal	Various; cask stored for future disposition, either on-site, intermediate off-site storage, bore-hole, or permanent repository. Recycling is possible.	Ultimately an off-site storage or disposal facility	Not applicable	**3,944 shipments of irradiated fuel over the 80 yr life of the plant. On-site storage, or off-site storage or disposal**	HALEU and all spent fuel used for the Oklo application would stay at the INL site post-demonstration (Oklo, 2020). Irradiated fuel shipments scaled to 1,000 MWt from surrogate SMR from Clinch River ESP (NRC, 2019c, pp. Table 6-10).
Workforce							
How many workers will be on-site for construction?	150	909 maximum on-site at one time construction workforce; maximum total construction workforce of 1,363 at peak	900	1,400	Not applicable	**909 maximum on-site at one time construction workforce; maximum total construction workforce of 1,400 at peak**	Scaled down the values analyzed for the Clinch River ESP to a 1,000 MWt reactor.
What is the anticipated construction period?	None provided	45 months	54 months	51 months	Not applicable	**54 months**	Consistent with vendor response

Table 8-4. Small- to Medium-Sized Advanced Reactor PPE Data Sources and Methodology

Parameter	***Information Sources***					***Small- to Medium-Sized Advanced Reactor Bounding Value***	***Source/Rationale***
	NRC ANR GEIS Value [(a)]	***Internal Research Value***	***Vendor Bounding Value***	***Versatile Test Reactor Draft EIS Value***	***Regulatory Limit Value***		
What is the number of total permanent staff to support operations?	50	207	420	600	Not applicable	**207**	Scaled down the values analyzed for the Clinch River ESP to a 1,000 MWt reactor. The VTR is a research reactor that will involve a larger staff to support research operations; this is a higher value than would be expected for demonstration prototypes. The construction workforce estimate is consistent with the VTR data (DOE, 2022b) and bounds the VTR value peak. The VTR value of 600 also includes the workforce associated with activities outside of reactor operations (e.g., fuel fabrication, post-irradiation examination of experiments, experiment design and support staff) that are not relevant to the demonstration reactors considered in this PPE.
What is the number of temporary staff during refueling (if planned)?	100	413	< 125	No information provided	Not applicable	**413**	Scaled down the values analyzed for the Clinch River ESP to a 1,000 MWt reactor.

Table 8-4. Small- to Medium-Sized Advanced Reactor PPE Data Sources and Methodology

Parameter	***Information Sources***					***Small- to Medium-Sized Advanced Reactor Bounding Value***	***Source/Rationale***
	NRC ANR GEIS Value (a)	***Internal Research Value***	***Vendor Bounding Value***	***Versatile Test Reactor Draft EIS Value***	***Regulatory Limit Value***		
What is the number of temporary staff during additional module installation (if planned)?	None provided	413	900	N/A	Not applicable	**413**	Scaled down the values analyzed for the Clinch River ESP to a 1,000 MWt reactor.
What are the distances from radiation sources to the nearest involved worker?	None provided	500 ft	~20 m	Nearest uninvolved worker: 330 ft	Not applicable	**~20 m**	Consistent with vendor response
Decommissioning							
Do you plan to decommission and remove the prototype from the INL site?	None provided	Not evaluated	TBD	No information provided	Not applicable	**Yes**	It is assumed that the prototype would be decommissioned to bound impacts associated with land use, fuel, transportation, and workforce.
What is the number of temporary staff during decommissioning (if planned)?	None provided	Not evaluated	450	No information provided	Not applicable	**450**	Consistent with vendor response
What is the number of months from start of decommissioning to completion (if planned)?	None provided	Not evaluated	10 yr	No information provided	Not applicable	**10 yr**	Selected the largest value from vendor responses.
How much waste would be generated during decommissioning (if planned)?	None provided	Bounded by the waste streams evaluated in NUREG-0586		No information provided	Not applicable	Bounded by the waste streams evaluated in NUREG-0586	The anticipated volumes of wastes evaluated in NUREG-0586 were based on industry decommissioning experience as of 2002. Appendix G of NUREG-

Table 8-4. Small- to Medium-Sized Advanced Reactor PPE Data Sources and Methodology

Parameter	***Information Sources***					***Small- to Medium-Sized Advanced Reactor Bounding Value***	***Source/Rationale***
	NRC ANR GEIS Value [(a)]	***Internal Research Value***	***Vendor Bounding Value***	***Versatile Test Reactor Draft EIS Value***	***Regulatory Limit Value***		
							0586, "Radiation Protection Considerations for Nuclear Power Facility Decommissioning" summarizes effluent releases for operating facilities and decommissioning facilities. Low-level waste volume estimates for decommissioning facilities are presented in Appendix K of NUREG-0586 (NRC, 2002c).

Sources: as provided in McDowell and Goodman (2021)

Key: AC = alternating current; ANR = advanced nuclear reactor; BWR = boiling-water reactor; CFR = Code of Federal Regulations; DOE = U.S. Department of Energy; EIS = Environmental Impact Statement; ER = Environmental Report; ESP = early site permit; GDC = General Design Criteria; GEIS = Generic Environmental Impact Statement; HALEU = high-assay low-enriched uranium; HTGR = High-Temperature Gas-Cooled Reactor; INL = Idaho National Laboratory; LFR = Lead-Cooled Fast Reactor; LMR = Liquid Metal Reactor; LWR = light water reactor; MSR = Molten Salt Reactor; NRC = U.S. Nuclear Regulatory Commission; PPE = Plant Parameter Envelope; PRISM = Power Reactor Innovative Small Module; RCRA = Resource Conservation and Recovery Act; ROW = right-of-way; SME = subject matter expert; SMR = small modular reactor; SRS = Savannah River Site; TBD = to be developed; Th = Thorium; TRISO = tri-structural isotropic; yr = year

Note:

* Refers to a table, section, or appendix in *Advanced Nuclear Reactor Plant Parameter Envelope and Guidance* from the National Reactor Innovation Center (McDowell & Goodman, 2021).

[a] Note that because NRC's ANR GEIS PPE/SPE generally focuses on microreactors, many of the parameters are not applicable to these small- to medium-sized advanced reactors. However, some of the parameters would provide appropriate bounding values regardless of the size of the reactor and are therefore included in this table.

9 List of Preparers

This chapter identifies organizations and individuals who contributed to the overall effort of producing this Technical Report.

DOUGLAS A. OUTLAW, LEIDOS

RESPONSIBILITIES: PROJECT MANAGER

Education: Ph.D., Physics, North Carolina State University
M.S., Nuclear Physics, North Carolina State University
B.S., Nuclear Physics, North Carolina State University

Experience/Technical Specialty:
Forty-six years. NEPA project management and analysis, nuclear physics, safety analysis, and risk assessment.

ERNEST HARR, LEIDOS

RESPONSIBILITIES: DEPUTY PROJECT MANAGER AND SPENT NUCLEAR FUEL/WASTE MANAGEMENT LEAD

Education: B.S., Zoology, University of Maryland

Experience/Technical Specialty:
Forty-one years. NEPA analysis; radiological analyses – normal operation, accidents and intentionally destructive acts; human health and safety – worker and public; radioactive and mixed waste management; transportation – radiological and nonradiological; remediation; decontamination and decommissioning; and regulatory and compliance analyses.

JOHN DIMARZIO, LEIDOS

RESPONSIBILITIES: ENVIRONMENTAL CONSEQUENCES LEAD

Education: M.S., Geology, George Washington University
B.S., Geology, University of Maryland

Experience/Technical Specialty:
Thirty-six years. Project management, NEPA compliance, geology, water resources, waste management, cumulative impacts, and environmental regulations.

FREDERICK CAREY, P.E., POTOMAC-HUDSON ENGINEERING, INC.

RESPONSIBILITIES: URANIUM ENRICHMENT ACTIVITY LEAD

Education: M.S., Environmental Engineering, Johns Hopkins University
B.S., Civil Engineering, University of Maryland

Experience/Technical Specialty:
Thirty-one years. NEPA project management and technical review of critical environmental and human health issues related to various types of Federal actions.

VIRGINIA BOONE, POTOMAC-HUDSON ENGINEERING, INC.

RESPONSIBILITIES: LAND USE, VISUAL AND SCENIC RESOURCES, WATER RESOURCES

Education: Postbaccalaureate Certificate, Geographic Information Systems, Penn State University World Campus
B.A., English, St. Mary's College of Maryland

Experience/Technical Specialty:

Eleven years. Environmental permitting and planning projects, including NEPA, Clean Water Act Section 401/404, Maryland Forest Conservation Act, and other Federal, state, and local regulation compliance, including project management support, information management, technical analysis, field work, site investigations, and geographic information systems.

BRAD BOYKIN, LEIDOS

RESPONSIBILITIES: NOISE

Education: Master of Biotechnology, Texas A&M University
B.S., Biomedical Science, Texas A&M University

Experience/Technical Specialty:

Sixteen years. Development of criteria pollutant and greenhouse gas emissions inventories, air dispersion modeling, air permitting support, NEPA analyses, determination of project compliance with air pollution standards and regulations, including General Conformity Regulation. Noise analysis documentation.

CHRIS CRABTREE, LEIDOS

RESPONSIBILITIES: AIR QUALITY, URANIUM CONVERSION AND HALEU STORAGE ACTIVITY LEAD

Education: B.A., Environmental Studies, University of California Santa Barbara

Experience/Technical Specialty:

Thirty-one years. Source emission quantifications, dispersion modeling, health risk assessments, greenhouse gas and climate change analyses, mitigation evaluations, determination of project compliance with air pollution standards and regulations, including NEPA, CEQA, General Conformity Regulations, and regional air pollution agencies.

PEDRO DA SILVA, P.E., POTOMAC-HUDSON ENGINEERING, INC.

EIS RESPONSIBILITIES: GEOLOGY AND SOILS

Education: M.S.E., Sustainable Water Engineering, University of California, Los Angeles
B.S., Chemical Engineering, University of California Santa Barbara

Experience/Technical Specialty:

Five years. Extensive field experience collecting, managing, analyzing, and presenting field data in industrial setting for private and Federal programs; design of small infrastructure projects; remediation treatment system O&M; environmental compliance work; and NEPA analysis support.

MIMI DROZDETSKI, POTOMAC-HUDSON ENGINEERING, INC.

RESPONSIBILITIES: LAND USE, VISUAL AND SCENIC RESOURCES

Education: B.S., Environmental Science and Technology, University of Maryland-College Park

Experience/Technical Specialty:

One year. Environmental analyst for NEPA, environmental planning, compliance and environmental media projects, as well as sustainability marketing, lifecycle analysis, and waste management education.

PEGGY FARRELL, PMP, QEP, CHMM, LEIDOS

RESPONSIBILITIES: *ENVIRONMENTAL JUSTICE*

Education: M.S., Natural Sciences and Environmental Studies, State University of New York at Buffalo
B.A., Biology and Environmental Studies, State University of New York at Binghamton

Experience/Technical Specialty:

Forty-four years. NEPA analysis, environmental planning, public outreach, and regulatory compliance. Experienced in analyzing impacts on multiple resources including environmental justice communities, land use, socioeconomics, hazardous materials and wastes, and cumulative.

VICKY FRANK, LEIDOS

RESPONSIBILITIES: QUALITY ASSURANCE OVERSIGHT AND TRAINING LEAD

Education: B.S., Biochemistry, University of California

Experience/Technical Specialty:

Thirty-three years. Data management/reporting/validation, Quality Assurance/Control, environmental health safety (EHS), hazardous materials/wastes (HAZWOPER), environmental planning (NEPA/CEQA), analytical chemistry/instrumentation, biology, and field sampling.

DAN GALLAGHER, LEIDOS

RESPONSIBILITIES: HUMAN HEALTH – NORMAL OPERATIONS LEAD; TECHNICAL LEAD

Education: M.E., Nuclear Engineering, Rensselaer Polytechnic Institute
B.S., Nuclear Engineering, Rensselaer Polytechnic Institute

Experience/Technical Specialty:

Forty-three years. Nuclear risk analysis.

HEATHER GORDON, LEIDOS

RESPONSIBILITIES: ENVIRONMENTAL JUSTICE; GEOGRAPHIC INFORMATION SYSTEM ANALYSIS

Education: M.S., Geography, University of New Mexico
B.A., Environmental Studies and Planning, Sonoma State University

Experience/Technical Specialty:

Twenty-seven years. Responsible for geospatial analysis across a wide range of disciplines, including hydrology, demography, archaeology, noise, and land use.

JOSEPH JIMENEZ, LEIDOS

RESPONSIBILITIES: HISTORIC AND CULTURAL RESOURCES

Education: M.A., Anthropology, Idaho State University
B.A., Anthropology, Idaho State University
Register of Professional Archaeologists (RPA #15644)

Experience/Technical Specialty:

Thirty-six years. Cultural resource project management, NEPA analysis, NRHP evaluations, Historic American Building Survey documentation review, Integrated Cultural Resource Management Plans, documentation/consultation support per National Historic Preservation Act Section 110; documentation/consultation support per National Historic Preservation Act Section 106; field and laboratory archaeology, project management and coordination, data collection, research, reporting, and writing.

ROY KARIMI, LEIDOS

RESPONSIBILITIES: HUMAN HEALTH – TRANSPORTATION

Education: Sc.D., Nuclear Engineering, Massachusetts Institute of Technology
N.E., Nuclear Engineering, Massachusetts Institute of Technology
M.S., Nuclear Engineering, Massachusetts Institute of Technology
B.S., Chemical Engineering, Abadan Institute of Technology

Experience/Technical Specialty:

Forty-one years. Nuclear power plant safety, risk and reliability analysis, design analysis, criticality analysis, accident analysis, consequence analysis, spent fuel dry storage safety analysis, transportation risk analysis, and probabilistic risk assessment.

MARK KIDDER, LEIDOS

RESPONSIBILITIES: HALEU DECONVERSION ACTIVITY LEAD

Education: B.S., Civil Engineering, South Dakota State University

Experience/Technical Specialty:

Twenty-one years. Engineering and construction estimating, civil and environmental design, environmental restoration, construction management, and project management.

ERIN KOUVOUSIS, POTOMAC-HUDSON ENGINEERING, INC.

RESPONSIBILITIES: INFRASTRUCTURE

Education: M.S., Ecology, Kent State University
B.S., Conservation, Kent State University

Experience/Technical Specialty:

Thirteen years. Environmental compliance and NEPA analysis, including assessment of water resources impacts and waste management.

MIRANDA LAWSON, LEIDOS

RESPONSIBILITIES: ENVIRONMENTAL JUSTICE REVIEW; QUALITY ASSURANCE

Education: B.S., Environment and Sustainability Sciences, Cornell University

Experience/Technical Specialty:

Two years. Environmental health and safety protocols, sustainable packaging, alternative fuels, environmental justice, energy justice, and climate change perspectives, public outreach, NEPA and Formerly Utilized Sites Remedial Action Program (FUSRAP) support.

ROB NAUMANN, POTOMAC-HUDSON ENGINEERING, INC.

RESPONSIBILITIES: URANIUM MINING AND MILLING ACTIVITY LEAD

Education: M.S., Environmental Science, Johns Hopkins University
B.S., Resource Ecology & Management, University of Michigan

Experience/Technical Specialty:

Twenty-five years. NEPA project management and resource analyst for biological resources and water resources.

CYNTHIA ONG, POTOMAC-HUDSON ENGINEERING, INC.

EIS RESPONSIBILITIES: TRAFFIC

Education: M.S., Environmental Sciences, Miami University
B.S., Civil Engineering, Purdue University

Experience/Technical Specialty:

Twelve years. NEPA analysis for traffic, noise, land use, and water resources; and civil engineering for stormwater management design, erosion and sediment control, and utility design.

MELANIE PETERSON, LEIDOS

RESPONSIBILITIES: COPYEDITING

Education: M.A., English, University of Missouri – St. Louis

Experience/Technical Specialty:

Thirteen years. Quality assurance, proofreading, editing, and document accessibility.

SARAH RAUCH, CSE, LEIDOS

RESPONSIBILITIES: BIOLOGICAL RESOURCES

Education: B.S., Plant Biology Environmental Science and Ecology, Arizona State University

Experience/Technical Specialty:

Seventeen years. Environmental permitting, regulatory compliance and assessment, NEPA reviews, natural resources fieldwork, and research.

DIEGO SANTAELLA, POTOMAC-HUDSON ENGINEERING, INC.

EIS RESPONSIBILITIES: URANIUM ENRICHMENT ACTIVITY LEAD SUPPORT

Education: B.S., Environmental Science and Technology, University of Maryland-College Park

Experience/Technical Specialty:

Four years. Environmental compliance and assessment, permitting, and NEPA analysis, including assessment of soil and geology resource impacts, and hazardous materials and waste management.

GEORGE SANTEE, LEIDOS

RESPONSIBILITIES: HUMAN HEALTH – FACILITY ACCIDENTS, HALEU DECONVERSION, HALEU FUEL FABRICATION ACTIVITY LEAD

Education: M.S., Nuclear Science and Engineering, Idaho State University
B.S., Applied Physics, Idaho State University

Experience/Technical Specialty:

Forty-three years. Safety and risk analysis, radiological and hazardous material consequence analysis, nuclear safety, regulatory compliance, health and safety assessment.

SUSAN SMILLIE, POTOMAC-HUDSON ENGINEERING, INC.

RESPONSIBILITIES: SOCIOECONOMICS

Education: M.En., Environmental Science, Miami University of Ohio
B.S., Biology, Smith College

Experience/Technical Specialty:

Thirty-six years. Environmental compliance and assessment, NEPA guidance and training, public involvement, energy and policy analysis, socioeconomics and environmental justice, land use, aesthetics, transportation/infrastructure, floodplains, wetlands, ecology, and power plant siting and permitting/licensing (nuclear, oil and gas pipelines, hydroelectric).

BRIAN TUTTEROW, LEIDOS

RESPONSIBILITIES: ENVIRONMENTAL JUSTICE

Education: B.A., Biology, Southern Illinois University at Edwardsville

Experience/Technical Specialty:

Twenty-three years. Aquatic, wetland, and terrestrial ecosystems monitoring and sampling; environmental compliance; sensitive environments; stream systems; in-water habitat planning and impact assessment; cultural resources assessment; socioeconomics and environmental justice analysis; and mitigation and conservation strategy development.

TARA UTSEY, LEIDOS

RESPONSIBILITIES: ASSISTANT DEPUTY PROJECT MANAGER, PUBLICATIONS TEAM LEAD

Education: B.A., Liberal Arts, DePaul University

Experience/Technical Specialty:

Thirty years. Quality assurance oversight, document deliverable development and management, document publishing, technical editing, and production team management.

JEN WALLIN, LEIDOS

RESPONSIBILITIES: ADMINISTRATIVE RECORD MANAGER

Education: M.S., Environmental Toxicology, Clemson University
B.S., Biology, Pacific Lutheran University

Experience/Technical Specialty:

Twenty-three years. Aquatic ecologist and environmental scientist, focus on EIS and ecological risk assessment preparation, and references management.

JESSICA WELSH, LEIDOS
RESPONSIBILITIES: COPYEDITING

Education: B.A., Journalism, The College of New Jersey

Experience/Technical Specialty:
Twenty-two years. Copyediting, quality assurance.

This page intentionally left blank.

10 References

ABC. (2015). *Bird-Friendly Building Design.* American Bird Conservancy with the New York City Audubon. Retrieved from https://abcbirds.org/wp-content/uploads/2015/05/Bird-friendly-Building-Guide_20151.pdf.

ACO. (2020). *Proposed Changes for LA-3605-0002, Environmental Report for the American Centrifuge Plant in Piketon, Ohio (for the HALEU Demonstration Program).* American Centrifuge Operating, LLC. Retrieved from https://www.nrc.gov/docs/ML2013/ML20139A098.pdf.

Acoustical Society of America. (1983). *American National Standard Specification for Sound Level Meters.* New York, N.Y.: ANSI S1.4-1983.

Acoustical Society of America. (1985). *American National Standard Specification for Sound Level Meters.* New York, NY: ANSI S1.4A-1985 Amendment to ANSI S1.4-1983.

Adena Health. (2023). *About Adena Pike Medical Center*. Retrieved April 2023, from https://www.adena.org/locations/Adena-Pike-Medical-Center.

ADEQ. (2023). *Assessed Water Map. Assessed-Streams 2022 and Assessed-Lakes 2022 layers*. Retrieved May 9, 2023, from Arizona Department of Environmental Quality: https://adeq.maps.arcgis.com/apps/webappviewer/index.html?id=e224fc0a96de4bcda4b0e37af3a4daec&showLayers=Counties;Assessed%20-%20Lakes%202022;Assessed%20-%20Streams%202022.

AEC. (1972). *Environmental Survey of Transportation of Radioactive Materials To and From Nuclear Power Plants.* Atomic Energy Commission, Directorate of Regulatory Standards. Retrieved from https://www.osti.gov/servlets/purl/4569134. December.

AEC. (1974). *Environmental Survey of the Uranium Fuel Cycle.* Atomic Energy Commission, Fuels and Materials, Directorate of Licensing.

ANSI. (2001). *ANSI-N14.1: American National Standard for Nuclear Materials—Uranium Hexafluoride-Packaging and Transportation.* American National Standard Institute. Retrieved from https://law.resource.org/pub/us/cfr/ibr/002/ansi.n14.1.2001.pdf. February 1.

APLIC. (2006). *Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006.* Washington, D.C.: Avian Power Line Interaction Committee, Edison Electric Institute.

APLIC. (2012). *Reducing Avian Collisions with Power Lines: The State of the Art in 2012.* Washington, D.C.: Edison Electric Institute Avian Power Line Interaction Committee. Retrieved from https://www.aplic.org/uploads/files/15518/Reducing_Avian_Collisions_2012watermarkLR.pdf.

ATSDR. (2003). *Public Health Statement Fluorides CAS# Hydrogen Fluoride 7664-39-3, Fluorine 7782-41-4, Sodium Fluoride 7681-49-4.* Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Diseases Registry. September.

ATSDR. (2009). *Case Studies in Environmental Medicine (CSEM). Uranium Toxicity course: WB 1524.* Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Diseases Registry. May 1.

ATSDR. (2012). *Vanadium - Tox FAQs CAS # 7440-62-2.* Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Diseases Registry.

ATSDR. (2023). *Health Consultation Evaluation of Radionuclides in Air and Water Near the White Mesa Uranium Mill White Mesa, White Mesa, San Juan County Utah, EPA facility registry ID:110000879425.* Agency for Toxic Substances and Disease Registry, Office of Community Health and Hazard Assessment, U.S. Department of Health and Human Services.

Bureau of Labor Statistics. (2021). *Table 1 Incidence rates of nonfatal occupational injuries and illnesses by industry and case types.* U.S. Department of Labor Bureau of Labor Statistics. Retrieved May 23, 2023, from https://www.bls.gov/iif/fatal-injuries-tables/archive/fatal-occupational-injuries-hours-based-rates-2007.pdf.

Bureau of Labor Statistics. (2022). *News release, Employer-Reported Workplace Injuries and Illnesses - 2021.* U.S. Department of Labor Bureau of Labor Statistics. November 9, 2022.

Cabell, C. (1980). *A Summary Description of the Fast Flux Test Facility.* Richland, WA: Hanford Engineering Development Laboratory. HEDL-400. Retrieved from https://www.osti.gov/servlets/purl/6032523.

CDC. (2021). *Deaths: Final Data for 2019.* Centers for Disease Control and Prevention, National Center for Health Statistic, National Vital Statistics System. National Vital Statistics Reports, Vol. 70, No. 8. Retrieved from https://www.cdc.gov/nchs/data/nvsr/nvsr70/nvsr70-08-508.pdf. July 26.

Census Reporter. (2023). *Community Profile Data for select small communities (queries in Arizona, Colorado and Utah)*. Retrieved from https://censusreporter.org/.

Centrus Energy Corp. (2022). *Understanding and Solving HALEU Nuclear Fuel Supply Chain Challenges.* National Association of Regulatory Utility Commissioners. January 7.

Centrus Energy Corp. (2023). *Centrus Completes Construction and Initial Testing of Haleu Demonstration Cascade, Expects to Begin Production by End of 2023*. Retrieved from https://www.centrusenergy.com/news/centrus-completes-construction-and-initial-testing-of-haleu-demonstration-cascade-expects-to-begin-production-by-end-of-2023/. February 9.

CEQ. (1997). *Environmental Justice Guidance Under the National Environmental Policy Act.* Council on Environmental Quality, Executive Office of the President. Washington, D.C. December 10.

Cinotti et al. (2010). Cinotti L., Smith C.F., Artioli C., Grasso G., and Corsini G. Lead-cooled fast reactor (LFR) design: safety, neutronics, thermal hydraulics, structural mechanics, fuel, core, and plant design. In D. G. Cacuci, *Handbook of Nuclear Engineering* (pp. 2749-2840). Springer US.

City of Richland. (2023). *City of Richland 2020 Traffic Counts ArcGIS Mapping Application*. Retrieved May 10, 2023, from https://richlandwa.maps.arcgis.com/apps/webappviewer/index.html?id=d1c0da5f309c468a9efcfc2b157aff3e.

CW & NHC. (2006). *CAMA Land Classification Map.* Provided by NRC (ML091690447) to the City of Wilmington and New Hanover County (CW & NHC).

Daher. (2020). *DN30-X Package for the transport of HALEU <20% Enrichment.* Presentation to the Nuclear Regulatory Commission. June 10. Retrieved from https://www.nrc.gov/docs/ML2017/ML20171A776.pdf.

Denison Mines (USA) Corp. (2007). *White Mesa Uranium Mill License Renewal Application State of Utah Radioactive Materials License No. UT1900479.* Prepared for Utah Department of Environmental Quality. Retrieved from https://documents.deq.utah.gov/legacy/businesses/e/energy-fuels-resources-usa/docs/2007/05May/VOLUME%201.pdf. February 28.

DOE. (1996a). *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement.* U.S. Department of Energy. DOE/EIS-0240. Retrieved from https://www.energy.gov/nepa/eis-0240-disposition-surplus-highly-enriched-uranium-0.

DOE. (1996b). Amended Record of Decision for DOE/EIS-0203 Programmatic Spent Nuclear Fuel Management. Washington, DC. March 8.

DOE. (1999). *Final Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride.* DOE/EIS-0269. April 1999. Retrieved from https://www.energy.gov/sites/default/files/2021-07/eis-0269-vol1-depleted-duf6-1999-04.pdf.

DOE. (2003). *Estimating Radiation Risk from Total Effective Dose Equivalent (TEDE), ISCORS Technical Report No. 1.* U.S. Department of Energy.

DOE. (2004a). *Finding of No Significant Impact (FONSI) for the United States Enrichment Corporation Incorporated, American Centrifuge Lead Cascade Facility at Piketon, Ohio (DOE EA-1495).* U.S. Department of Energy.

DOE. (2004b). *Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, Ohio, Site.* DOE/EIS-0360. U.S. Department of Energy. June.

DOE. (2004c). *Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky, Site.* DOE/EIS-0359. U.S. Department of Energy. June.

DOE. (2011). *Environmental Impact Statement for the Proposed American Centrifuge Plant in Piketon, Ohio, DOE adopts NUREG-1834, DOE/EIS-0468.* U.S. Department of Energy. Retrieved from https://www.energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/EIS-0468-FEIS-2011.pdf.

DOE. (2014). *Final Uranium Leasing Program Programmatic Environmental Impact Statement (DOE/EIS-0472).* U.S. Department of Energy. Retrieved from https://www.energy.gov/sites/default/files/2015/01/f19/EIS-0472-FPEIS-Vol_1-2014.pdf. March.

DOE. (2020). *Final Supplemental EIS for Disposition of Depleted Uranium Oxide Product.* DOE/EIS-0359-S1 and DOE/EIS-0359-S2. U.S. Department of Energy.

DOE. (2022a). *General Guidance for Justice40 Implementation.* U.S. Department of Energy. Retrieved from https://www.energy.gov/sites/default/files/2022-07/Final%20DOE%20Justice40%20General%20Guidance%20072522.pdf.

DOE. (2022b). *Final Versatile Test Reactor Environmental Impact Statement.* U.S. Department of Energy Office of Nuclear Energy. DOE/EIS-0542. Retrieved from https://www.energy.gov/nepa/articles/doeeis-0542-final-environmental-impact-statement.

DOE. (2023a). *Draft Solicitation No. 89243223RNE000031 – Purchase of High-Assay Low-Enriched Uranium (HALEU) – Enrichment.* U.S. Department of Energy. June 5.

DOE. (2023b). *Portsmouth Cleanup*. Retrieved May 16, 2023, from U.S. Department of Energy, Portsmouth/Paducah Project Office: https://www.energy.gov/pppo/portsmouth-cleanup.

DOE. (2023c). *Solicitation No. 89243223RNE000033 - High-Assay Low-Enriched Uranium (HALEU) Deconversion Acquisition – IDIQ RFP.* U.S. Department of Energy. November 28, 2023.

DOE. (2023d). *Calculation Analysis Package - HALEU Storage Facility.* U.S. Department of Energy.

EIA. (2023). *2022 Domestic Uranium Production Report.* U.S. Energy Information Administration. May 2023.

ENERCON. (2017). *Environmental Report, Renewal of Source Materials License SUB526.* ADAMS Accession No. ML17048A244.

EPA. (1974a). *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, 550/9-74-004.* Office of Noise Abatement and Control.

EPA. (1974b). *Population Distribution of the United States as a Function of Outdoor Noise Level.* Washington, D.C.: U.S. Environmental Protection Agency.

EPA. (1978). *Protective Noise Levels.* Washington, D.C. Report 5 550/9-79-100. November: U.S. Environmental Protection Agency, Office of Noise Abatement and Control.

EPA. (2016). *Promising Practices for EJ Methodologies in NEPA Reviews.* Report of the Federal Interagency Working Group on Environmental Justice & NEPA Compliance. U.S. Environmental Protection Agency.

EPA. (2020). *Categories of Hazardous Waste Generators*. Retrieved October 7, 2020, from U.S. Environmental Protection Agency: https://www.epa.gov/hwgenerators/categories-hazardous-waste-generators.

EPA. (2022). *Approved or Established TMDLs*. Retrieved April 19, 2023, from U.S. Environmental Protection Agency: https://www.epa.gov/npdes/approved-or-established-tmdls. Updated on July 19, 2022.

EPA. (2023a). *National Emission Standards for Hazardous Air Pollutants (NESHAP)*. Retrieved from U.S. Environmental Protection Agency: https://www.epa.gov/stationary-sources-air-pollution/national-emission-standards-hazardous-air-pollutants-neshap-8. May.

EPA. (2023b). *Nonattainment Areas for Criteria Pollutants (Green Book)*. Retrieved from U.S. Environmental Protection Agency: https://www.epa.gov/green-book. April 27.

FBP. (2022). *Portsmouth Site Annual Site Environmental Report 2021.* Fluor-BWXT Portsmouth LLC. DOE/PPPO/03-1111&D1. FBP-ER-RCRA-WD-RPT-0403.

FTA. (2006). *Transit Noise and Vibration Impact Assessment.* Federal Transit Administration Office of Planning and Environment. FTA-VA-90-1003-06. Prepared by Harris Miller Miller & Hanson Inc. Retrieved from https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/FTA_Noise_and_Vibration_Manual.pdf .

FTA. (2018). *Transit Noise and Vibration Impact Assessment Manual.* prepared by John A. Volpe Transportation Systems Center: FTAS Report No. 0123.

GEH GLE. (2008). *Environmental Report for the GLE Commercial Facility.* GE-Hitachi Global Laser Enrichment LLC.

GEH GLE. (2012). *Resubmittal of Revision 7 to Global Laser Enrichment License Application - Public Version (ML12256A682).* GE-Hitachi Global Laser Enrichment LLC. Retrieved from www.nrc.gov/docs/ML1225/ML12256A682.pdf. August 30.

General Electric. (2022). *Global Nuclear Fuel and TerraPower Announce Natrium Fuel Facility*. Retrieved from GE News: https://www.ge.com/news/press-releases/global-nuclear-fuel-and-terrapower-announce-natrium-fuel-facility. October 21.

GNF-A. (2008). *Global Nuclear Fuel–Americas Environmental RAI Responses.* Wilmington, NC.

GNF-A. (2021). Letter to NRC Director, Division of Fuel Management re: Natrium HALEU Fuel Fabrication Pre-Application Discussions. Global Nuclear Fuel - Americas. October 19 letter from Scott P. Murray, Manager, Facility Licensing.

Groetzinger, K. (2020). *The White Mesa Mill Has Become A Dumping Ground for Radioactive Waste, Tribe and Advocates Say*. Retrieved May 24, 2023, from KUER 90.1: https://www.kuer.org/public-lands/2020-05-20/the-white-mesa-mill-has-become-a-dumping-ground-for-radioactive-waste-tribe-and-advocates-say. May 20, 2020.

Harris, C. (1991). *Handbook of Acoustical Measurements and Noise Control.* New York, N.Y.: McGraw-Hill Book Company.

Honeywell. (2018). *Honeywell Metropolis Works Response to RAIs for the Environmental Report.* January 22.

IAEA. (1992). *Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Protection Standards.* Vienna, Austria: International Atomic Energy Agency. Techncal Report Series 332.

IDOT. (2023). *IDOT Traffic Counts*. Retrieved May 1, 2023, from Illinois Department of Transportation: https://idot.maps.arcgis.com/apps/webappviewer/index.html?id=3b727581bda74bae90954863185a8e8f.

INL. (2019). *UO2 HALEU Transportation Package Evaluation and Recommendations.* INL/EXT-19-56333, Revision 0, November. U.S. Department of Energy Idaho National Laboratory. Retrieved from https://www.nrc.gov/docs/ML2114/ML21141A321.pdf.

Kilmer, W. (2022). *ACU'S Next Lab Submits Construction Application with NRC to Build Research Reactor Sponsored by Natura Resources*. Retrieved April 17, 2023, from Abilene Christian University: https://acu.edu/2022/08/17/acus-next-lab-submits-construction-application-with-nrc-to-build-research-reactor-sponsored-by-natura-resources/. August 17.

Lyman, E. (2021). *"Advanced" Isn't Always Better: Assessing the Safety, Security, and Environmental Impacts of Non-Light-Water Nuclear Reactors.* Union of Concerned Scientists.

Marschke, S., & Gorden, M. (2019). *Evaluation of Illinois Emergency Management Agency Comments on the Draft Environmental Assessment for the Proposed Renewal of Source Material License SUB-526 Metropolis Works Uranium Conversion Facility (Massac County, Illinois).* Arlington, Virginia: SC&A.

McDowell, B. K., & Goodman, D. (2021). *Advanced Nuclear Reactor Plant Parameter Envelope and Guidance.* National Reactor Innovation Center. Richland, WA: Pacific Northwest National Laboratory. February 18.

Menge et al. (1998). *Menge, C. W., Rossano, C. F., Anderson, G. S., and Bajdek, C. J. FHWA Traffic Noise Model® Technical Manual.* Washington, D.C.: FHWA-PD-96-010 and DOT-VNTSC-FHWA-98-2, prepared by U.S. Department of Transportation, John A. Volpe National Transportation Systems Center, Cambridge, Mass., for U.S. Department of Transportation, Federal Highway Administration.

MRLC. (2019). *All NLCD Land Cover 2019 CONUS Land Cover*. Retrieved May 11, 2023, from Multi-Resolution Land Characteristics: https://www.mrlc.gov/viewer/.

NCDOT. (2023a). *NCDOT Annual Average Daily Traffic (AADT) Mapping Application: AADT Data*. Retrieved April 2023, from North Carolina Department of Transportation: https://ncdot.maps.arcgis.com/apps/webappviewer/index.html?id=964881960f0549de8c3583bf46ef5ed4.

NCDOT. (2023b). *NCDOT Annual Average Daily Traffic (AADT) Mapping Application*. Retrieved May 10, 2023, from North Carolina Department of Transportation: https://ncdot.maps.arcgis.com/apps/webappviewer/index.html?id=964881960f0549de8c3583bf46ef5ed4.

NCRP. (1991). *Effects of Ionizing Radiation on Aquatic Organisms.* Bethesda, MD: National Council on Radiation Protection and Measurements. Report No. 109.

NDEE. (2021). *2020 Water Quality Integrated Report*. Retrieved April 20, 2023, from Nebraska Department of Environment and Energy: http://dee.ne.gov/Publica.nsf/Pages/WAT352.

NDEQ. (2019). *Nebraska Administrative Code Title 117 – Nebraska Surface Water Quality Standards*. Retrieved from Nebraska Department of Environmental Quality: http://deq.ne.gov/RuleAndR.nsf/Pages/117-TOC/%24FILE/WQScont.pdf. June 24, 2019.

NEI. (2019). *Industry Groundwater Protection Initiative - Final Guidance Document.* Washington, D.C.: Nuclear Energy Institute. NEI 07-07 [Rev 1].

NHC. (2016). *New Hanover County, North Carolina, Comprehensive Plan 2016.* New Hanover County Commissioners.

NMDOT. (2023). *MS2 Transportation Data Management System - Annual average daily traffic data*. Retrieved May 1, 2023, from New Mexico Department of Transportation: https://nmdot.public.ms2soft.com/tcds/tsearch.asp?loc=Nmdot.

NRC. (1975). *Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants: Supplement I, NUREG-75/038.* U.S. Nuclear Regulatory Commission. Retrieved from https://www.nrc.gov/docs/ML1409/ML14091A176.pdf.

NRC. (1977a). *Regulatory Guide 1.111: Methods for Estimating Atmospheric Transport and Disperson of Gaseous Effluents in Route Releases from Light-Water-Cooled Reactors.* Revision 1. July. U.S. Nuclear Regulatory Commission Office of Standards Development.

NRC. (1977b). *Final Environmental Impact Statement on the Transportation of Radioactive Materials by Air and Other Modes, NUREG 0170.* Washington, DC: U.S. Nuclear Regulatory Commission, Office of Standards Development. December.

NRC. (1978). *Environmental Report for White Mesa Uranium Project San Juan County, Utah for Energy Fuels Nuclear, Inc.* Nuclear Regulatory Commission.

NRC. (1980). *Final Generic Environmental Impact Statement on Uranium Milling Project M-25, NUREG-0706.* U.S. Nuclear Regulatory Commission. Retrieved from https://www.nrc.gov/docs/ML0327/ML032751663.pdf.

NRC. (1986). *Environmental Assessment for Renewal of Materials License No. SNM-778 Babcock and Wilcox Lynchburg Research Center, NUREG-1227.* U.S. Nuclear Regulatory Commission Office of Nuclear Material Safety and Safeguards. Retrieved from https://www.nrc.gov/docs/ML2021/ML20212C435.pdf.

NRC. (1987). *Shipping Container Response to Severe Highway and Railway Accident Conditions NUREG/CR-4829.* Prepared for U.S. Nuclear Regulatory Commission by the Lawrence Livermore National Laboratory. L. E. Fischer, C. K. Chou, M. A. Gerhard, C. Y. Kimura, R. W. Martin, R. W. Mensing, M. E. Mount, M. C. Witte. Retrieved from https://www.nrc.gov/docs/ML0708/ML070810403.pdf.

NRC. (1997a). *Environmental Assessment for Renewal of Source Material License No. SUA-1358, White Mesa Uranium Mill.* U.S. Nuclear Regulatory Commission.

NRC. (1997b). *Final Environmental Impact Statement to Construct and Operate the Crownpoint Uranium Solution Mining Project, Crownpoint, New Mexico, NUREG–1508.* Washington, D.C.: U.S. Nuclear Regulatory Commission. February.

NRC. (1999a). *Environmental Assessment for Source Material License SUA-1350, Renewal for Operations and Amendment for the Reclamation Plan, Sweetwater Uranium Mill.* U.S. Nuclear Regulatory Commission.

NRC. (1999b). *Environmental Assessment for Renewal of Special Nuclear Material License: No. SNM-124. Nuclear Fuel Services, Inc. Erwin, Tennessee.* U.S. Nuclear Regulatory Commission Division of Fuel Cycle Safety and Safeguards, NMSS. Docket 70-143. Retrieved from https://www.nrc.gov/docs/ML0506/ML050600258.pdf.

NRC. (2000a). *Reexamination of Spent Fuel Shipping Risk Estimates, NUREG/CR 6672, March.* Washington, DC: U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards.

NRC. (2000b). *Regulatory Guide 1.183 Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors.* U.S. Nuclear Regulatory Commission Office of Nuclear Regulatory Research.

NRC. (2001). *A Baseline Risk-Informed, Performance-Based Approach for In-Situ Leach Uranium Extraction Licensees, NUREG/CR-6733.* U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards.

NRC. (2002a). *Environmental Assessment for Proposed License Amendments to Special Nuclear Material License No. SNM-124 Regarding Downblending and Oxide Conversion of Surplus High-Enriched Uranium. Nuclear Fuel Services, Inc., Erwin, Tennessee Plant.* U.S. Nuclear Regulatory Commission Division of Fuel Cycle Safety and Safeguards, NMSS. Prepared by Center for Nuclear Waste Regulatory Analyses, San Antonio, TX. Docket 70-143. Retrieved from https://www.nrc.gov/docs/ML0505/ML050540096.pdf.

NRC. (2002b). *NUREG-1520 Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility Final Report.* Washington, DC: U.S. Nuclear Regulatory Commission, Office of Nuclear

Material Safety and Safeguards. Retrieved from https://www.nrc.gov/docs/ML0209/ML020930033.pdf.

NRC. (2002c). *Final Generic Environmental Impact Statement of Decommissioning of Nuclear Facilities: Regarding the Decommissioning of Nuclear Power Reactors, NUREG–0586, Supplement 1, Volumes 1 and 2.* Washington, D.C.: U.S. Nuclear Regulatory Commission.

NRC. (2005a). *Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico, NUREG-1790.* U.S. Nuclear Regulatory Commission Office of Nuclear Material Safety and Safeguards, Division of Waste Management and Environmental Protection. Retrieved from https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1790/index.html.

NRC. (2005b). *Environmental Assessment Related to the Renewal of NRC License No. SNM-42 for BWX Technologies, Inc. (BWXT).* U.S. Nuclear Regulatory Commission Office of Nuclear Material Safety and Safeguards, Division of Waste Management and Environmental Protection. Docket No. 70-27.

NRC. (2006a). *Environmental Assessment for Renewal of NRC License No. SUB-526 for the Honeywell Specialty Materials Metropolis Work Facility.* Washington, D.C.: U.S. Nuclear Regulatory Commission. June.

NRC. (2006b). *Environmental Impact Statement for the Proposed American Centrifuge Plant in Piketon, Ohio, NUREG-1834.* U.S. Nuclear Regulatory Commission Office of Nuclear Material Safety and Safeguards. Retrieved from https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1834/index.html.

NRC. (2007/2019). *NUREG-0800 Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. LWR Edition.* U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation. Formerly issued as NUREG-75/087.

NRC. (2009a). *Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities, NUREG-1910.* U.S. Nuclear Regulatory Commission Office of Federal and State Materials and Environmental Management Programs and the Wyoming Department of Environmental Quality Land Quality Division. Retrieved from https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1910/index.html.

NRC. (2009b). *Environmental Assessment for the Renewal of U.S. Nuclear Regulatory Commission License No. SNM–1097 for Global Nuclear Fuel – Americas, Wilmington Fuel Fabrication Facility.* U.S. Nuclear Regulatory Commission Office of Federal and State Materials and Environmental Management Programs, Division of Waste Management and Environmental Protection. Docket No. 70-1113. Retrieved from https://www.nrc.gov/docs/ML0911/ML091180239.pdf.

NRC. (2009c). *Environmental Assessment for the Renewal of U.S. Nuclear Regulatory Commission License No. SNM–1227 for AREVA NP, Inc. Richland Fuel Fabrication Facility.* U.S. Nuclear Regulatory Commission Office of Federal and State Materials and Environmental Management Programs, Division of Waste Management and Environmental Protection. Docket No. 70-1257. Retrieved from https://www.nrc.gov/docs/ML0907/ML090700258.pdf.

NRC. (2010). *Environmental Impact Statement for the Moore Ranch ISR Project in Campbell County, Wyoming: Supplement to the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities — Final Report, NUREG-1910, Supplement 1.* U.S. Nuclear Regulatory

Commission Office of Federal and State Materials and Environmental Management Programs. Retrieved from https://www.nrc.gov/docs/ML1022/ML102290470.pdf.

NRC. (2011a). *Environmental Impact Statement for the Nichols Ranch ISR Project in Campbell and Johnson Counties, Wyoming: Supplement to the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities — Final Report, NUREG-1910, Supplement 2.* U.S. Nuclear Regulatory Commission Office of Federal and State Materials and Environmental Management Programs. Retrieved from https://www.nrc.gov/docs/ML1034/ML103440120.pdf.

NRC. (2011b). *Environmental Impact Statement for the Lost Creek ISR Project in Sweetwater County, Wyoming: Supplement to the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities — Final Report, NUREG-1910, Supplement 3.* U.S. Nuclear Regulatory Commission Office of Federal and State Materials and Environmental Management Programs. Retrieved from https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1910/s3/index.html.

NRC. (2011c). *Environmental Impact Statement for the Proposed Eagle Rock Enrichment Facility in Bonneville County, Idaho.* Office of Federal and State Materials and Environmental Management Programs.

NRC. (2012a). *Environmental Impact Statement for the Proposed Fluorine Extraction Process and Depleted Uranium Deconversion Plant in Lea County, New Mexico – Final Report, NUREG-2113.* U.S. Nuclear Regulatory Commission Office of Federal and State Materials and Environmental Management Programs. Retrieved from https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr2113/index.htm.

NRC. (2012b). *Environmental Impact Statement for the Proposed GE-Hitachi Global Laser Enrichment, LLC Facility in Wilmington, North Carolina, NUREG-1938.* U.S. Nuclear Regulatory Commission Office of Federal and State Materials and Environmental Management Programs. Retrieved from https://www.nrc.gov/docs/ML1204/ML12047A040.pdf.

NRC. (2013a). *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437.* U.S. Nuclear Regulatory Commission Office of Nuclear Reactor Regulation. Retrieved from https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1437/r1/index.html.

NRC. (2013b). *Standard Review Plans for Environmental Reviews for Nuclear Power Plants NUREG-1555 Supplement 1: Operating License Renewal Final Report.* U.S. Nuclear Regulatory Commission Office of Nuclear Reactor Regulation. Retrieved from https://www.nrc.gov/docs/ML1310/ML13106A246.pdf.

NRC. (2014a). *Environmental Impact Statement for the Dewey-Burdock Project in Custer and Fall River Counties, South Dakota: Supplement to the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities — Final Report, NUREG-1910, Supplement 4.* U.S. Nuclear Regulatory Commission Office of Federal and State Materials and Environmental Management Programs. Retrieved from https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1910/s4/v1/index.html.

NRC. (2014b). *Environmental Impact Statement for the Ross ISR Project in Crook County, Wyoming: Supplement to the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities: Final Report, NUREG-1910, Supplement 5.* U.S. Nuclear Regulatory Commission. Retrieved from https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1910/s5/index.html.

NRC. (2014c). *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel, NUREG-2157.* U.S. Nuclear Regulatory Commission Office of Nuclear Material Safety and Safeguards. Retrieved from https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr2157/v1/index.html.

NRC. (2015). *Environmental Assessment for the Proposed Louisiana Energy Services, URENCO USA Uranium Enrichment Facility Capacity Expansion in Lea County, New Mexico Docket No. 70-3103.* Washington D.C.: U.S. Nuclear Regulatory Commission.

NRC. (2016). *Environmental Impact Statement for the Reno Creek In Situ Recovery Project in Campbell County, Wyoming: Supplement to the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities, Final Report, NUREG-1910 Supplement 6.* U.S. Nuclear Regulatory Commission Office of Nuclear Material Safety and Safeguards. Retrieved from https://www.nrc.gov/docs/ML1634/ML16342A973.pdf.

NRC. (2018). *Final Environmental Assessment for the Proposed Renewal of SUA-1350 Sweetwater Uranium Project in Sweetwater County, Wyoming.* U.S. Nuclear Regulatory Commission. Retrieved from https://www.nrc.gov/docs/ML1813/ML18135A206.pdf. June.

NRC. (2019a). *Environmental Assessment for the Proposed Renewal of Source Material License SUB–526 Metropolis Works Uranium Conversion Facility (Massac County, Illinois). Honeywell International, Docket No. 040-03392.* U.S. Nuclear Regulatory Commission. Retrieved from https://www.nrc.gov/docs/ML1927/ML19273A012.pdf.

NRC. (2019b). *Tennessee Valley Authority Clinch River Nuclear Site Early Site Permit ESP-006.* Washington, D.C.: U.S. Nuclear Regulatory Commission. Retrieved from https://www.nrc.gov/docs/ML1935/ML19352D868.pdf.

NRC. (2019c). *Environmental Impact Statement for an Early Site Permit (ESP) at the Clinch River Nuclear Site: Final Report NUREG-2226.* U.S. Nuclear Regulatory Commission Office of New Reactors with U.S. Army Corps of Engineers Nashville District. Retrieved from https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr2226/v1/index.html.

NRC. (2020a). *Uranium Recovery (Extraction) Methods*. Retrieved 2023, from U.S. Nuclear Regulatory Commission: https://www.nrc.gov/materials/uranium-recovery/extraction-methods.html. Page Last Reviewed/Updated Wednesday, December 02, 2020.

NRC. (2020b). *Comparison of Conventional Mill, Heap Leach, and In Situ Recovery Facilities*. Retrieved 2023, from U.S. Nuclear Regulatory Commission: https://www.nrc.gov/materials/uranium-recovery/extraction-methods/comparison.html. Page Last Reviewed/Updated Wednesday, December 02, 2020.

NRC. (2020c). *NRC News - NRC Approves License Renewal for Honeywell Uranium Conversion Facility.* Office of Public Affairs, Headquarters.

NRC. (2020d). *Heap Leach and Ion-Exchange Facilities*. Retrieved 2023, from U.S. Nuclear Regulatory Commission: https://www.nrc.gov/materials/uranium-recovery/extraction-methods/heap-leach-ion-exchange.html. Page Last Reviewed/Updated Wednesday, December 02, 2020.

NRC. (2021a). *In-Situ Recovery Facilities*. Retrieved 2023, from U.S. Nuclear Regulatory Commission: https://www.nrc.gov/materials/uranium-recovery/extraction-methods/isl-recovery-facilities.html. Page Last Reviewed/Updated Friday, May 14, 2021.

NRC. (2021b). *Conventional Uranium Mills*. Retrieved 2023, from U.S. Nuclear Regulatory Commission: https://www.nrc.gov/materials/uranium-recovery/extraction-methods/conventional-mills.html. Page Last Reviewed/Updated Monday, May 17, 2021.

NRC. (2021c). *Environmental Assessment for the Proposed Amendment of US. Nuclear Regulatory Commision License Number SNM-2011 for the American Centrifuge in Piketon, Ohio.* Washington DC: U.S. Nuclear Regulatory Commssion. Retrieved from https://www.nrc.gov/docs/ML2108/ML21085A705.pdf.

NRC. (2021d). *Certificate of Compliance, for ES-3100.* Docket No. 71-9315, USA/9315/B(U)F-96, Rev 16. January 5. Nuclear Regulatory Commission. Retrieved from https://rampac.energy.gov/docs/default-source/certificates/1019315.pdf.

NRC. (2021e). *Draft Generic Environmental Impact Statement for Advanced Nuclear Reactors (ANRs), NUREG-2249.* U.S. Nuclear Regulatory Commission Office of Nuclear Material Safety and Safeguards. Retrieved from https://www.nrc.gov/docs/ML2122/ML21222A055.pdf.

NRC. (2022a). *NUREG-0713 Vol 42 Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2020.* Washington D.C.: U.S. Nuclear Regulatory Commission.

NRC. (2022b). *Certificate Of Compliance for NAC International Package Model No. Optimus™-L.* Docket No. 71-9390, USA/9390/B(U)F-96, Rev 1. Nuclear Regulatory Commission. Retrieved from https://rampac.energy.gov/docs/default-source/certificates/1019390.pdf. January 24.

NRC. (2022c). *Final Environmental Impact Statement for the License Renewal of the Columbia Fuel Fabrication Facility in Richland County, South Carolina, NUREG-2248.* U.S. Nuclear Regulatory Commission Office of Nuclear Material Safety and Safeguards. Retrieved from https://www.nrc.gov/docs/ML2220/ML22201A131.pdf.

NRC. (2023a). *Environmental Impact Statement for the Disposal of Mine Waste at the United Nuclear Corporation Mill Site in McKinley County, New Mexico, NUREG-2243.* U.S. Nuclear Regulatory Agency.

NRC. (2023b). *Certificate of Compliance for Radioactive Material Packages - Safety Analysis Report for the DN30-X Package. 0045-BSH-2020-001-Rev.3.* Docket No. 71-9388, USA/9362/AF-96, Rev. 0, March 27. Nuclear Regulatory Commission. Retrieved from https://rampac.energy.gov/docs/default-source/certificates/1019388.pdf.

NRC. (2023c). *MSRR – Abilene Christian University Application*. (U. N. Commission, Producer) Retrieved April 17, 2023, from https://www.nrc.gov/reactors/non-power/new-facility-licensing/msrr-acu.html. January 27.

NRC. (2023d). *New Fuel Cycle Facility Licensing and Construction*. Retrieved September 10, 2023, from Nuclear Regulatory Commission: https://www.nrc.gov/materials/fuel-cycle-fac/new-fac-licensing.html. Page Last Reviewed/Updated April 20, 2022.

NWCC. (2002). *Permitting of Wind Energy Facilities: A Handbook.* Prepared by the National Wind Coordinating Committee Siting Subcommittee, Washington, D.C.

ODOD. (2023). *Ohio County Profiles: 2021 Annual Edition.* Ohio Department of Development, Office of Strategic Research. Retrieved from https://devresearch.ohio.gov/reports_countytrends_map.htm. April 2023.

ODOT. (2023). *MS2 Transportation Data Management System: AADT Data*. Retrieved April 2023, from Ohio Department of Transportation: https://odot.public.ms2soft.com/tcds/tsearch.asp?loc=Odot&mod=TCDS.

Oklo. (2020). *Oklo Inc., Project 99902046: Oklo Power Combined Operating License Application for the Aurora at INL.* Sunnyvale, CA.

ORNL. (2015). *Molten Salt Reactor Experiment.* Commemorating Brochure for the Molten Salt Reactor (MSR) 2015 Workshop, October 15-16, 2015. Oak Ridge National Laboratory. Retrieved from https://public.ornl.gov/conferences/MSR2015/pdf/20151022104041810.pdf.

ORSANCO. (2020). *Assessment of Ohio River Water Quality Conditions. Assessment Years: 2014-2018.* Ohio River Valley Water Sanitation Commission. Retrieved May 2, 2023, from http://www.orsanco.org/wp-content/uploads/2020/06/ORSANCO_2020_305b_Report.pdf. June.

OSE ISC. (2013). *New Mexico Water Use by Categories 2010.* New Mexico Office of the State Engineer Interstate Stream Commission. New Mexico Office of the State Engineer Technical Report 54.

OSE ISC. (2016). *Lea County Regional Water Plan.* New Mexico Office of the State Engineer Interstate Stream Commission.

Pappano, P. (2020). *Fuel & HALEU Needs.* X-Energy, LLC.

Patel, S. (2020). *Oklo Microreactor Is INL's Pick for First-of-a Kind HALEU-Fueled Nuclear Demonstration*. (I. N. Laboratory, Producer) Retrieved April 17, 2023, from POWER magazine: https://www.powermag.com/oklo-micro-reactor-is-inls-pick-for-first-of-a-kind-haleu-fueled-nuclear-demonstration/. February 19.

PNM. (2020). *AVANGRID and PNM Resources to Combine in Strategic Merger Transaction*. Retrieved April 28, 2023, from Public Service Company of New Mexico: https://www.pnm.com/documents/28767612/28801999/PNM+Local+NEWS+RELEASE.pdf/0edf5d9c-fa65-5055-5ac8-d9a8faf0ac58?t=1603295351337.

Podmore, Z. (2021). *Can the White Mesa Uranium Mill Shake Southern Utah's Radioactive Past?* Retrieved from The Salt Lake Tribune: https://www.sltrib.com/news/2021/01/30/can-white-mesa-uranium/. January 30.

PORTS Demolition. (2023). *Portsmouth D&D Program*. Retrieved May 16, 2023, from https://portsdemo.com/project-view/.

Power. (2017). *Global Nuclear Fuel Update*. Retrieved from https://www.powermag.com/global-nuclear-fuel-update/.

PR Newswire. (2023). *PNM Resources and Avangrid agree to merger extension.* Retrieved from PR Newswire: https://www.prnewswire.com/news-releases/pnm-resources-and-avangrid-agree-to-merger-extension-301854986.html. June 20.

Saricks, C., & Tompkins, M. M. (1999). State Level Accident Rates for Surface Freight Transportation: A Reexamination, ANL/ESD/TM 150, April. Argonne, Illinois: Argonne National Laboratory, Energy Systems Division, Center for Transportation Research.

SCDOT. (2023). *SCDOT Traffic Analysis and Data Application*. Retrieved May 10, 2023, from South Carolina Department of Transportation: https://scdottrafficdata.drakewell.com/publicmultinodemap.asp.

TCEQ. (2022). *2022 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d)*. Retrieved April 27, 2023, from Texas Commission on Environmental Quality: https://www.tceq.texas.gov/waterquality/assessment/22twqi/22txir. July 7, 2022.

TDOT. (2023). *TDOT MS2 Traffic Count Database System*. Retrieved May 10, 2023, from Tennessee Department of Transportation: https://tdot.public.ms2soft.com/tcds/tsearch.asp?loc=Tdot&mod=TCDS.

Transportation Research Board. (1994). *TRB Special Report 209: Highway Capacity Manual.* Washington, D.C. 3rd Edition.

TRISO-X. (2022). *Environmental Report for the TRISO-X Fuel Fabrication Facility.*

UDOT. (2023). *Map of Annual Average Daily Traffic (AADT) for roadway segments in Utah*. Retrieved May 20, 2023, from Utah Department of Transportation: https://udot.utah.gov/connect/docs/aadt-google-map/.

UDWMRC. (2017). *Radioactive Material License No. UT 1900479 and Utah Ground Water Discharge Permit No. UGW370004 Technical Evaluation and Environmental Assessment: White Mesa Uranium Mill Energy Fuels Resources.* Utah Division of Waste Management and Radiation Control. Retrieved from https://documents.deq.utah.gov/waste-management-and-radiation-control/facilities/energy-fuels-white-mesa/DRC-2017-002761.pdf.

UMTRI. (2003). *Evaluation of the Motor Carrier Management Information System Crash File, Phase One, UMTRI-2003-6.* University of Michigan Transportation Research Institute, Center for National Truck Statistics.

UNCW. (2023). *About UNCW*. Retrieved from University of North Carolina Wilmington: https://uncw.edu/about/know-us/.

Uranium Producers of America. (2014). *In Situ Recovery: Uranium In Situ Recovery Technology*. Retrieved 2023, from https://www.theupa.org/uranium_technology/in_situ_recovery/. Page copyrighted in 2014.

USCB. (2023a). *Quick Facts: queries for states in the project region of influence, and associated counties and communities*. Retrieved from U.S. Census Bureau: https://www.census.gov/quickfacts/fact/table/US/PST045221 and https://www.census.gov/quickfacts/fact/table/US/PST045222.

USCB. (2023b). *American Community Survey (5-year average 2017-2021). DP03 Selected Economic Characteristics*. Retrieved from United States Census Bureau: https://data.census.gov/table?tid=ACSDP1Y2021.DP03.

USCB. (2023c). *American Community Survey (5-year average 2017-2021). DP04 Selected Housing Characteristics*. Retrieved from U.S. Census Bureau: https://data.census.gov/table?tid=ACSDP1Y2021.DP04.

USCB. (2023d). *American Community Survey (5-year average 2017-2021). DP05 ACS Demographic and Housing Estimates*. Retrieved from U.S. Census Bureau: https://data.census.gov/table?tid=ACSDP1Y2021.DP05.

USCB. (2023e). How the Census Bureau Measures Poverty. Retrieved April 21, 2023, from https://www.census.gov/topics/income-poverty/poverty/guidance/poverty-measures.html.

USDA. (2012). *Draft Environmental Impact Statement for the La Jara Mesa Mine Project.* U.S. Department of Agriculture. Retrieved from https://laramide.com/wp-content/uploads/2017/11/Draft_Environmental_Impact_Statement_La_Jara_Mesa_2012.pdf.

USDA. (2013). *Draft Environmental Impact Statement for Roca Honda Mine Sections 9, 10 and 16, Township 13 North, Range 8 West, New Mexico Principal Meridian, Cibola National Forest, McKinley and Cibola Counties, New Mexico.* U.S. Department of Agriculture, U.S. Forest Service Southwestern Region. MB-R3-03-25.

USDA. (2017a). *2017 Census of Agriculture - County Data - New Mexico.* U.S. Department of Agriculture, National Agricultural Statistics Service.

USDA. (2017b). *2017 Census of Agriculture - County Data - Texas.* U.S. Department of Agriculture, National Agricultural Statistics Service.

USDA. (2017c). *2017 Census of Agriculture - County Data - Ohio.* U.S. Department of Agriculture, National Agricultural Statistics Service.

USDOT. (2017). *Simplified Highway Capacity Calculation Method for the Highway Performance Monitoring System.* U.S. Department of Transportation. Retrieved from https://www.fhwa.dot.gov/policyinformation/pubs/pl18003/hpms_cap.pdf. October.

USDOT. (2021). *Traffic Safety Facts 2019.* Washington, D.C.: National Highway Traffic Safety Administration. Retrieved from https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813141. DOT HS 813 141. August.

USEC. (1995). *Uranium Hexafluoride: A Manual of Good Handling Practices. USEC-651, Revision 7.* United States Enrichment Corporation. Retrieved from https://www.osti.gov/servlets/purl/205924.

USEC. (2004). *Environmental Report for the American Centrifuge Plant in Piketon, Ohio LA-3602-0002.* Bethesda Md: USEC.

USEC. (2006). *Environmental Report for the American Centrifuge Plant. LA-3605-0002. (Rev 7).* U.S. Enrichment Corporation. February 17.

USFWS. (2013). *Revised Voluntary Guidelines for Communication Tower Design, Siting, Construction, Operation, Retrofitting, and Decommissioning.* Arlington, VA: U.S. Fish and Wildlife Service.

USFWS. (2023). *IPaC (Information for Planning and Consultation)*. Retrieved from U.S. Fish and Wildlife Service: https://ipac.ecosphere.fws.gov/.

Utah DEQ. (2018). *Radioactive Material License Renewal Number UT 1900479. Amendment 8.* Utah Department of Environmental Quality. Retrieved from https://documents.deq.utah.gov/waste-management-and-radiation-control/facilities/energy-fuels-white-mesa/DRC-2018-001587.pdf. February.

VDOT. (2019). *Virginia Department of Transportation Daily Traffic Volume Estimates Including Vehicle Classification Estimates, Jurisdiction Report 15.* Virginia Department of Transportation. Retrieved from https://www.virginiadot.org/info/resources/Traffic_2019/AADT_015_Campbell_2019.pdf.

WNN. (2022). *USNC eyes summer start-up for Oak Ridge fuel plant*. Retrieved May 3, 2022, from World Nuclear News: https://www.world-nuclear-news.org/Articles/USNC-eyes-summer-start-up-for-Oak-Ridge-fuel-plant. March 3.

Wojtnik, R. (2019). *New $20M Framatome facility to open by year's end*. Retrieved from Tri-Cities Area Journal of Business: https://www.tricitiesbusinessnews.com/2019/12/framatome/. October

WSDOT. (2023). *WSDOT MS2 Traffic Count Database System*. Retrieved May 10, 2023, from Washington State Department of Transportation: https://wsdot.public.ms2soft.com/tcds/tsearch.asp?loc=Wsdot&mod=TCDS.

X-energy. (2022). *TRISO-X Submits First Ever High-Assay Low-Enriched Uranium Fuel Fabrication Facility License Application to the Nuclear Regulatory Commission.* News Release, April 6.

Zbib et al. (2021). Zbib, A., C. J. Yeager, C. L. Painter, D. L. Blanchard, M. Nutt, J. Katalenich, B. McNamara, S. Grabinski, and P. Fuhrman. *Fuel Fabrication Capability Assessment in Support of Advanced Reactor Deployments*. Pacific Northwest National Laboratory. April.

This page intentionally left blank.