U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

ML23300A053

Environmental Assessment for the Construction Permit Application for the Abilene Christian University Molten Salt Research Reactor

Completed: March 2024

Environmental Center of Expertise

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Division of Rulemaking, Environmental, and Financial Support

Office of Nuclear Material Safety & Safeguards

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ABSTRACT

This environmental assessment describes the environmental review conducted by the U.S. Nuclear Regulatory Commission (NRC) staff for the application by Abilene Christian University (ACU) for a construction permit under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, “Domestic Licensing of Production and Utilization Facilities,” authorizing the construction of a molten salt research reactor (MSRR) in the existing Gayle and Max Dillard Science and Engineering Research Center (SERC) building on the ACU campus in Abilene, Texas. The environmental assessment follows the requirements in 10 CFR Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions,” which is the NRC’s regulation that implements the National Environmental Policy Act of 1969, as amended (NEPA). Specifically, the environmental assessment includes the information required by 10 CFR 51.30, “Environmental assessment,” 10 CFR 51.31, “Determinations based on environmental assessment,” and 10 CFR 51.32, “Finding of no significant impact.” The proposed action is whether to issue a construction permit to ACU to authorize the construction of the MSRR in the SERC building. The need for the proposed action is to conduct research on molten salt reactor technology. The NRC staff identified alternatives to the proposed action as required by Section 102(2)(E) of NEPA and the environmental impacts of the proposed action and alternatives as appropriate. The NRC staff determined that the environmental impacts of the proposed action would be SMALL for each potentially affected environmental resource, meaning that the environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. The NRC staff also determined that there are no alternatives that meet the need for the proposed action and that are environmentally preferrable to the proposed action. On the basis of the environmental assessment, the NRC staff concludes that, because the impacts would be SMALL for each potentially affected environmental resource, the potential direct, indirect, and cumulative environmental impacts of the proposed action will not have a significant effect on the quality of the human environment. Accordingly, the NRC staff has determined not to prepare an environmental impact statement for the proposed action. This finding and the related environmental documents are available for public inspection as discussed herein.

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EXECUTIVE SUMMARY

The proposed action before the U.S. Nuclear Regulatory Commission (NRC) is whether to issue a construction permit (CP) to Abilene Christian University (ACU) authorizing the construction of a molten salt research reactor (MSRR) in the existing Gayle and Max Dillard Science and Engineering Research Center (SERC) building on the ACU campus in Abilene, Texas. Section 1 of this environmental assessment (EA) presents an introduction to the proposed action and the need for the proposed action, which is to conduct research on molten salt reactor technology. Section 2 of the EA describes the proposed design of the MSRR and its siting inside of the SERC building. Section 3 of the EA summarizes the direct, indirect, and cumulative environmental impacts of the proposed action. The NRC staff concludes therein that these impacts would be SMALL for each potentially affected environmental resource, meaning that the environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. This conclusion is based on the staff's review of ACU's CP application and associated responses to requests for supplemental information and requests for clarifying information, the staff's communications with Federal, State, and local agencies, as well as Tribal officials, and the staff's independent environmental review. Section 3 of the EA includes the NRC staff's National Historic Preservation Act of 1966, as amended, Section 106 review and finding that the proposed action will result in no historic properties affected. The NRC staff solicited public comments for 30 days on this finding and shared the initial draft of this EA with this finding with Tribes, the Texas Commission on Environmental Quality, the Advisory Council on Historic Preservation, and the Texas Historical Commission for comment over a 30-day period. The NRC did not receive any comments. Section 4 of the EA evaluates the environmental impacts of reasonable alternatives to the proposed action and concludes that there are no alternatives that meet the need for the proposed action and that are environmentally preferrable to the proposed action. Section 5 of the EA presents the staff's conclusions and finding that, because the impacts would be SMALL for each potentially affected environmental resource, the proposed action will not have a significant effect on the quality of the human environment. Accordingly, the staff has determined not to prepare an environmental impact statement for the proposed action. Table ES-1 summarizes the environmental impacts of the proposed action and the staff's conclusions for each resource considered and where that impact is discussed in this EA.

Table ES-1 Summary of the Environmental Impacts of the Construction, Operation, and Decommissioning of the Molten Salt Research Reactor

Resource	Environmental Assessment Section	Summary of Impact	Impact
Land Use and Visual Resources	3.1	The proposed MSRR is accommodated within an academic research building (the SERC) on the ACU campus. The MSRR would be compatible with other uses of the building and with surrounding land uses. The SERC is located in an area zoned for commercial use. There are no effects on prime or unique farmland, mineral resources, forestry or agricultural resources, floodplains, wetlands, parks, preserves, or other special land uses. The site is not in a coastal zone. The MSRR would not change the external appearance of the academic building, which is typical of a college campus.	SMALL
Air Quality and Noise	3.2	Air emissions of criteria pollutants would be below 100 tons per year (TPY), and hazardous air pollutants would be below 10 TPY individually and 25 TPY combined. Emissions would comply with non-Title V permitting requirements. Standard control measures would mitigate fugitive dust releases.	SMALL
Hydrogeology and Water Resources	3.3	There would be no disturbance of geologic features of economic or natural value. Disturbances are limited to previously disturbed soils. Best management practices (BMPs) for soil erosion and sediment control would be employed. Water demands would be met by municipal suppliers. There would be no use of groundwater and no direct use of surface water. There would be no use of cooling towers, ponds, or reservoirs. Wastewater would be treated by municipal wastewater treatment facilities. Stormwater would be managed using BMPs.	SMALL
Ecological Resources	3.4	The MSRR would be built in an existing academic building (the SERC) and would not involve temporary or permanent losses of natural habitat. No disturbances to forest or other natural vegetation, natural soils, wetlands, surface waters, shorelines, or riparian lands. No Section 404 permit required. BMPs to control stormwater runoff that might reach wetlands or aquatic habitats. Local wildlife already acclimated to campus noise. No	SMALL

Resource	Environmental Assessment Section	Summary of Impact	Impact
		Federally endangered species would be affected.	
Historical and Cultural Resources	3.5	No historic properties are in direct effects area of potential effects. No ground disturbance would occur as part of the undertaking. Two National Register of Historic Places-listed ACU buildings (Administration Building and Luce Hall) are over 400 meters from the area of potential effects. The proposed undertaking would not adversely affect either historic property.	SMALL
Socioeconomic and Environmental Justice	3.6	Small numbers of workers would not substantially affect employment levels in the surrounding area, but the demand for some skilled labor might compete with other planned technology projects. The small size of the MSRR and its distance from the closest census blocks with populations meeting environmental justice (EJ) criteria indicate little potential for EJ effects.	SMALL
Human Health	3.7	Radiological releases, doses to the public, and occupational doses would be less than the limits established for protection of human health and the environment in 10 CFR Part 20 (TN283). ACU would implement normal safety practices contained in Occupational Safety and Health Administration regulations in 29 CFR Part 1910 (TN654) to protect occupational health. Emissions would comply with the Resource Conservation and Recovery Act (TN1281), Clean Air Act (TN1141), and other environmental regulations.	SMALL
Nonradiological Waste Management	3.8	ACU would manage wastes generated consistent with the university's current waste management plan. Management of solid waste, including construction and demolition waste, would involve waste reduction efforts, recycling, and BMPs. Liquid wastes would be trucked off-site for proper disposal. Gaseous emissions would comply with the Texas Commission on Environmental Quality regulations.	SMALL
Uranium Fuel Cycle and Radiological Waste Management	3.9	A low quantity of uranium is used during operations. Fuel processes are bounded by Table S-3 of 10 CFR 51.51 (TN250), developed by the NRC to protect human health and the environment. Environmental impacts from storage of	SMALL

Resource	Environmental Assessment Section	Summary of Impact	Impact
		spent fuel would be less than the environmental impact provided by the Continued Storage Generic EIS (TN4117). The estimated volume of low-level radioactive waste (LLRW) is less than or comparable to that of a light-water reactor (LWR), and the NRC staff determined that there is adequate capacity for LLRW disposal. The on-site storage of spent fuel would have to meet the same regulatory requirements as currently licensed LWRs.	
Transportation of Radioactive Material	3.10	Transportation of radioactive fuels and wastes to and from the MSRR would be performed in compliance with U.S. Department of Transportation (DOT) and NRC regulations and constitutes only a small percentage of the total materials of these types shipped each year.	SMALL
Postulated Accidents	3.11	The NRC staff is conducting an independent review of the consequences of accidents in its Safety Evaluation Report for the CP application. The MSRR would have to meet the NRC requirements for postulated accidents. The nearest resident dose from accidents would also be below the radiation dose limits for individual members of the public.	SMALL
Climate Change	3.12	Climate change is a global phenomenon that the MSRR would not appreciably alter. None of the impact conclusions in this EA for the MSRR would change as a result of climate change.	SMALL

ABBREVIATIONS AND ACRONYMS

°C	degree(s) Celsius
°F	degree(s) Fahrenheit
%	percent
AADT	annual average daily traffic
ac	acre(s)
ACU	Abilene Christian University
ACUPD	ACU Police Department
AD	anno Domini
AFB	Air Force Base
AHCP	Advisory Council on Historic Preservation
AISD	Abilene Independent School District
ALARA	as low as is reasonably achievable
APD	City of Abilene Police Department
APE	Area of Potential Effect
BF_2	beryllium fluoride
BMP	best management practice
BP	before present
BWXT	BWX Technologies, Inc.
CAP	criteria air pollutant
CEQ	Council on Environmental Quality
CFR	*Code of Federal Register*
CH_4	methane
cm	centimeter(s)
Centrus	Centrus Energy Corp.
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CP	construction permit
dB	decibel(s)
Dba	A-weighted decibel(s)

Db Ldn	day/night average noise level
DFW	Dallas–Fort Worth
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EA	environmental assessment
EIS	environmental impact statement
EJ	environmental justice
EPA	U. S. Environmental Protection Agency
ER	environmental report
F_2	fluorine gas
FR	*Federal Register*
FHS	fuel handling system
FLiBe	lithium-fluorine and beryllium-fluorine salts
FSH	Fort Stockton Holdings
ft	foot/feet
ft^2	square foot (feet)
ft^3	cubic foot (feet)
ft^3/yr	cubic foot (feet) per year
g	gram(s)
gal	gallon(s)
gal/min	gallon(s) per minute
GCRP	U.S. Global Change Research Program
GEIS	Generic Environmental Impact Statement
GHG	greenhouse gas
g/mi	gram(s)/mile
GMS	gas management system
hr(s)	hour(s)
HALEU	high-assay low-enriched uranium
HAP	hazardous air pollutant
HCl	hydrogen chloride
HF	hydrogen fluoride
HUD	U.S. Department of Housing and Urban Development

in.	inch(es)
kg	kilogram(s)
km	kilometer(s)
kph	kilometer(s) per hour
L	liter(s)
L/yr	liter(s) per year
lb	pound(s)
lb/yr	pound(s) per year
Li-7	lithium-7
LLRW	low-level radioactive waste
LR	license renewal
LWR	light-water reactor
m	meter(s)
m^2	square meter(s)
m^3	cubic meters
MG	million gallons
MHA	maximum hypothetical accident
mg/m^3	milligram(s) per cubic meter
mi	mile(s)
mL	milliliters
mph	mile(s) per hour
mrem	milli-Roentgen equivalent man
mrem/hr	millirem(s) per hour
mrem/yr	millirem(s) per year
MSA	metropolitan statistical area
MSRE	Molten Salt Reactor Experiment
MSRR	molten salt research reactor
mSv	millisievert(s)
mSv/yr	millisievert(s) per year
MT	metric ton(s)
MTU/yr	metric tons of uranium per year
MWe	megawatt(s) electric
MWt	megawatt(s) thermal

NAAQS	National Ambient Air Quality Standards
NCDC	National Climatic Data Center
NEPA	National Environmental Policy Act of 1969, as amended
NEXT Laboratory	Nuclear Energy eXperimental Testing Laboratory
NHPA	National Historic Preservation Act of 1966, as amended
N_2O	nitrous oxide
NO_X	nitrogen oxide(s)
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NRRA	Natura Resources Research Alliance
NNSR	Nonattainment New Source Review
O_3	ozone
OL	operating license
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
PM	particulate matter
PNNL	Pacific Northwest National Laboratory
PSAR	Preliminary Safety Analysis Report
PSD	Prevention of Significant Deterioration
rem	Roentgen equivalent man
rem/yr	Roentgen equivalent man per year
ROI	region of influence
RRY	reference reactor-year
sec/m^3	second(s) per cubic meter
SAFSTOR	safe storage
SERC	Gayle and Max Dillard Science and Engineering Research Center
SO_2	sulfur dioxide
TAC	Texas Administrative Code
TASA	Texas Historical Commission’s Texas Archaeological Sites Atlas
TCEQ	Texas Commission on Environmental Quality
TEDE	total effective dose equivalent
THC	Texas Historical Commission

TPY	ton(s) per year
U-235	uranium-235
UF_4	uranium tetrafluoride
UF_6	uranium hexafluoride
UCSB	U.S. Census Bureau
wt%	weight percent
WCS	Waste Control Specialists, LLC

1 INTRODUCTION

On August 12, 2022, as supplemented by correspondence dated October 14, 2022 (ACU 2022-TN9529), September 27, 2023 (ACU 2023-TN9099), and November 14, 2023 (ACU 2023-TN8909), Abilene Christian University (ACU, the applicant) filed, pursuant to Section 104c. of the Atomic Energy Act of 1954, as amended, and Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," an application (ACU 2023-TN8909) for a construction permit (CP) for a molten salt research reactor (MSRR) (a "non-power reactor" as defined in 10 CFR 50.2, "Definitions" [TN249]), which would be located on the ACU campus in Abilene, Texas. The MSRR would be a high-temperature research reactor that uses a molten fluoride-based fuel salt. A notice of receipt and availability of the CP application was published in the *Federal Register* on October 14, 2022 (87 FR 62463-TN8940). ACU proposed to build the MSRR within an existing academic building termed the Gayle and Max Dillard Science and Engineering Research Center (SERC), recently constructed and opened on the ACU campus.

The U.S. Nuclear Regulatory Commission (NRC) staff determined that the CP application was acceptable for docketing under Docket No. 50-610 and provided ACU with notice of this determination by letter dated November 18, 2022 (NRC 2022-TN8890). In accordance with 10 CFR Part 51 (TN250), "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," which is the NRC's regulation that implements the National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. § 4321, et seq. – TN661), the NRC staff conducted an environmental review of the CP application, and that review is described in this environmental assessment (EA). Consistent with 10 CFR 51.30, "Environmental assessment," and 10 CFR 51.31, "Determinations based on environmental assessment," the EA identifies the proposed action and includes a brief discussion of the need for the proposed action, alternatives as required by Section 102(2)(E) of NEPA, and the environmental impacts of the proposed action and alternatives as appropriate, as well as a list of agencies and persons consulted, and identification of sources used. Consistent with 10 CFR 51.32, "Finding of no significant impact," the EA concludes with a finding of no significant impact that identifies the proposed action, states that the NRC has determined not to prepare an environmental impact statement for the proposed action, briefly presents the reasons why the proposed action will not have a significant effect on the quality of the human environment (i.e., because the impacts would be SMALL for each potentially affected environmental resource, meaning that the environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource), incorporates the EA by reference, notes any other related environmental documents, and states that the finding and any related environmental documents are available for public inspection and where the documents may be inspected. The NRC staff is separately performing a detailed safety review of the CP application that will be documented in a Safety Evaluation Report.

Research reactors, used for research, training, and development, contribute to almost every field of science, including physics, chemistry, biology, medicine, geology, archaeology, and environmental sciences. Research reactors are essential for the education and training of reactor operators and nuclear engineers and for basic and applied research with capabilities applied in many fields within the nuclear industry as well as in fusion research, environmental science, advanced materials development, drug design, and nuclear medicine.

Because ACU built the SERC building as a multipurpose research building of which the MSRR would occupy only a portion, the already-completed erection of the SERC building itself was not an activity that constituted “construction,” as described in 10 CFR 50.10(a)(2)(x) (TN249), that would require the issuance of an NRC CP (NRC 2021-TN8941). Therefore, this EA evaluates only those environmental impacts resulting from the installation of the MSRR into the existing SERC building as the direct and indirect environmental impacts of the proposed action of issuing the CP. However, the EA also considers the past environmental impacts of the building of the SERC building as part of its evaluation of the cumulative environmental impacts of the proposed action of issuing the CP.

The proposed action before the NRC is whether to issue a CP to ACU authorizing the construction of the MSSR in a Research Bay room with a floor pit (i.e., Systems Pit) and an overhead crane, within the SERC building on the ACU campus (Figure 1-1). The site of the SERC building was formerly occupied by athletic fields and associated outbuildings. ACU initiated construction of the SERC building in June 2022. During an inauguration ceremony, the SERC building was opened on September 1, 2023.

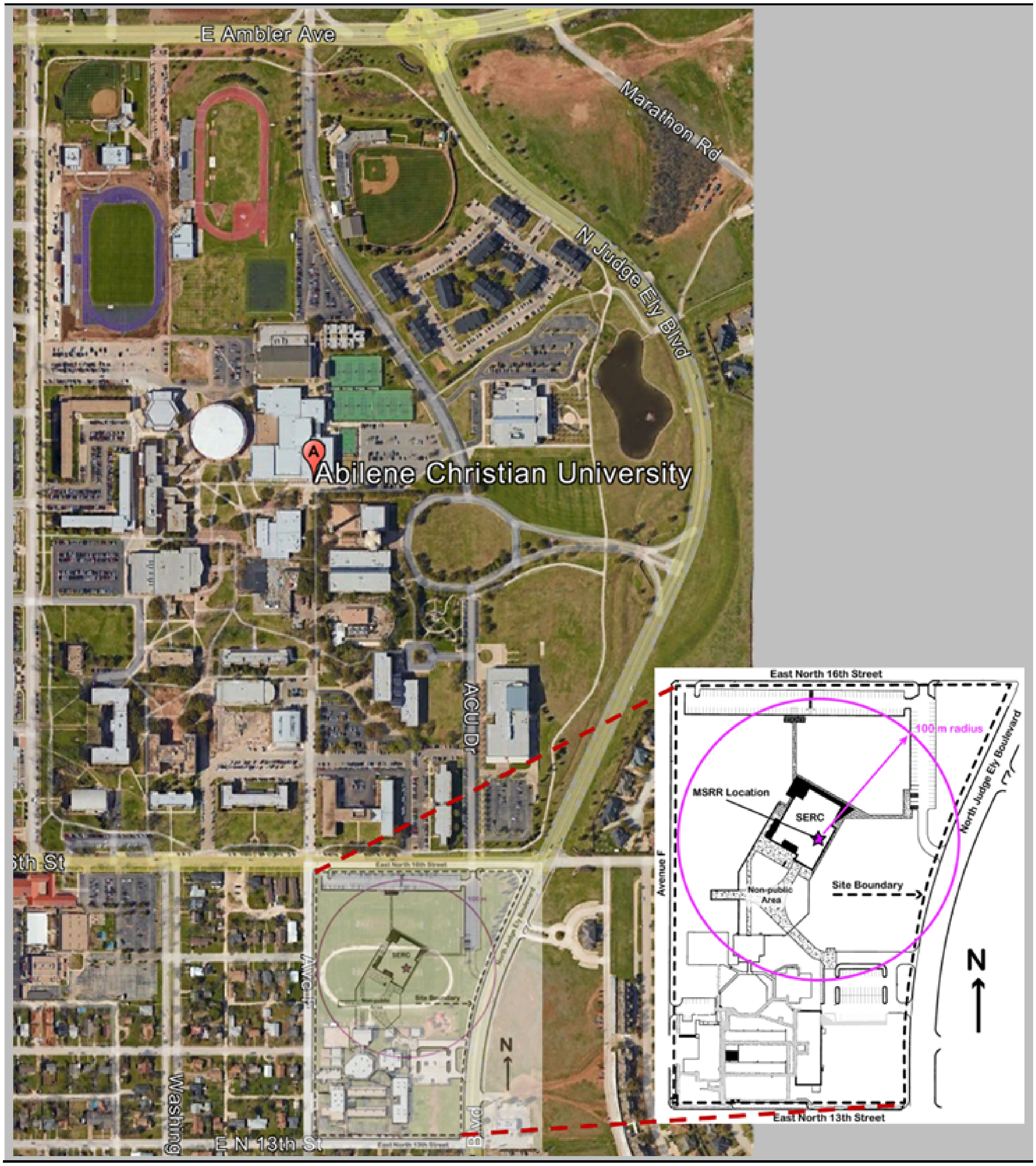

Figure 1-1 The Gayle and Max Dillard Science and Engineering Research Center (SERC) Site Overlaid on Previous Abilene Christian University Campus Athletic Fields. Adapted from: ACU 2023-TN8909.

1.1 Identification of Proposed Action

The proposed action before the NRC is whether to issue a CP to ACU authorizing the construction of the MSRR within the SERC building. The SERC building is situated on the ACU campus, a private university located in West Texas that is nationally recognized for undergraduate teaching and research. The site of the SERC building was formerly occupied by athletic fields and associated outbuildings. Site preparation and construction of the SERC building began in 2022 and was completed in 2023. The need for the proposed action is to conduct research on molten salt reactor technology.

The issuance of a CP is a separate licensing action from the issuance of an operating license (OL). If the NRC issues a CP for the MSRR and ACU were to seek NRC approval to operate the MSRR, then ACU would have to submit a separate application for an OL pursuant to the NRC's regulations, and ACU would have to obtain NRC approval before it could operate the MSRR. To conduct a complete and effective environmental review, this EA addresses the environmental impacts of the full life cycle of the MSRR, i.e., its construction, operation, and decommissioning. The NRC staff recognizes that new and significant information regarding the operation and decommissioning of the MSRR may become available subsequent to any issuance of the CP and before any issuance of an OL. The NRC staff would therefore review any application for an OL for the MSRR for new and significant information related to the environmental impacts of operating and decommissioning the MSRR that might alter the staff's conclusions in this EA for the CP application.

1.2 Regulatory Provisions, Permits, and Required Consultations

The applicant evaluated each environmental regulatory requirement and permit necessary for the construction of the MSRR as listed in Tables 19.1-1 and 19.1-2 of the Preliminary Safety Analysis Report (PSAR) (ACU 2023-TN8909 │ Section 19.1|) included with the CP application. The applicant is responsible for applying for each of the permits listed in Tables 19.1-1 and 19.1-2 of the PSAR and for any other necessary permits and approvals for the construction of the MSRR. The NRC staff is responsible for performing consultations required under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq. - TN1010), and the National Historic Preservation Act of 1966, as amended (NHPA; 54 U.S.C. 300101 et seq. - TN4157). Appendices C, "Chronology of Key Environmental Review Correspondence," and D, "Regulatory Compliance and List of Federal, State, and Local Permits and Approvals," of this EA contain information on related correspondence and associated permits and approvals.

1.3 Scoping

Although, consistent with its regulations, the NRC staff did not conduct a scoping process for this EA,[1] the staff still strived to involve relevant State, Tribal, and local governments and other potentially interested parties to the extent practicable in developing the EA. To implement coordination of the environmental review process, the NRC staff sent letters early in the process to potentially interested parties, inviting their participation in shaping the analysis for the EA, including the Texas State Historic Preservation Officer, the Texas Historical Commission (THC), the U.S. Fish and Wildlife Service, and 10 Tribes that may have an interest in the proposed action. References to these publicly available coordination letters are included in Appendix B, "Agencies, Organizations, Tribes, and Individuals Consulted," of this EA. The NRC staff also

[1] 10 CFR 51.26, "Requirement to publish notice of intent and conduct scoping process," only requires the conduct of a scoping process when it is determined that an environmental impact statement will be prepared.

shared its NHPA Section 106 finding that the proposed action will result in no historic properties affected with the public and shared the initial draft of this EA with this finding with Tribes, the Texas Commission on Environmental Quality (TCEQ), the Advisory Council on Historic Preservation (ACHP), and the THC for comment over a 30-day period. The NRC did not receive any comments.

2 PROPOSED ACTION

The proposed action before the NRC is whether to issue a CP to ACU under 10 CFR Part 50 (TN249) that would authorize the construction of the MSRR within the existing SERC building on the ACU campus in Abilene, Texas. Located in the southeastern area of the ACU campus, the SERC building, which was designed and built by ACU, is a 28,000 square foot (ft^2) (2,323 square meter [m^2]), multilevel structure containing laboratory spaces targeted to support research in chemistry, physics, and a variety of engineering disciplines in addition to housing the MSRR. The need for the proposed action is to conduct research on molten salt reactor technology. The issuance of a CP is a separate licensing action from the issuance of an OL, which would allow the operation of facilities constructed pursuant to a CP.

2.1 Site Location and Layout

The applicant described the site location and layout in Section 19.2.1 of the PSAR (ACU 2023-TN8909). ACU proposed that the MSRR be built within the existing multiuse SERC building. As depicted in Figure 1-1 and Figure 19.2-3 of the PSAR (ACU 2023-TN8909), the SERC site encompasses approximately 15 acres (ac) of land that had previously been occupied by athletic fields and associated outbuildings. Figures 3.1-1 through 3.1-3 of the PSAR (ACU 2023-TN8909) depict the layout of the SERC building and the proposed layout of the MSRR, which would include a reactor building and Systems Pit. The use of the SERC site would take advantage of existing roads and other utilities within the ACU campus, and no land outside the 15-ac SERC site would be disturbed to build, operate, or decommission the MSRR. The only new roads and parking lots that would need to be constructed would be built within the 15-ac SERC site to directly service the SERC building. The proposed action would not involve building or operating transmission lines, switchyards, intake or discharge structures or pipelines, access roads, heavy haul roads, rail lines or spurs, barge facilities, batch plants, or other off-site facilities.

2.2 Operational Processes

The applicant estimated the numbers of workers and vehicular deliveries in Section 19.4.8 of the PSAR (ACU 2023-TN8909). The applicant estimated that construction would require an estimated average of dozens to less than 100 onsite workers. Operation is estimated to involve less than approximately 10 dedicated workers per weekday (with only a few full-time positions) and waste shipments as necessary. Decommissioning would require an estimated average of 10 or less workers and, due to the small size of the MSRR, a limited number of shipments of decontaminated reactor system components (ACU 2023-TN8909). As a multiuse academic building, the SERC building would remain after the decommissioning of the MSRR.

2.3 Water Consumption and Treatment

The applicant stated that no water beyond that consumed for sanitary purposes by workers is expected to be used during the construction of the MSRR (ACU 2023-TN8909). Water use for operations will include drinking water and sanitary system use, facility heating and cooling, fire suppression, and industrial purposes. The fire suppression system is anticipated to use between 0.1 and 0.2 gallons per minute (gal/min) over 1,500 ft^2, dependent on final National Fire Protection Association 13, “Standard for the Installation of Sprinkler Systems,” area classifications. All potable water for the SERC building and the MSRR will be obtained from the City of Abilene. As discussed in Section 3.9.2, “Radiological Waste Management,” of this EA, and in accordance with the ACU waste management plan (ACU 2023-TN8909), radiological contaminated wastewater generated in the radiologically controlled area will be collected and packaged for appropriate shipment and disposal at the Waste Control Specialists, LLC (WCS) low-level radioactive waste (LLRW) disposal site using a licensed waste broker. Nonradiological wastewater that meets the requirements of the ACU waste management plan (ACU 2023-TN8909) will be discharged directly to the City of Abilene's collection system for treatment or will be appropriately collected and disposed of as nonradiological hazardous wastewater.

2.4 Cooling and Heating Systems

The proposed cooling and heating systems are described in Section 19.2.4 of the PSAR (ACU 2023-TN8909). As noted in Section 19.4.6.2 of the PSAR, the MSRR does not withdraw or discharge water for cooling or other purposes from surface or groundwater. For this reason, there would be no need for cooling towers or for intake or discharge structures or piping to support cooling towers. Heat from the fuel salt is transferred through a heat exchanger to the coolant salt and then to the environment through a salt to an air radiator (i.e., the atmosphere), which would be the ultimate heat sink. As described in Section 14.3.3 of the PSAR, on reactor shutdown, decay heat is passively removed from the fuel salt, and the MSRR may be operated without a working primary heat removal system with a restriction on reactor power. Thermal management includes a heat rejection system, which transfers heat from the fuel salt to the coolant salt (secondary) cooling system through the heat exchanger and then transfers that heat to the atmosphere through a forced air radiator. Air to cool the radiator is pulled from outside, flowing across the radiator, and then returned back to the outside environment (see Figure 19.2.4 of the PSAR for the MSRR process flow diagram [ACU 2023-TN8909]).

2.5 Waste Management

Wastes generated during the construction, operation, and decommissioning of the MSRR would include radioactive, nonradioactive, and hazardous wastes (ACU 2023-TN8909 | Section 19.2.5). The applicant indicated that all waste disposal would occur in permitted nonradioactive, nonhazardous, and hazardous waste facilities and licensed radioactive disposal facilities (ACU 2023-TN8909 | Section 19.2.5). The proposed radioactive liquid, solid, and gaseous waste systems are described in Section 19.2.5 of the PSAR (ACU 2023-TN8909).

Included in the PSAR are descriptions of the Radiation Protection Program, which will be provided in any OL application. Additional details of the Radiation Protection Program will include organization and staffing levels, authorities and responsibilities, position qualifications, personnel training requirements, and document control and record-keeping procedures (ACU 2023-TN8909 | Section 11.1.2|).

The estimated types, quantities, and number of shipments of radioactive wastes are discussed in Section 3.10, "Transportation of Radioactive Material," of this EA. The shipments of radioactive wastes would include dry active waste from fuel salt samples, liquid waste, and other radiologically contaminated laboratory waste with a destination of the WCS LLRW disposal site in Andrews County, Texas. Spent fuel salt is expected to be returned to the U.S. Department of Energy (DOE) upon the permanent cessation of operations of the MSRR. The proposed nonradioactive and hazardous waste systems are described in Section 19.4.10 of the PSAR (ACU 2023-TN8909). Direct radiation sources are described in Sections 19.3.9.6 and 19.3.9.7 of the PSAR and would all be within the reactor building (ACU 2023-TN8909).

The applicant’s proposed pollution prevention and waste minimization program is described in Section 19.2.5 of the PSAR (ACU 2023-TN8909).

3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

This section of the EA presents the affected environment and the environmental impacts of the proposed action of whether to issue a CP to ACU authorizing the construction of the MSRR in the SERC building. This section is organized into separate sections addressing specific environmental resources identified by the NRC staff as being relevant to the proposed action. Each section is organized by resource, addressing the affected environment for potential direct and indirect impacts from each of the three life cycle phases for the MSRR (i.e., construction, operation, and decommissioning) and cumulative impacts from the MSRR. Each section culminates in a section addressing the NRC staff's conclusions regarding the significance of the environmental impacts on the resource. Certain sections addressing two substantially independent though interrelated environmental resources, e.g., air quality and noise, are divided into two subsections organized as indicated above and lead to separate conclusions.

The NRC staff recognizes that new and significant information regarding the operation and decommissioning of the MSRR may become available subsequent to any issuance of the CP and before any issuance of an OL. The NRC staff would therefore review any application for an OL for the MSRR for new and significant information related to the environmental impacts of operation and decommissioning that might alter the staff's conclusions in this EA for the CP application.

The order of presentation of environmental resources follows that used in Section 19.4, "Impacts of Proposed Construction, Operations, and Decommissioning," of the Final Interim Staff Guidance Augmenting NUREG-1537 (NRC 2012-TN5528) with the following exceptions. First, the NRC staff considered it more efficient to combine the sections about the geologic environment (Geology, Soils, and Seismology) and Water Resources into a single Hydrogeology and Water Resources section (i.e., Section 3.3 of this EA). Second, the NRC staff presents the environmental justice (EJ) analysis as part of the socioeconomic analysis in Section 3.6, "Socioeconomics and Environmental Justice," of this EA. The NRC staff considered the efficiencies in discussing the EJ analysis with the supporting socioeconomic information for ease of referencing all of the necessary information in one section. Third, the NRC staff developed a separate section on nonradiological waste and included its consideration of radiological waste in a section termed "Uranium Fuel Cycle and Radiological Waste Management" to also capture uranium fuel cycle impacts.

The applicant presented a list of past, present, and reasonably foreseeable future projects and other actions used in its consideration of cumulative impacts in Table 19.4-7 in the PSAR (ACU 2023-TN8909 | Table 19.1-7). Included in that table are past and present actions affecting water resources in the SERC site area, including the Cedar Creek Waterway greenbelt development, construction of the Abilene Convention Center hotel, road maintenance projects, the Abilene Regional Airport and Dyess Air Force Base (AFB) operations, and various ACU campus infrastructure improvement projects. The NRC staff reviewed Table 19.4-7 in the PSAR and determined that the summarized items represent an appropriate range of other actions for consideration in its cumulative impacts assessment and incorporates that table by reference herein. The NRC staff recognizes that only a subset of other actions is relevant to the cumulative impact analysis for each environmental resource evaluated. The NRC staff also expects that continued urbanization in the City of Abilene and vicinity would contribute to the cumulative impacts.

The subsections under each resource addressing cumulative impacts highlight those specific actions from Table 19.4-7 in the PSAR that are most relevant to an analysis of the cumulative impacts for that resource. The NRC staff does not consider the effects of the construction of the SERC building to be direct or indirect impacts with respect to the proposed action. Therefore, this EA evaluates only those environmental impacts resulting from the installation of the MSRR into the existing SERC building as the direct and indirect environmental impacts of the proposed action. However, the EA also considers the past environmental impacts of the building of the SERC building as part of its evaluation of the cumulative environmental impacts of the proposed action.

Because the environmental impacts would be SMALL for each potentially affected resource, meaning that the environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource, the NRC staff finds that the proposed action will not have a significant effect on the quality of the human environment.

3.1 Land Use and Visual Resources

3.1.1 Affected Environment

The MSRR would be installed within the existing SERC building on a site of approximately 15 ac in the southeast corner of the ACU campus in the City of Abilene, Texas (ACU 2023-TN8909 | PSAR Section 19.2.1). As depicted in Figure 1-1 of this EA, the SERC site is in an urban setting bounded by the following city streets: East North 16th Street to the north, Judge Ely Boulevard to the east, East North 13th Street to the south, and Avenue F to the west (ACU 2023-TN8909 | PSAR Section 19.2.1). Figure 19.3-1 of the PSAR depicts the major land uses in and surrounding the City of Abilene, which are typical for a small city. Lands directly north of the SERC site are part of the ACU campus, and lands directly south and west of the SERC site consist mainly of low density, single-family residential neighborhoods with occasional restaurants and other businesses (ACU 2023-TN8909 | PSAR Section 19.3.2). Lands to the east and southeast of the SERC site are dominated by open fields and agriculture (ACU 2023-TN8909 | PSAR Section 19.3.2). Figure 19.3-3 of the PSAR depicts areas that the City of Abilene has designated as sensitive development areas, including areas associated with Abilene Regional Airport and Dyess AFB. The SERC site is not situated within those areas.

The SERC site is zoned for commercial use (ACU 2023-TN8909 | PSAR Section 19.3.1.6). Maps of planned future land use for the City of Abilene (PSAR Figure 19.3-4) suggest that the land use character of the area surrounding the SERC site is not anticipated to change in the foreseeable future (ACU 2023-TN8909 | PSAR Section 19.3.1.7). Because the SERC site is situated in an existing developed area where soils have been previously disturbed by urban development, it does not potentially contain prime or unique farmland designated under the Farmland Protection Policy Act of 1981 (ACU 2023-TN8909 | PSAR Section 19.3.1.6). Abilene is not situated within areas regulated under the Coastal Zone Management Act of 1972. The site does not contain any known mineral resources that could potentially be exploited (ACU 2023-TN8909 | PSAR Section 19.1.7).

The scenic quality of the SERC site is low because of its lack of notable features, uniform landform, low vegetation diversity, absence of water, muted colors, and regional commonality (ACU 2023-TN8909 | PSAR Section 19.3.2). The site is described as having a low sensitivity rating because of the low scenic value, only moderate use by viewers, low public interest in visual changes, and the lack of natural areas (ACU 2023-TN8909 | PSAR Section 19.3.2).

3.1.2 Environmental Impacts of Construction, Operation, and Decommissioning

No land use changes would result from the construction, operation, and decommissioning of the MSRR. The components of the MSRR would be fabricated off-site in existing manufacturing facilities, and the MSRR would be installed inside the existing SERC building (ACU 2023-TN8909 │ PSAR Section 19.4.1.1|). No changes would take place to the MSRR during operations (ACU 2023-TN8909 │ PSAR Section 19.4.1.2|). Decommissioning would involve dismantling and removing the MSRR from the SERC building, but the applicant expects that the SERC building would continue to be used for other research purposes (ACU 2023-TN8909 │ PSAR Section 19.4.1.3|). Construction, operation, and decommissioning of the MSRR would not interfere with other activities taking place in or contemplated for the SERC building.

Construction, operation, and decommissioning of the MSRR in the SERC building would be consistent with the zoning established by the City of Abilene for the ACU campus. There would be no disturbance of prime or unique farmland, work within the coastal zone regulated under the Coastal Zone Management Act of 1972, or effects on special land uses or mineral resources (ACU 2023-TN8909 │ PSAR Section 19.4.1.1, 19.4.1.2, and 19.4.1.3|).

No changes to the visual quality of the SERC site and surrounding lands would result from the construction, operation, and decommissioning of the MSRR. The MSRR would be installed inside the existing SERC building, operations would occur inside the same building (ACU 2023-TN8909 │ PSAR Section 19.4.2.2|), and the SERC building would remain in use as an academic research building after the MSRR is decommissioned (ACU 2023-TN8909 │ PSAR Section 19.4.1.3|). The exterior appearance of the SERC building and how it appears from nearby roadways, residences, and public places would not be changed by any part of the MSRR life cycle.

3.1.3 Cumulative Impacts

Building the SERC building constituted a land use change to the 15-ac SERC site, transforming it from a former elementary school property acquired by ACU for the expansion of its campus. Table 19.4-7 of the PSAR identifies other past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts of the construction, operation, and decommissioning of the MSRR. None of these projects substantially influence how the SERC building and the MSRR have affected and would affect land uses or visual resources.

3.1.4 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative impacts from the proposed action on land use and visual resources would be SMALL. The MSRR life cycle would not involve any land use changes or changes to the visual qualities of the surrounding area. Building the SERC building also did not involve substantial land use or visual changes, and other projects are not anticipated that would substantially change land use patterns or visual qualities surrounding the SERC site.

3.2 Air Quality and Noise

3.2.1 Affected Environment

3.2.1.1 Climatology and Meteorology

Abilene is located in Taylor County in north central Texas and has a subtropical subhumid climate with mild dry winters and very hot summers (Larkin and Bomar 1983-TN8429). This region has mostly flat areas. Meteorological data is collected at the nearby Abilene Regional Airport station and is reported to the National Climatic Data Center (NCDC). This station is located about 3.8 miles (mi) (6.11 kilometers [km]) south-southeast of the SERC site. In support of this EA, the 10-year (yr) NCDC data during the period of 2013–2022 was analyzed. The air temperature in Abilene ranged from −4 degrees Fahrenheit (°F) (−20 degrees Celsius [°C]) to 125 °F (52 °C) during this 10-year period. The monthly mean temperature varied between 44.5 °F (7 °C) during January to 84 °F (29 °C) during July and August. Annual average precipitation was 16.4 inches (in.) (41.6 centimeters [cm]) during the 10-year period. The highest precipitation was noted during May, June, and October with monthly precipitation of 5.2 in. (13 cm), 4.4 in. (11 cm), and 4.9 in. (12.4 cm), respectively. The monthly climate normal are shown in Figure 3-1 below for the 10-year period of 2013–2022. Annual average wind speed is 10.9 miles per hour (mph) (17.4 kilometers per hour [kph]). The monthly average wind speeds ranged from 12.8 mph (20.7 kph) during April and May to 9 mph (14.5 kph) during September. The NCDC data show that the wind mostly blows from the south and south-southeast directions, and sometimes from the north at the SERC site (NOAA 2023-TN8989).

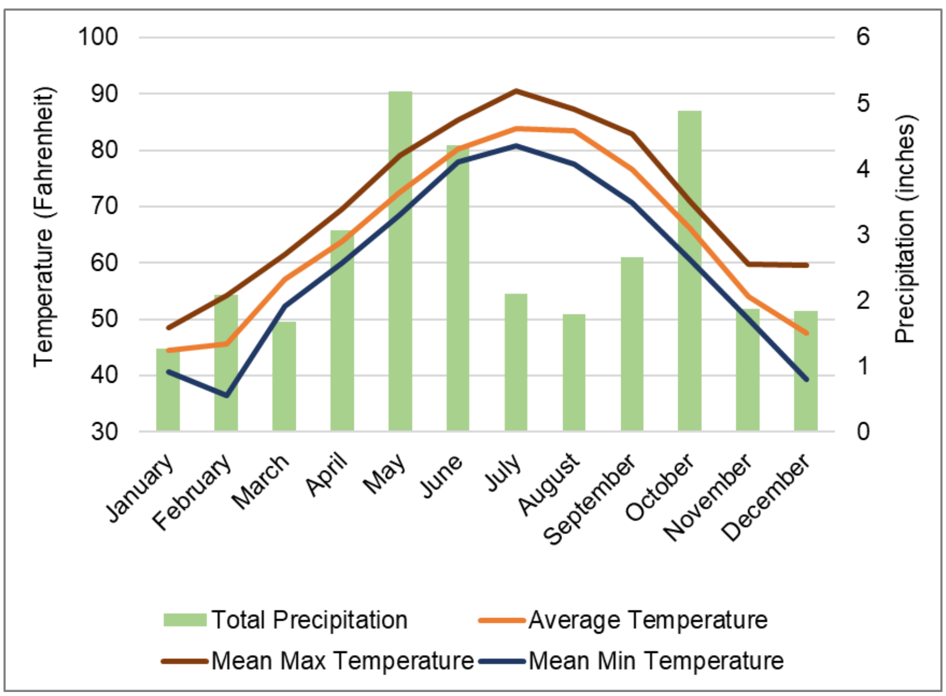

Figure 3-1 Monthly Climate Normal (2013–2022) for Abilene Regional Airport. Data from the National Oceanic and Atmospheric Administration NOAA Database-TN8668.

The applicant discussed severe weather events for the SERC site in Section 2.3.1.4 of the PSAR (ACU 2023-TN8909). There were 68 tornado events in Taylor County during the period of

1950–2022 (NOAA 2023-TN8432). Most of these tornadoes were EF1 category with eleven EF2 and two EF3 category tornadoes. An EF2 tornado impacted Dyess AFB and residential neighborhoods in Abilene on May 18, 2019. About 404 events with strong winds from thunderstorms were reported in Taylor County. Four of these events had wind speed greater than 70 knots while about 157 events had wind speed in the range of 50 to 60 knots, and 57 events had speeds between 60 and 70 knots (NOAA 2023-TN8432). Only 13 heavy snow events were recorded during the 1950–2022 timeframe in Taylor County. A powerful snow storm, the "Valentines Snow Storm," caused heavy snowfall of up to 9.5 in. (24.13 cm) in Abilene during February 2021 (NOAA 2023-TN8432). In Taylor County during the period of 1950–2022, 67 flash flood and 15 flood events were reported (NOAA 2023-TN8432).

The applicant calculated a dilution factor (χ/Q) of 0.101 seconds per cubic meter (sec/m^3) at the boundary of 100 m away from the SERC site using the F stability class (ACU 2023-TN8909). The NRC recommends determination of local dilution factors from a frequency distribution of wind speed with seven stability classes for 16 directional sectors from local meteorological data (NRC 2007-TN278). The applicant used Clean Air Act Assessment Package (CAP88-PC) provided meteorological data for the years of 1988 to 1992 collected at Abilene Regional Airport. The stability analysis shows about 32 percent data with very stable atmosphere (Classes E and F), 51 percent neutral (Class D), and 17 percent unstable (Classes A, B, and C). χ/Q values were simulated in the range of 9×10^{-7} to 4×10^{-6} sec/m^3 at 100 m distance from two 15.2 m high stacks.

3.2.1.2 Air Quality

Under the Federal Clean Air Act Amendments of 1990 (Clean Air Act Amendments of 1990-TN4539), the U.S. Environmental Protection Agency (EPA) established National Ambient Air Quality Standards (NAAQS), which define the acceptable levels for six criteria air pollutants (CAPs)—nitrogen oxides (NO_X), ozone (O_3), sulfur dioxide (SO_2), carbon monoxide (CO), lead, and suspended particulate matter (PM). As per the Clean Air Act, the EPA designates a geographic area as "attainment" when it meets the NAAQS or "nonattainment" when the area does not meet the standards. Once designations take effect, State and local governments with nonattainment areas must develop implementation plans outlining how areas will attain and maintain the standards by reducing air pollutant emissions.

The SERC site is in the Abilene–Wichita Falls Air Quality Control Region (AQCR 210; 40 CFR 81.132 [TN7226]). This region is classified as attainment/unclassifiable for all CAPs (40 CFR 81.344 [TN7226] — Texas). The nearest nonattainment area is the Dallas–Fort Worth (DFW) area which is approximately 94 mi (151 km) northeast of the SERC site. DFW is in severe nonattainment based on 2008 8-hour (h) ozone standards (40 CFR 81.344 [TN7226] - Texas).[2]

The EPA also regulates emissions of 188 hazardous air pollutants (HAPs), including hydrogen fluoride (HF), that are known or suspected to cause cancer, other serious health effects, or adverse environmental effects. Major stationary sources are required to comply to National Emission Standards for Hazardous Air Pollutants that have the potential to emit more than 10

[2] The NRC performs a conformity determination if a proposed action is located in a nonattainment or maintenance area. Because the SERC site is in an attainment/unclassifiable area and is far from the DFW nonattainment region, the NRC is not required to perform a conformity determination to determine whether the potential emissions could violate the NAAQS (40 CFR Part 93-TN2495).

tons per year (TPY) of any single HAP or 25 TPY of any combination of HAPs. This provision under 40 CFR Part 61, Subpart I, does not regulate radionuclide emissions for NRC licensees.

New facilities that emit air pollutants could be subject to Federal regulatory requirements, depending on the location and type and amount of air pollutant emissions. A new or modified major source may have to meet Prevention of Significant Deterioration (PSD) (as defined in 40 CFR 52.21 [TN4498]) and Nonattainment New Source Review (NNSR) permits. Major stationary sources are also required to comply to National Emission Standards for Hazardous Air Pollutants. Any facility with the potential to emit 100 TPY or more of CO or NO_x; or 25 TPY of volatile organic compounds or SO_2 or inhalable PM; or 15 TPY of PM_{10}; or 10 TPY of $PM_{2.5}$; or 10 TPY of any HAP; or 25 TPY of any combination of HAPs is required to obtain a valid Title V permit and is considered a major air emission source. As discussed below, the operation of the MSRR would be far below the major source thresholds. Therefore, the MSRR would not be subject to Federal requirements.

Minor new source permits are required for stationary sources that do not require the PSD or NNSR permits. States can customize the requirements of the minor NNSR program if their program meets minimum requirements. Emissions from new sources in Texas are evaluated by the State agency, the TCEQ. The TCEQ regulates the release of air contaminants in the State of Texas through the Texas Clean Air Act. State rules for regulating HAPs are found in the Texas Administrative Code (TAC), Title 30, Part 1, Chapter 113, Subchapter B. The MSRR's potential emissions meet the de minimis levels of Texas State's registration requirements given in 30 TAC 116.119(a) (TX Admin. Code [TAC] 30-116-TN8666). There is currently no plan for using a diesel engine or any other fossil-fueled equipment at the MSRR. However, if the applicant considered using a diesel engine, such as a backup generator, then the applicant would be required to file an air permit with the TCEQ.

The EPA promulgated the Regional Haze Rule to improve and protect visibility in national parks and wilderness areas from haze (40 CFR 51.308-51.309 [40 CFR Part 51-TN1090]). 40 CFR Part 81, Subpart D, lists the mandatory Class I Federal Areas where visibility is an important value. The Regional Haze Rule requires States to develop regional haze State implementation plans to reduce visibility impairment at Class I Federal Areas. Texas has two Class I areas in western Texas—Big Bend National Park and Guadalupe Mountains National Park. Both Class I Federal Areas are more than 31 mi (50 km) distant from the SERC site. The SERC site is approximately 330 mi (531 km) and 354 mi (570 km) from Big Bend National Park and Guadalupe Mountains National Park, respectively. Because the MSRR is not a major source and because the SERC site is more than 31 mi (50 km) from the nearest Class I area, a Class I visibility impact analysis is not needed.

Greenhouse gases (GHGs) include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and fluorinated gases (EPA 2023-TN8434). In May 2010, the EPA issued the GHG Tailoring Rule. This rule set the thresholds for a phase-in approach to regulating GHG emissions under the PSD and Title V permitting programs. According to the rule, operating permits issued to major sources of GHGs under the PSD or Title V permitting programs must contain provisions requiring the use of best available control technology to limit the emissions of GHGs, if the sources have potential of non-GHG pollutant emissions and if their estimated GHG emissions are at least 75,000 TPY of CO_2 equivalent (CO_2e). In June 2014, the U.S. Supreme Court issued its decision in Utility Air Regulatory Group v. EPA, 573 U.S. 302 (2014-TN7924), in which it held that the EPA may not treat GHGs as an air pollutant for determining whether a source is a major source required to obtain a PSD or a Title V permit. The Court also stated that the EPA could continue to require PSD and Title V permits otherwise required based on emissions of conventional pollutants. The recent Supreme Court decision in West Virginia v. EPA, 597 U.S. ___ 2022 (TN8185), limits the EPA's authority to regulate GHGs through industry-wide measures under the Clean Air Act. The rules discussed above, however, remain in effect.

3.2.1.3 Noise

The EPA recommends maintaining environmental noises below 70 A-weighted decibel (dBA) sound level over 24 hrs (or 75 dBA over 8 hrs) to prevent hearing loss (EPA 1974-TN3941). The U.S. Department of Housing and Urban Development (HUD) environmental noise regulations (24 CFR Part 51-TN1016) set the acceptability standard of 65 dB day/night average noise level (Ldn) for new housing construction. The Ldn refers to a 24-h average A-weighted noise level obtained after the addition of 10 decibels (dB) to levels measured in the night between 10:00 p.m. and 7:00 a.m. due to the increased sensitivity to noise during those hours.

There are residences in the immediate vicinity of the SERC site on the south and west sides of the site boundary which is 0.06 mi (100 m) from the site. There are residences and student dormitories on the east side starting at about 0.21 mi (338 m) from the site. U.S. Interstate 20 (I-20) is about 1 mi (1.6 km) northeast of the site, and I-20 is a major source of background noise due to heavy traffic. The applicant estimated a background noise level between 40 and 65 dBA at 100 m distance from the SERC site on the south and west side where the residences are located. The heavy traffic from I-20 on the north and east sides is estimated to generate background noise levels between 60 and 75 dBA (ACU 2023-TN8889).

3.2.2 Environmental Impacts of Construction, Operation, and Decommissioning

3.2.2.1 Air Quality

The MSRR generates gaseous effluents resulting from process operations and the ventilation of operating areas. Cooling air exhausted from the coolant loop radiator is vented through the side of the Research Bay. Effluent from the reactor off-gas system is mixed with room air and ventilated through a stack to the roof. This effluent will be monitored for HF and combustible gases prior to release using a Radiation and Environmental Monitoring System. Fume hoods, instrument exhaust, and beryllium handling laboratory exhaust are ventilated through a stack to the roof via high-efficiency particulate air and carbon filtration. Reactive processes within the MSRR can generate HF and volatile halides and particles in the off-gas system (Andrews et al. 2021-TN8667). Under the Texas Administrative Code, Title 30, Section 106.262, the State of Texas sets the HF and hydrogen chloride emissions limit values of 0.5 milligrams per cubic meter (mg/m^3) and 1 mg/m^3, respectively, in the exhaust stream. The NRC staff expects that the control systems, including carbon filtration units, will capture the trace amounts of HF or any other hazardous gases and that, therefore, the emissions to the ambient atmosphere during operation will be negligible.

The major construction and eventual decommissioning activity for the MSRR will be occurring inside the SERC building. There will be no heavy construction or demolition work such as earthwork or dewatering activities that can generate fugitive dust. Most of the air emissions will come from the use of trucks to deliver materials to, or remove materials from, the SERC building. The applicant determined the potential emissions from these heavy-duty diesel trucks using emission factors (in grams/mile [g/mi]) from the U.S. Bureau of Transportation Statistics (DOT 2021-TN9074).

The applicant identified the heavy-duty diesel trucks that will be used for the delivery of materials and fuels to the SERC building as the major air emissions source. Table 3-1 below lists the CAPs air emissions estimates from these trucks during construction and operation. The applicant estimated that about 30 trucks would be used during construction with each traveling 1000 mi. It is expected that CAPs air emissions estimates for decommissioning activities would be similar to those related to construction. For operation, it was assumed that one truck would be used for delivery and would travel 100 mi per week. Operation is assumed to occur 52 weeks per year with the truck traveling 5200 mi in a year. Some CAPs may be emitted by the on-site staff and workers driving. Such vehicle air emissions from travel of on-site workers will be significantly low. Currently, the applicant does not have an air permit to operate any diesel engine or other fossil-fueled equipment at the SERC building. In the future, if such an air permit is obtained to operate a diesel engine as a backup generator, then the diesel combustion would add air pollutants to the atmosphere. It is still expected that the air quality impact of such periodic use of fossil-fueled equipment for emergency operation would be minor and would not contribute significantly to air emissions releases.

Table 3-1 Air Emissions Estimates for Diesel Trucks During Construction and Operation Phases

Parameter	Carbon Monoxide	Volatile Organic Compound	Nitrogen Oxide(s)	Particulate Matter	Sulfur Dioxide	Lead
Emission factor (g/mi)	2	0.269	4.169	0.103	0	0
Traffic Emissions During Construction (pounds per year [lb/yr])	132	18	276	7	0	0
Traffic Emissions During Operation (lb/yr)	23	3	48	1	0	0

Source: ACU 2023-TN9561

Nonradioactive gaseous waste produced as a result of MSRR operation would be similar to that produced in other science buildings on the ACU campus and does not require a separate TCEQ permit or registration. The number of additional delivery trucks to ACU associated with the installation and operation of the MSRR is a small fraction of the number of daily delivery vehicles. MSRR setup would be primarily indoors and very small amounts of emissions are expected to be released to the ambient air during construction.

3.2.2.1.1 Greenhouse Gases

Commission Order CLI-09-21 (NRC 2009-TN6406) provides the current direction to the NRC staff to include the consideration of the impacts of the emissions of CO_2 and other GHGs that drive climate change in its environmental reviews for major licensing actions. Estimates of GHG emissions from a reference 1000 megawatt electric (MWe) advanced reactor were developed using the approaches in Interim Staff Guidance COL/ESP-ISG-026 (NRC 2013-TN2595), “Interim Staff Guidance on Environmental Issues Associated with New Reactors” (NRC 2013-TN2595), and the 2016 final guidance from the Council on Environmental Quality (CEQ) on consideration of GHG emissions and the effects of climate change in NEPA reviews (CEQ 2016-TN4732). The GHG emissions estimates from the 1000 MWe advanced reactor and the scaling calculations for the MSRR are contained in the NRC staff document “Greenhouse Gas

Emissions Estimates for a Reference 1,000 MWe Reactor and the Abilene Christian University Molten Salt Research Reactor" (NRC 2023-TN9095).

The calculation of GHG emissions for the MSRR treats the MSRR as a 1 megawatt thermal (MWt) advanced reactor. The GHG estimates for such a 1 MWt MSRR were downscaled from the estimates for a 3415 MWt (1000 MWe) reference reactor based on the MSRR's rated thermal power and construction and operation assumptions. GHGs are emitted from equipment and vehicles used during construction, operation, the uranium fuel cycle, transportation of fuel and waste, and decommissioning, including extended safe storage (SAFSTOR).

The NRC staff calculated the GHG emissions for the MSRR to be approximately 25,000 metric tons (MT) of CO_2e using the assumptions discussed in the "Greenhouse Gas Emissions Estimates for a Reference 1,000 MWe Reactor and the Abilene Christian University Molten Salt Research Reactor" (NRC 2023-TN9095) and presented in Table 3-2 below. Comparing the entire life cycle estimated GHG emissions from construction, operation, the uranium fuel cycle, transportation of fuel and waste, and decommissioning activities to the 2019 total gross annual U.S. energy sector emissions, the MSRR's GHG emissions would be about 0.0005 percent of the 2019 GHG emissions from the U.S. energy sector.

Table 3-2 Life Cycle Assumptions and Green House Gas Emissions for the Abilene Christian University Molten Salt Research Reactor Compared to the Reference Reactor

Emission Source/Activity	Reference Reactor Activity Duration (in years)	Abilene Christian University Activity Duration (in years)	Total Green House Gas Emissions (MT CO_2e)
Construction Equipment	7	2	5,571
Construction Workforce	7	2	6,143
Plant Operations	40	20	33
Operations Workforce	40	20	25
Uranium Fuel Cycle	40	20	99
Fuel and Waste Transportation	40	20	3
Decommissioning Equipment	10	10	9,500
Decommissioning Workforce	10	10	4,000
SAFSTOR Workforce	40	40	4
TOTAL	-	-	25,378

Source: NRC 2023-TN9095

3.2.2.2 *Noise*

There will be no major noise-generating equipment outside of the SERC building during construction, operation, and decommissioning of the MSRR. During construction and decommissioning, the noise from delivery trucks is estimated to be 85 dBA at 15 meters (m) (49 feet [ft]) from the source. Though the delivery trucks may add some noise to the background near the residential areas and in the campus, the impact is expected to be minimal and would be for short time periods (ACU 2023-TN8889).

During operation, significant noise will be generated inside the SERC building from the MSRR coolant loop's radiator fans. The applicant determined that these fans may generate noise in the range of 87–97 dBA at a distance of 3 m (9.8 ft) based on equipment specifications in the products catalog (Grainger 2023-TN8891, ACU 2023-TN8889). The control room is located on the first floor of the SERC building, partitioned from the MSRR's Research Bay and Systems Pit, and will not experience high levels of noise under normal conditions. Most areas of the SERC building will have noise levels consistent with existing office and laboratory spaces with the exception of the machine shop, which is located in an interior room away from the offices. The SERC building is surrounded by 9 in. thick concrete walls which will aid in reducing the noise traveling through the wall to the outside. Since the only source of significant noise, the radiator fans, will be operating inside the SERC building, the NRC staff expects that the area residents and users of public facilities in the area would not notice the operational noises of the MSRR (ACU 2023-TN8909 | PSAR Section 19.4.3.2|).

3.2.3 Cumulative Impacts

Table 19.4-7 of the PSAR identifies past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts of the proposed action (ACU 2023-TN8909). Construction activities at the ACU campus may coincide with the SERC site activities and may affect the air quality. Other proposed construction activities such as Heritage Square, Cedar Creek Waterway, Convention Center hotel, and roads construction will also affect the air quality during the period of construction activities. New projects would all be governed by new construction air permits processed through the TCEQ. Ongoing operations from the Abilene Regional Airport, Elmdale Airpark, Abilene Landfill, Abilene railyard, Dyess AFB, and small manufacturers contribute emissions and will affect local and regional air quality. Permitting reviews performed by the TCEQ are conducted to ensure that new permits do not result in regional air quality degradation and NAAQS violation. The incremental impact on air quality from the construction, operation, and decommissioning of the MSRR would be very small.

3.2.4 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative air quality and noise impacts of the proposed action would be SMALL. Air emissions from the MSRR would be well below all thresholds considered in the analysis and the MSRR would not be a major source of air emissions. The GHG emissions of the MSRR would be 0.0005 percent of the overall U.S. energy sector. The NRC staff expects that the area residents and users of public facilities in the area would not notice the operational noises of the MSRR and the impact of noise from the construction and decommissioning of the MSRR is expected to be minimal and would be for short time periods. The incremental impact on air quality and noise from the construction, operation, and decommissioning of the MSRR would be very small.

3.3 Hydrogeology and Water Resources

3.3.1 Hydrogeology

3.3.1.1 Affected Environment

The SERC site is within the central portion of the North Central Plains physiographic province of Texas. The province is characterized by prairies and grasslands with sandy clay soils and bedrock areas of shale, sandstone, and limestone bounding drainage areas of generally flat to gently rolling terrain. Site-specific investigations have included the installation and evaluation of nine geotechnical borings ranging from depths of 5 to 60 ft (ACU 2023-TN8909 | PSAR Section 2.5, p. 2-100 to 2-111|). Characterized by on-site boring logs, the area of the SERC site is underlain by shale and weathered shale containing sandstone seams (ACU 2023-TN8909 | PSAR Section 2, p. 2-100 to 2-111, 3-7|), reflecting riverine and deltaic depositional environments. At the site, weathering of the surrounding shale and sandstones has produced approximately 10–15 ft of silt and sandy clay overlain by approximately 2–4 ft of undifferentiated fill. The weathered shale is encountered between 10 and 15 ft below ground surface at the SERC site and underlain by progressively more competent shale with depth.

Surface soils were previously reworked to accommodate the athletic fields and most recently the SERC building, with construction initiated in mid-2022. To the south of the athletic fields, the Taylor Elementary School buildings and properties were purchased by ACU in 2020 and have since been repurposed for ACU programs. The SERC building is a 28,000 ft^2 center with dedicated spaces to support research in chemistry, physics, and engineering disciplines in addition to the MSRR. Recent investigations in the SERC site area have included geotechnical soil investigations for the development of the ACU Golf Team Clubhouse (eHT 2023-TN8783) northeast of the SERC building. The local geology and properties of site soils are provided in the PSAR (ACU 2023-TN8909 | PSAR Section 2.5, p. 2-89|). Based on site borings (ACU 2023-TN8909 | Section 2.5.2, p. 2-89|), the water table is estimated to be at a depth greater than 35 ft below ground surface.

The SERC site is located in a relatively stable region of the North American tectonic plate with low geologic hazards from earthquakes (USGS 2018-TN8778). Based on investigations performed for the SERC building construction, no folds, faults, synclines, anticlines, domes, or basins were found in the area of the site (ACU 2023-TN8909, PSAR | Section 2.5.2, p. 2-90|). Sinkholes due to subsurface geologic structural conditions are uncommon in the area of the SERC site. During preparation for the construction of the SERC building, leveling of the SERC site and reworking of the surface soil occurred to a depth of approximately 35 ft for the MSRR Systems Pit, with concrete piers under the Research Bay foundation structure extending to a depth of approximately 55 ft below grade (ACU 2023-TN8909 | PSAR Section 3.1.1, p. 3-2|). The SERC site is not vulnerable to landslides, tsunamis, or volcanism because of the soil composition, geology, and surrounding geography of the site location. The propensity for soil liquefaction will be evaluated during the OL stage (ACU 2023-TN8909 | PSAR Section 2.5.7, p. 2-91|).

3.3.1.2 Environmental Impacts of Construction, Operation, and Decommissioning

Construction of the SERC building temporarily disturbed approximately 7 ac of a 15 ac site that had already been affected by previous development. Additional academic buildings (repurposed Taylor Elementary School) occupy the remainder of the 15-ac site. The primary impacts to the geologic environment of deformation and disturbance would occur on a local scale because of the excavation and the installation of the foundation pier in the area of the 6,000 ft^2 Research Bay. Construction impacts would be temporary and localized. Before construction, the topsoil was removed, stockpiled, or regraded. Therefore, the common impacts from construction of the SERC building and the MSRR on geology and soil resources would be low.

The geology of the SERC site is similar to the surrounding area with no rare or unique geologic resources or economically viable rock material, minerals, or energy resources that could be affected. The site has been previously disturbed during construction for the athletic fields and the 1955 development of the former Taylor Elementary School to the south. Construction on the SERC site would not adversely affect the surface or subsurface geologic environment, given the applicant's implementation of the required grading permits and associated best management practices (BMPs) during grading, including a sediment and erosion control plan as required by the City of Abilene's Construction Site Inspection Control Program (City of Abilene 2023-TN8779). Although the SERC site area would be disturbed by excavation and grading, the disturbance would not be substantially greater than the disturbance from the previous construction and redevelopment of the former athletic fields on the SERC site.

For the Reactor Bay, the applicant excavated depths to accommodate a Systems Pit measuring 25 ft below grade and 15 ft wide within a Research Bay above measuring 120 ft × 50 ft × 80 ft with a final grade of approximately 1,720 ft. Consistent with the City of Abilene's site development ordinances (City of Abilene 2023-TN8784), site preparation is anticipated to minimally affect the surrounding site's drainage and topography. Construction mitigation strategies require construction BMPs, and the development of a Storm Water Pollution Prevention Plan in accordance with City of Abilene development ordinances, including the implementation of the necessary erosion control measures, which would effectively minimize the impacts of soil erosion. The NRC staff determined that the effects of construction on the geologic environment would likely be low given the implementation of mitigation strategies in compliance with permitting and local building code requirements.

Based on the NRC staff's evaluation, no geologic resources would be utilized or altered during the operational life of the MSRR; therefore, the MSRR would have a negligible effect on the geologic environment. At the OL stage, the NRC staff will review the application for new and significant information, if any, that may alter the staff's conclusions made for the CP application.

Based on the NRC staff's evaluation, decommissioning would have little effect on the geologic environment, as the SERC site is a previously developed site on the ACU campus. In addition to NRC requirements for decommissioning, applicable demolition permits and BMPs would minimize the effects of decommissioning impacts on the geologic environment. Therefore, the NRC staff determined that no mitigation is necessary to minimize adverse geologic environmental impacts. At the decommissioning stage, the NRC staff will review the application for new and significant information, if any, that may alter the staff's conclusions made for the CP application.

3.3.1.3 Cumulative Impacts

Table 19.4-7 of the PSAR identifies past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts of the proposed action (ACU 2023-TN8909). Soil erosion and sediment runoff are typical effects of surface disturbances due to construction, operation, and decommissioning. Past, current, and reasonably foreseeable future projects in the area would add to the total extent of disturbed soil, permanently altering the building sites and soils. Within the SERC site area, the proposed action would take place in the previously developed area of the ACU campus, where similar construction of roads, parking lots, buildings, and utility lines has occurred or has been planned. The NRC staff anticipates that the applicant would use the same construction best practices as those for other campus construction projects in compliance with Federal, State, and local environmental laws, rules, regulations, and statutes in coordination with the City of Abilene.

As with the SERC building, similar measures will be implemented for the MSRR and nearby projects, such as securing appropriate construction and building permits and BMPs, further limiting the compounded impact, including erosion and sediment control measures. Neither existing projects nor the proposed action would further contribute to impacts to the geologic environment, as there are no identified sensitive or economic geologic resources in the area and the proposed MSRR would be located in a previously disturbed developed area.

3.3.1.4 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative hydrogeologic impacts of the proposed action would be SMALL. This conclusion is based primarily on the lack of disturbances to areas of natural terrain and the fact that the disturbances to geology and soils that will occur would be limited to previously disturbed developed areas of low economic value as geologic resources. The reuse of previously disturbed developed areas provides the economic benefits of the reactor without requiring the disturbance of natural ground or areas of economically viable geologic resources that have not been previously disturbed.

3.3.2 Water Resources

3.3.2.1 Affected Environment

Hydrologically, the area of Abilene is located over the Cross Timbers Aquifer. This aquifer is classified as a minor aquifer (TWDB 2011-TN8785). Minor aquifers are aquifers that produce minor amounts of water over large areas or large amounts of water over small areas. Abilene is several miles from the Edward-Trinity and Seymour major aquifers (aquifers that produce large amounts of water over large areas) (ACU 2023-TN8909 | Section 2.4.2, p. 2-78|). None of these aquifers have been designated as a sole source aquifer by the EPA (EPA 2020-TN6709). A sole source aquifer supplies at least 50 percent of the drinking water for its service area where there are no reasonably available alternative drinking water sources should the aquifer become contaminated. Wells surrounding the area are primarily used for groundwater monitoring, closed-loop geothermal applications, and irrigation.

No groundwater is used for the City of Abilene’s current public water supply because of the relatively low (brackish) quality of the Cross Timbers Aquifer. Recently, the cities of Abilene, Midland, and San Angelo entered into a groundwater supply contract, negotiating a 50-year agreement with Fort Stockton Holdings (FSH) for potential future supplies, as FSH owns substantial groundwater rights in far West Texas for the Edwards-Trinity aquifer (ARN 2020-TN8786). The Edwards-Trinity potential water supply will permit access to a future municipal water supply capable of withstanding drought periods. Currently, Taylor County is classified as being in a severe drought, with the western area including the Abilene area classified as being in an extreme drought (TWDB 2023-TN8788). Although the city considered the development of a new Cedar Ridge Reservoir for water supply reserves, there is currently a debate as to whether that project will move forward given the FSH agreement (ARN 2020-TN8787).

The area of the SERC site is bounded by Rainy Creek to the east and Cedar Creek to the west, both of which drain into Fort Phantom Hill Lake reservoir. The general direction of groundwater flow in the Fort Phantom Hill watershed is northerly toward the reservoir, with the slopes of the water table generally correlated to the slope of the land (BRA Undated-TN8789). Fort Phantom Hill Lake, Hubbard Creek Reservoir, and O.H. Ivie Reservoir are the source of the area's primary potable water supply. Raw water is transported from area lakes through underground pipelines to treatment facilities. Currently, the raw water delivered to the treatment plants has a firm capacity of 60 million gallons (MG) daily with a maximum treatment system capacity of 46 MG daily and a treated ground storage capacity of 23.3 MG (City of Abilene Undated-TN8790). During 2011, a period of low rainfall, high temperatures, and drought, the peak daily demand for the City of Abilene was approximately 37 MG of water. Attributed to conservation measures that are ongoing (City of Abilene Undated-TN8791), the city used 1 billion fewer gallons in 2011 than in 1998 with 14,000 more residents (City of Abilene Undated-TN8791).

Within the area of the SERC site, the geologic formations of the Cross Timbers Aquifer primarily consist of limestone, shale, and sandstone occurring in layers and lenses, reflecting riverine and deltaic depositional environments (TWDB 2019-TN8792). The aquifer consists of four Paleozoic-age water bearing geologic groups, which are, from oldest to youngest, the Strawn, Canyon, Cisco, and Wichita groups. Beneath the shallow aquifer, a deeper groundwater zone consists of weathered bedrock grading into fractures and joints of the underlying competent bedrock. Subsequent regrading and development have resulted in a relatively flat site with no distinguishable surface water drainage features.

As with other ACU campus facilities, the City of Abilene will provide water for basic utilities, such as sprinkler systems, toilets, sinks, cleaning, and potentially chemical showers (ACU 2023-TN8909 | PSAR Section 19.4.5.3, p. 19-58|). The applicant does not intend to use groundwater for construction, operation, or decommissioning (ACU 2023-TN8909 | PSAR Section 19.4.5.2, p. 19-58|). Industrial users in the City of Abilene are required to adhere to an industrial pretreatment program to protect wastewater quality (ACU 2023-TN8909 | Section 19.4.14.4.2 Surface and Groundwater Resources, p. 19-87|). The applicant stated that wastes, discharges, and emissions over the life cycle of the MSRR would be managed in accordance with applicable Federal, State, and local laws and regulations (ACU 2023-TN8909 | PSAR Section 19.4.9.1|).

The applicant stated that written procedures will be developed to establish compliance with the requirements of 10 CFR Part 20, "Standards for Protection Against Radiation," Subpart F, "Surveys and Monitoring," and that additional details concerning required radiation monitoring and surveying programs will be provided in the OL application (ACU 2023-TN8909 | PSAR Sections 1.3.3, p. 1-10 and 11.1.4, p. 11-3|). Therefore, monitoring details were not included in the applicant's radiological environmental monitoring plan at the CP stage.

The peak maximum water demand for dormitories on the ACU campus (i.e., Sikes Hall) has been estimated as approximately 4,346 gal per month per resident (Saucedo 2019-TN8793). Applying this peak to an average of 160 Sikes Hall residents over the 2013–2018 study period equates to a total of approximately 23,200 gal per day. Given that a large portion of the total usage is devoted to showers and laundry, and that residents would be in the dormitory substantially more than the majority of the many fewer students in the SERC building, the SERC building water usage would be much less than that of the dormitories. As discussed above, the City of Abilene has ample reserve capacity to service the SERC building, even in the highly unlikely event that the SERC building water usage should approach that of a dormitory.

Through appropriate permits in conformance with local ordinances, the wastewater from the SERC building will be routed to the city's wastewater collection system. This system has a rated pumping capacity of approximately 24 MG daily with an emergency storage basin of approximately 23 MG (City of Abilene Undated-TN8794). The wastewater treatment system allows for up to 7 MG daily of highly treated reclaimed water to be returned to Fort Phantom Hill Lake reservoir to increase clean water supplies for the city. The MSRR is a zero-release facility, and there is no connection from the Reactor Bay to the sanitary sewer system. Therefore, no effluent releases are possible, and there is no sewage effluent monitoring plan (ACU 2023-TN9099).

Given the required permitting process for the City of Abilene and the city's recent master planning for future public water supply and wastewater service (City of Abilene 2020-TN8795), municipal capacities are currently, and will be in the future, sufficient for the anticipated water supply and water treatment requirements related to the proposed action.

3.3.2.2 Environmental Impacts of Construction, Operation, and Decommissioning

Building the SERC building involved temporary disturbance of approximately 7 ac on the SERC site. The applicant performed sufficient excavation for a Systems Pit measuring 25 ft deep by 80 ft long below the Research Bay with a finished grade of 1,720 ft for the building. Based on site borings (ACU 2023-TN8909 | PSAR Section 2.5.2, pp. 2-89 and 2-90|), the water table is approximately 35 ft below grade, and dewatering was not necessary during construction and will not be necessary during the installation, operation, and decommissioning of the MSRR. No raw surface water or groundwater would be used or withdrawn for MSRR operations, and the City of Abilene will supply the site with potable water.

Stormwater and wastewater discharge permits prescribe the amount of any surface water discharge and establish the parameters to minimize impacts to the surrounding environment in compliance with City of Abilene storm water (City of Abilene 2023-TN8779) and wastewater (City of Abilene Undated-TN8796) requirements. Stormwater BMPs combined with the required permitting for stormwater management minimize the effects of SERC site runoff. Consistent with other facilities on the ACU campus, wastewater service for the SERC building is provided by the City of Abilene. As mentioned above, the MSRR Reactor Bay will have no connection to the sewer system. The applicant summarized the permits and approvals in Table 19.1-2 of the PSAR applicable to surface water hydrology and quality applicable to the construction and operation of the MSRR (ACU 2023-TN8909 | PSAR Table 19.1-1|). There are no discernable surface water features draining the SERC site, and the majority of surface runoff flows to street drainage. No raw surface water or groundwater was directly used during the construction of the SERC building or will be used during the construction of the MSRR. Adherence to the City of Abilene's permitting requirements and BMPs and the implementation of a Storm Water Pollution Prevention Plan and associated permits during construction resulted in minimal effects to the groundwater and surface water quality surrounding the SERC site. Based on its review, the NRC staff expects that building and operating the MSRR would have at most minimal impacts on water resources on or near the SERC site. At the OL stage, the NRC staff will review the application for any new and significant information, if any, that might alter the staff's conclusions made for the CP application.

The applicant stated that permits required for decommissioning the MSRR will be provided in the decommissioning plan submitted in support of the permanent cessation of operations. At the decommissioning stage, the NRC staff will review the application for new and significant information, if any, that may alter the staff's conclusions made for the CP application.

3.3.2.3 Cumulative Impacts

Table 19.4-7 of the PSAR identifies past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts of the proposed action (ACU 2023-TN8909). Key past and present actions affecting water resources in the SERC site area include ACU infrastructure development and improvements, Cedar Creek Waterway greenbelt development, the construction of the Abilene Convention Center hotel, road maintenance projects, Abilene Regional Airport and Dyess AFB operations, and various ACU campus infrastructure improvement projects. Construction, operation, and decommissioning of the MSRR would not directly use groundwater or surface water. The proposed action would be required to implement appropriate stormwater management, spill prevention, and response plans; to implement a radiological environmental monitoring program during operations (ACU 2023-TN8909 | PSAR Section 11.1.7, p. 11-4|); and to comply with local permitting requirements. Moreover, because the SERC building was built within a previously developed area and the MSRR would be built, operated, and decommissioned within the SERC building, the MSRR would not contribute to adverse cumulative impacts to groundwater or surface water resources in the Abilene area. At the OL application stage, the NRC staff will review the radiological environmental monitoring program for compliance with NRC regulations with respect to MSRR operation.

3.3.2.4 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative water resource impacts of the proposed action would be SMALL. This conclusion is based primarily on the fact that the water demands of the SERC building and the MSRR would be met through municipal supplies and that there would be no direct use of groundwater or surface water. The NRC staff recognizes that there could be minor impacts to the municipal water supply due to the relatively small increased daily demands from the SERC building and the MSRR. Given the municipal water supply source and the low water demands related to the proposed action, the proposed action will result in minimal effects to aquifers and surface water bodies.

3.4 Ecological Resources

3.4.1 Affected Environment

The MSRR would be sited in the rolling plains ecoregion of Texas, as described in Section 19.3.6.1 of the PSAR. The natural vegetation in most of the area around Abilene has been converted to intensive agricultural land or pasture used for grazing cattle (ACU 2023-TN8909 | PSAR Section 19.3.6.1|). The surrounding landscape contains a low density of small intermittent streams and few rivers and has been extensively altered by human activity and livestock grazing, including the introduction of many invasive species of grasses, forbs, legumes, and woody species (ACU 2023-TN8909 | PSAR Section 19.3.6.1|).

Before the commencement of the building of the SERC building, the SERC site consisted of approximately 15 ac of manicured grassy fields used for sports (ACU 2023-TN8909 | PSAR Section 19.3.6.2|). Vegetation consisted of common grasses and weeds providing a poor habitat even for urban wildlife (ACU 2023-TN8909 | PSAR Section 19.3.6.2|). The lands immediately surrounding the SERC site are urban without natural ecosystems, although some lands farther east of the site provide a natural habitat, which is described in more detail in Section 19.3.6.3 of the PSAR. There is no aquatic habitat on or adjoining the SERC site. The nearest aquatic habitat is associated with two creeks approximately 1,500 ft from the SERC site (ACU 2023-

TN8909 | PSAR Section 19.4.6.2|). Three Federally listed endangered species are known to occur in the Abilene area (ACU 2023-TN8909 | PSAR Section 19.3.6.4|), but the SERC site and surrounding areas do not provide a natural habitat that could be inhabited or exploited by any of those species.

3.4.2 Environmental Impacts of Construction, Operation, and Decommissioning

No natural terrestrial or aquatic habitat would be affected by the construction, operation, and decommissioning of the MSRR. The components of the MSRR would be fabricated off-site in existing manufacturing facilities, and the MSRR would be installed inside the already-built SERC building. The exterior areas surrounding the SERC building are all urban, and any noise generated by the MSRR would be experienced only by urban wildlife already accustomed to human activities and urban noise. Because the MSRR would not affect any natural habitat and would be situated entirely within the SERC building, which itself is entirely within an area of urban development lacking a natural habitat, construction, operation, and decommissioning of the MSRR would have no effect on any protected species or habitats occurring in the Abilene area.

3.4.3 Cumulative Impacts

The building of the SERC building converted approximately 15 ac of manicured lawns to urban development and had no effect on the natural terrestrial or aquatic habitat. Table 19.4-7 of the PSAR identifies other past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts of the construction, operation, and decommissioning of the MSRR. None of these projects substantially influence how the SERC building and the MSRR could affect nearby terrestrial or aquatic species and habitats.

3.4.4 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative impacts from the proposed action on ecological resources would be SMALL. The MSRR life cycle would not involve the disturbance of any natural terrestrial or aquatic habitats or wetlands. The areas surrounding the SERC building that could experience noise and human activity from the MSRR are all urban without a habitat for other than urban wildlife adapted to urban conditions.

3.5 Historic and Cultural Resources

Historic and cultural resources refer to archaeological sites, historic buildings, traditional cultural properties important to a living community, shipwrecks, and other resources considered through the NHPA (National Historic Preservation Act-TN4157). Historic and cultural resources that have been determined to be significant include those that have been determined eligible for inclusion on or formally listed in the National Register of Historic Places (NRHP). Section 106 of the NHPA requires Federal agencies to take into account the effects of their undertakings on historic properties that are listed or eligible for listing on the NRHP (36 CFR Part 800-TN513). If historic and cultural resources are present, the eligibility of any historic properties for listing on the NRHP is determined through the application of the NRHP criteria in 36 CFR 60.4 (36 CFR Part 60-TN1682) in consultation with the State Historic Preservation Office, American Indian Tribes (Tribes) that attach cultural and religious significance to historic properties, and other interested parties.

In accordance with 36 CFR 800.8(c), the NRC initiated the NHPA Section 106 consultation process and notified consulting parties, including the ACHP, the THC (i.e., the State Historic Preservation Officer), and Tribes, of its intent to use the NEPA process to comply with Section 106 of the NHPA (see Section 3.5.6.2 of this EA for more information regarding consultations).

The undertaking before the NRC is whether to issue a CP to ACU authorizing the construction of the MSRR in the SERC building. ACU would need to apply for, and receive, a separate OL from the NRC in order to operate the MSRR. That authorization would constitute a separate undertaking and would require a separate NHPA Section 106 review and consultation. Similarly, decommissioning the MSRR would require separate authorization from the NRC and a separate NHPA Section 106 review and consultation.

The MSRR would be constructed within the existing SERC building on the ACU campus (Figure 3-2). The SERC building, which was designed and built by ACU for laboratory space and to house the MSSR, is located on a parcel in the southeast corner of the ACU campus in the City of Abilene, which is located 150 mi (241 km) west of Fort Worth, in west central Texas. The SERC site encompasses approximately 15 ac of land, which the NRC staff considers to be the Area of Potential Effect (APE) for the proposed action. The APE is bounded by East North 16th Street to the north, North Judge Ely Boulevard to the east, East North 13th Street to the south, and Avenue F to the west. The proposed location for the MSRR covers approximately 25,000 ft^2 within the SERC building.

3.5.1 Cultural Background

The general cultural chronology of the region is divided by the following periods: the Paleoindian (12,000–8,500 before present [BP]); the Archaic (8,500–1,250 BP), the Late Prehistoric (1,250 BP–250 anno Domini [AD]), Protohistoric (1,600–1,800 AD), and Historic (1,800 AD to present).

3.5.2 Paleoindian Period

The Paleoindian period is generally accepted by archaeologists as falling between 12,000 BP to around 8,500 BP. The time period is characterized by small groups of highly mobile nomadic hunters following megafauna across the landscape. Tool use typically associated with the Paleoindian period consists of Clovis and Folsom points.

The Clovis culture is characteristically associated with the Paleoindian period. The Clovis were nomadic hunters who hunted big game megafauna across the landscape. The Folsom culture (10,800–10,300 BP) is closely associated with the Paleoindian period as well. Stone tool assemblages from the Clovis and Folsom are similar in style. Clovis points are large projectile points that were used to hunt megafauna. They are lanceolate shaped with short fluting notched out within the bottom half of the points. Folsom points look similar in style; however, they are thinner, more symmetrical, and have the fluting higher up within the point (Gray & Pape 2020-TN8912).

3.5.3 Archaic Period

During the Archaic period (8,500–1,250 BP), populations began to be more sedentary, relying on more crops and less megafauna for subsistence. During the Early Archaic (8,500–6,000 BP), sites were smaller and stone assemblages more varied, suggesting that the populations were still somewhat highly mobile. In contrast with the Early Archaic period, the populations increased during the Late Archaic period (4,000–1,250 BP). The archaeological record shows an increase

Figure 3-2 Project Area of Potential Effect. Source ACU 2023-TN8909.

of sites dating to around 4,500 BP, coinciding with warmer, dryer conditions. Archaic sites have been documented along the eastern and southern margins of the Edwards Plateau, south of Taylor County (Fields et al. 2005-TN8913). Tool features consistent with this period included stemmed and later barbed dart points, ground stones, and hearths with either burned stone or caliche cobbles (Gray & Pape 2020-TN8912).

Bison appeared to be a more consistent food source, as evidenced by local stone tool varieties, such as Castroville, Darl, Edgewood, Ensor, Fairland, and Nolan. Castroville, Montell, and Marcos dart points are typically considered part of bison-hunting tool kits (Fields et al. 2005-TN8913).

3.5.4 Late Prehistoric

The Late Prehistoric period consisted of the time around 1,250 BP to 250 AD. Ceramics and technology, such as the bow and arrow, were introduced during the Late Prehistoric (Gray & Pape 2020-TN8912, Fields et al. 2005-TN8913). Archaeological sites of this time period demonstrate a shift from mobility to increased sedentism. More diagnostic resources (e.g., artifacts that tell us date of use, when sites were occupied, etc.) include cord marked pottery, corner notched Scallorn points, and larger lithic tools (Gray & Pape 2020-TN8912). Archaeological evidence across central Texas also indicates evidence of interactions with the Caddoan, Plains, and Puebloan populations across the region.

The Palo Duro cultural complex was the contemporary culture of the Late Prehistoric period. They are considered to represent foraging populations who mainly occupied the canyonlands along the Caprock Escarpment, the geographic transition point that separates the flat plains to the west and the broken and rough rolling plains to the east. The Palo Duro peoples harvested a range of wild plants and other foods, including mesquite beans and shin oak acorns (Fields et al. 2005-TN8913).

The Sam Wahl site in northern Garza County is one of the most significant sites representing the Palo Duro complex. The site contained circular pithouses, subterranean storage pits, and baking pits that contributed to the redefinition of the Palo Duro Complex.

3.5.5 Protohistoric

The Protohistoric period is considered to range between 1600 and 1800 AD. Several Spanish expeditions, first by Francisco Vasquez de Coronado in 1541, later followed by Luis de Moscoso de Alvarado, documented the north central region of Texas (Cestaro et al. 2017-TN8914). After 1600, Spanish influence grew significantly within the region. The Spanish were not the only explorers in the region; the French made several expeditions across north central Texas to establish trade routes throughout (Cestaro et al. 2017-TN8914).

Tribes such as the Lipan Apaches, Jumanos, and Comanches and other Indigenous groups historically occupied the north central area during the Protohistoric (Fields et al. 2005-TN8913). Tribes with ancestral ties to the APE include the Comanche, Jumanos, the Lipan Apache, and the Kickapoo Tribe (Native Land Digital 2023-TN8730). A brief discussion of each Tribe is provided below.

3.5.5.1 Comanche

The traditional territories of the Comanche include the territories in present Wyoming, Nebraska, Kansas, Colorado, New Mexico, Oklahoma, and Texas (Comanche Nation 2023-TN8731). The Comanche call themselves Nʉmʉnʉʉ" (NUH-MUH-NUH), which means "The People" in their language.

Known as Lords of the Plains, the horse was an important resource in the Tribe's culture. The Comanche were master horsemen, which was advantageous in war times. Buffalo was also important as it provided food, clothing, tepee covering, and other goods. The Tribe migrated across the Plains in the late 1600s and early 1700s, ultimately settling in southwest Oklahoma. Today, the Comanche has approximately 17,000 members. Approximately 7,000 members live in and around Lawton and Fort Sill, Oklahoma and surrounding counties near the Tribe's headquarters outside of Lawton.

3.5.5.2 Jumanos

The Jumanos originated from the southern part of present Durango, Chihuahua (Mexico). They eventually migrated north, settling in New Mexico and western Texas. The Jumanos relied on farming for survival, growing corn, squash, tomatoes, chili peppers, onion, cactus pears, and potatoes (Jumano Nation 2022-TN8921). Small game was also consumed, including goat, antelope, armadillos, skunks, rabbits, birds, and fish.

The Jumanos followed buffalo herds during hunting seasons and would trade the hides at La Junta, Chihuahua. The Jumanos lived in Rancherias, large complexes where several families lived together. Rancherias were not tied to one particular family as there was no ownership of the facilities. Once a Rancheria was built, the family stayed for whatever time period was necessary. Once vacated, other Rancheria families would move in and would stay for limited durations.

In the 1600s, the Jumanos attempted to seek an alliance with the Spanish in an effort to halt Apache advances into their homelands. They asked for Christian missions to be established within their territory. Although the Spanish visited them, it does not appear that a mission was constructed (Jumano Nation 2022-TN8915). In the mid-1700s, the Jumanos tried to create an alliance with the Apache, despite once being enemies. Post 1750s, the Jumanos appeared to disappear from the historic record as a distinct Tribe. It is thought that some of their populations were incorporated into other regional Tribes, such as the Lipan and Mescalero Apache, Caddo, and Wichita. Infectious diseases contributed to a decreased population as well.

In 2019, the Jumano Nation was recognized by the Texas Legislature (Jumano Nation 2022-TN8916). Today, the Jumano Indian Nation continues in West Texas. Some of their populations continue to live in Mexico today.

3.5.5.3 The Lipan Apache

The Lipan Apache were traditional hunters and gatherers who relied on limited agriculture for subsistence. Their name means “The Light Gray People” and commemorates the Lipan Apache’s ancient journey from Canada south to their eventual homeland of Texas (Lipan Apache Tribe 2023-TN8917).

The Lipan Apache first migrated to present Texas between 1000 and 1400 AD, searching for a homeland which contained buffalo and deer to hunt and fertile river banks where they could plant foods, such as corn and squash (Lipan Apache Tribe 2023-TN8918). Additionally, they traded buffalo and deer hides for goods, such as chili pepper, sugar, and tobacco (Lipan Apache Tribe 2023-TN8919). The Lipan Apache eventually settled in south central Texas (Lipan Apache Tribe 2023-TN8920). Following their war with the Comanches in the 1700s, the Lipan Apache expanded their homeland further south. In the 1750s, a portion of the Tribe moved to Coahuila, in Mexico.

Although the Lipan Apache signed numerous treaties in the 1800s with the United States, Spain, Mexico, and Texas, those treaties no longer exist. The Lipan Apache have survived Spanish, Mexican, and U.S. soldiers’ attempts to wipe them out. Despite this, the Lipan Apache continue to be a sovereign Tribe within Texas today, protecting their heritage, including their language, traditions, ceremonies, and sacred history (Lipan Apache Tribe 2023-TN8918).

3.5.5.4 The Kickapoo Tribe

The Kickapoo Tribe is a Woodland Tribe who were related to the Sac and Fox Nation. In the mid-18th century, the Kickapoo primarily resided in what they refer to as the "Prairie Band" along the Sangamon River in Illinois and the "Vermillion Band" off the Wabash River in Indiana. The Prairie Band eventually migrated to the then-Spanish province of Texas before the 1821 Mexican Revolution (Kickapoo Tribe of Oklahoma 2023-TN8734). The Spanish had originally given them land, but then were forcibly removed in 1839 after the Texas Revolution. The Kickapoo reestablished in Nacimiento, Mexico where the Mexican government gave them land in exchange for protecting Mexico's northern borders. Some Kickapoo stayed in Nacimiento; others settled with the Chickasaw and Creek nations. In 1873, the Mexican Kickapoo were forced to relocate to Indian Territory.

The Kickapoo today are in McCloud, Oklahoma, with many Kickapoo residing in Lincoln and Pottawatomie counties. Some of their members live near Topeka, Kansas; Eagle Pass, Texas; and Nacimiento, Mexico (Kickapoo Tribe of Oklahoma 2023-TN8734).

3.5.5.5 Taylor County History

Taylor county was established in 1858 by the Texas Legislature. The county was named after brothers Edward, George, and James Taylor, who fought and died in the Battle of the Alamo (TCHC 2023-TN8717).

The county was largely still occupied by the Comanche until the 1870s, when European settlers began to move in (TSHA 2019-TN8720). Around 1880, the Texas and Pacific Railroad was built across Texas. The railroad contributed to the establishment of Abilene, making it a hub for shipping and connecting the area to larger markets. Buffalo Gap was the original county seat until 1883, when Abilene became the new county seat.

Post 1900s, Abilene became an agricultural community, primarily focusing on the cultivation of cotton. The cattle and poultry industries also grew during the 1900s (TSHA 2019-TN8720). Camp Barkeley was constructed in the early 1940s, first set up as a training camp for infantry and supply troops. It later transitioned to a medical replacement training center. Camp Barkeley was deactivated in 1945. After the camp closed, Dyess AFB was later established in 1956 in the same location (TSHA 2019-TN8721).

In the 1960s–1970s, Taylor County prioritized industrialization, becoming home to over 140 industrial plants. Dyess AFB also provided jobs to the local economy. Agriculture continues to be a primary industry for Taylor County. The county today is a transportation, financial, shopping, medical, business, and educational hub, with three universities, two community colleges, and a pharmacy school.

3.5.6 Current Abilene Christian University History

In 1903, A.B. Barret and Charles Roberson founded ACU, as it is known today. The university was originally called the Childers Classical Institute, first operating from church leader's W.H. Childers' home in town. In Fall 1906, the university officially opened its doors to 25 students (ACU 2023-TN8670 and NPS 1992-TN8714).

The school was informally known as Abilene Christian in the community during this time. Abilene Christian College became its formal name under Jesse P. Sewell's leadership as college president in 1912. Sewell oversaw the campus expansion and assisted with the school's accreditation as a junior college in 1914 and a senior college in 1919. By 1929, under a different president, the campus opened with eight buildings, including an Administration building, residence halls, an education building, dining hall, gym, auditorium, and housing for the president (ACU 2023-TN8670).

ACU continued its expansion post World War II. The school received official accreditation from the Southern Association of Colleges and Schools in 1951. Enrollment increased during the successive decades, reaching over 4000 students by 1977. Today, ACU continues to focus on strategic growth, investing in learning initiatives and technological advances that serve their students (ACU 2023-TN8670). This includes the Nuclear Energy eXperimental Testing Laboratory (NEXT Laboratory), aimed at experimenting with using molten salts instead of water as a coolant for nuclear reactors.

ACU is leading the Natura Resources Research Alliance (NRRA) consortium with the goal of designing, licensing, and commissioning the first university-based MSRR. Partners include the Georgia Institute of Technology, Texas A&M University, and the University of Texas at Austin (ACU 2023-TN8671). Historic and Cultural Resources in the Area of Potential Effect

The NRC staff reviewed the THC's Texas Archaeological Sites Atlas (TASA) and Texas Historic Sites Atlas databases in April 2023 and confirmed that no previously recorded archaeological sites exist within the APE (THC 2020-TN8672). A 1-km review in the databases identified two NRHP-listed buildings, one historic road, and one previous survey within 1 km of the APE (THC 2020-TN8672).

The two historic buildings are on the ACU campus. Luce Hall, 430 m northwest of the APE, was built in 1929 and is significant for its Classical Revival style (NPS 1992-TN8715). Immediately southeast of Luce Hall is the Abilene Christian College Administration building. It is significant under Criterion A for its association with events in local educational efforts. It has also served as ACU's main building since its construction in 1928/1929. The Administration building is also significant for its Classical Revival architecture (NPS 1992-TN8714). Both buildings were listed on the NRHP in 1992.

The one historic road is approximately 1,700 m north of the APE. The Bankhead Highway was one of the country's earliest transcontinental highways in the early 1900s. The highway stretched through Texas for over 850 mi, crossing towns such as Dallas, Fort Worth, Abilene, and El Paso, following the present routes of U.S. interstates 67 and 80 (THC 2022-TN8673).

The one cultural resources survey intersects the southeast corner of the APE. The survey was performed in 1990 for the Texas Department of Highways and Public Transportation. The survey was along the east side of the APE, adjacent to Judge Ely Blvd (TASA 2023-TN8987).

3.5.6.1.1 Original Taylor Elementary School

The original Taylor Elementary School was first established in 1955 in its present location within the now-ACU campus. The school was built during a time when Texas was desegregating its schools. It appears that this building may have been constructed during the Equalization School era, a result of the 1954 Brown v. Board of Education of Topeka, Kansas Supreme Court decision, which ruled that segregation in public schools was unconstitutional. Equalization schools served the purpose of educating primarily African American students as a means to continue segregation but still meet the mandate from the Supreme Court decision (NTHP 2015-

TN8922). After further research, it was determined that the school district did not integrate schools until the 1962–1963 school year, when African American students enrolled in Dyess Elementary (Gallaway 1994-TN8939, Bullock 2019-TN8938).

The Taylor Elementary School was part of a general design provided to the Abilene Independent School District (AISD) by prominent architect David S. Castle. Castle's firm designed most of AISD's schools constructed between 1950 and 1955 (ARN 2018-TN8923).

Castle was based in Abilene and his firm designed many of the city's buildings between the 1910s and 1950s. Castle worked throughout West Texas, creating plans for courthouses, churches, hotels, shopping centers, movie theaters, and schools (PTH 2023-TN8924, The Grace Museum 2023-TN8925). Most of the Castle-designed buildings are still in use today. Buildings he designed, such as the Federal building and the Paramount Theater, are listed on the NRHP (NPS 1992-TN8926, NPS 1982-TN8927). After Castle's death in 1956, his son took over the firm. The business eventually closed in the early 1960s (ARN 2018-TN8923).

In 2020, AISD constructed a replacement Taylor Elementary School off of 10th street, just over 1 mi southeast of the original school. The new 95,000 ft^2 school opened in January 2021 (ARN 2021-TN8928, Sedalco 2023-TN8929, KTXS News 2020-TN8930). ACU purchased the original school around 2021 for its campus expansion, intending to house the theater and science departments (KTAB/KRBC News 2021-TN8931, KTXS News 2019-TN8932).

3.5.6.2 National Historic Preservation Act Section 106 Consultation

As part of its review of the CP application, the NRC staff initiated NHPA Section 106 consultation via letters dated May 5 and 8, 2023 with the THC (NRC 2023-TN8933), the ACHP, and the following Tribes: Alabama-Coushatta Tribe of Texas, Apache Tribe of Oklahoma, Caddo Nation of Oklahoma, Cheyenne and Arapaho Tribes of Oklahoma, the Delaware Nation of Oklahoma, Delaware Tribe of Indians, Kickapoo Tribe of Texas, Tonkawa Tribe of Indians of Oklahoma, Wichita and Affiliated Tribes of Oklahoma, and the Ysleta del Sur Pueblo. The Caddo Nation of Oklahoma responded on May 16, 2023 (Caddo Nation 2023-TN9540) and the Kickapoo Traditional Tribe of Texas responded on May 23, 2023 (Kickapoo 2023-TN9541) declining consultation. On June 12, 2023, the Delaware Nation responded indicating that they did not have concerns with the location of the proposed action (Delaware Nation 2023-TN9542). On August 14, 2023, the Chitimacha Tribe of Louisiana responded that the location of the proposed action is not part of their aboriginal homeland (Chitimacha 2023-TN9543). The NHPA Section 106 consultation letters are listed in Appendix D of this EA.

The THC provided comments via email dated June 12, 2023 requesting additional information on a potential historic resource within the APE (THC 2023-TN9544). Between June and August 2023, ongoing communication occurred to understand and resolve THC's comments.

As part of the NRC staff's environmental audit, the applicant provided photographs of the original Taylor Elementary School within the APE. The property was sold to ACU in 2021. The applicant subsequently had discussions with the THC regarding potential historic properties within the APE. The THC requested images of the original Taylor Elementary School. The images were provided on August 1, 2023. The NRC staff requested a summary of the call between the applicant and the THC. After the submission of the photos to the THC, the THC provided a concurrence of no historic properties affected on August 11, 2023 (THC 2023-TN9545). On August 29, 2023, Pacific Northwest National Laboratory (PNNL), on behalf of the NRC staff, met with the THC to further clarify the THC's preliminary concurrence provided to the

NRC staff. The meeting clarified confusion regarding the existence of the SERC building, confirmed the extent of the undertaking contained within the SERC building, and provided a better understanding of the THC's determination of no historic properties affected for the original Taylor Elementary School within the APE (THC 2023-TN9546).

The ACHP confirmed its receipt of the NRC staff's letter (NRC 2023-TN8936) on June 5, 2023 and responded on June 12, 2023 (ACHP 2023-TN9547). The ACHP mistakenly understood that the undertaking had resulted in an adverse effect. The NRC staff responded to the ACHP on September 7, 2023 (NRC 2023-TN8937) clarifying that the NRC staff was in the process of developing an EA and had not made a determination of effect related to the undertaking. To date, the ACHP has not responded to this clarification or to subsequent contact attempts within the required timeframe (36 CFR 800.6(a)(1)(iii)). As the ACHP indicates in its questions and answers regarding NHPA Section 106, if no response is received from the ACHP within the 15-day period from a submittal date, an agency can assume that the ACHP has decided against participating (ACHP 2023-TN9124).

3.5.6.3 Environmental Impacts of Construction, Operation, and Decommissioning

The APE for the proposed action corresponds to the approximately 15 ac parcel that surrounds the SERC building. While the undertaking is limited to whether to issue a CP for the MSRR (which would be installed within the existing SERC building), the NRC staff did not reduce the APE from that identified in the CP application.

The NRC staff consulted with 11 Tribes as part of this effort. No impacts are expected to occur on traditional cultural properties of significance as none were identified as part of this consultation.

The original Taylor Elementary School is in the southern portion of the APE. The school does not appear to be eligible under Criterion A as it does not appear to be associated with events important in history or prehistory. The school does not appear to be eligible under Criterion B as it does not have an association with people significant in our past. The school does appear to be significant under Criterion C as it was designed by the prominent local architect David S. Castle. Between the early to mid-1900s, his firm designed and built hundreds of schools, hotels, churches, courthouses, medical and municipal buildings, and recreational buildings in Abilene and across Texas. The school does not appear to be significant under Criterion D as it does not appear to have the data potential to answer questions in our history or prehistory that are not already available.

The original Taylor Elementary School building retains integrity in the areas of location, design, materials, setting, feeling, and workmanship. The building remains in its original location. In addition to the building's original form remaining intact, it also continues to resemble Castle's initial blueprints provided to the school district in the early 1950s. Additionally, the building is consistent with designs and construction methods used post World War II: a sleek one-story brick building, flat roofs, and glass block windows. The school's setting is intact as most of the features (playground, building arrangement, etc.) are extant. The school retains integrity of feeling as the property continues to convey a 1950s aesthetic and is surrounded by midcentury modern homes. However, the school does not appear to be associated with a person or event significant to Abilene and Taylor County. Because the MSRR would be installed within the existing SERC building, it does not appear that direct or indirect impacts to the original Taylor Elementary School, or any other potential historic properties, would occur.

The undertaking before the NRC is whether to issue a CP to ACU authorizing the construction of the MSRR in the SERC building. ACU would need to apply for, and receive, a separate OL from the NRC in order to operate the MSRR. Similarly, decommissioning the MSRR would require separate authorization from the NRC. Both actions would require a separate NHPA Section 106 review and consultation.

3.5.6.4 Cumulative Impacts

The description of the affected environment for the APE above serves as the baseline for the assessment of cumulative impacts on historic and cultural resources. Historic and cultural resources are nonrenewable resources; therefore, certain activities can result in a permanent loss of the resource.

Table 19.4-7 of the PSAR (ACU 2023-TN8909) identifies other past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts from the MSRR. A potentially eligible elementary school, the original Taylor Elementary School, is in the southern portion of the approximately 15-ac APE. The only project that may have potential cumulative impacts is Higher Ground, ACU's campus infrastructure improvement plan, which includes potential building demolition, renovation, and construction. The close proximity of these activities (within 1 mi at various locations on the ACU campus) may have direct and indirect impacts to historic properties. However, in most cases, impacts can be minimized using creative design or other BMPs.

Overall, the cumulative impacts of the proposed action combined with other past, present, and reasonably foreseeable future actions is potentially moderate, but the contribution of the MSRR to those cumulative impacts would be minimal.

3.5.7 Conclusions

The MSRR would be installed within the existing SERC building. As such, it does not appear that direct or indirect impacts to historic properties would occur. Even though other projects in the area surrounding the SERC site have resulted in past impacts and may potentially result in future impacts on historic and cultural resources, the MSRR would not contribute further to those impacts. Therefore, the NRC staff concludes that the potential direct, indirect, and cumulative impacts from the proposed action on historic and cultural resources would be SMALL.

For the purposes of the NRC staff's NHPA Section 106 review, as discussed above, the undertaking of authorizing the construction of the MSRR within the existing SERC building will result in no historic properties affected, as defined in 36 CFR 800.4(d)(1). The State Historic Preservation Office concurred with this determination on August 11, 2023 (THC 2023-TN9546). No response was received from the ACHP within the 15-day period of the NRC staff's clarification of this determination. The NRC staff also shared its NHPA Section 106 finding that the undertaking will result in no historic properties affected with the public and shared the initial draft of this EA with this finding with Tribes, the TCEQ, the ACHP, and the THC for comment over a 30-day period. The NRC did not receive any comments.

3.6 Socioeconomics and Environmental Justice

This section of the EA describes the baseline socioeconomic and EJ characteristics with respect to the proposed action that include the populations, the economy of the region, and the region's infrastructure and public services.

3.6.1 Affected Environment

This section of the EA provides a discussion of the socioeconomic conditions of the region of influence (ROI) related to the proposed action, including economic development, demographics, housing, community services and infrastructure, and EJ. The ROI for the proposed action is the Abilene metropolitan statistical area (MSA), Texas. Taylor County is considered to be part of the Abilene MSA.

The primary data sources for economic development, demographics, and housing are the 2017–2021 American Community Survey 5-Year Estimates and the 2010/2020 Decennial Census of the U.S. Census Bureau (USCB). The data sources for community services and infrastructure are mainly local sources.

3.6.1.1 Economic Development

According to the USCB's 2017–2021 American Community Survey 5-Year Estimates, as Table 3-3 shows, the civilian labor forces for the City of Abilene, Taylor County, and the Abilene MSA were 58,166, 68,512, and 80,930, respectively. The numbers of employed persons for the City of Abilene, Taylor County, and the Abilene MSA were 56,351, 66,625, and 78,405, respectively. The unemployment rates in the City of Abilene, Taylor County, and the Abilene MSA were 3.1, 2.8, and 3.1 percent, respectively (USCB 2021-TN9532).

According to the USCB's 2017–2021 American Community Survey 5-Year Estimates, as Table 3-3 shows, the per capita personal incomes for the City of Abilene and Taylor County were $27,397 and $29,698 (in 2021 inflation-based dollars, same below), and the median household incomes were $54,493 and $57,811, respectively (USCB 2021-TN9532). Comparatively, the per capita personal income for the Abilene MSA was $28,402, and the median household income was $57,356 (USCB 2021-TN9532).

Table 3-3 Estimated Income Information for the Socioeconomic Region of Influence

Parameter	City of Abilene	Taylor County	Abilene Metropolitan Statistical Area
Civilian labor force	58,166	68,512	80,930
Employed persons	56,351	66,625	78,405
Unemployment rate	3.1%	2.8%	3.1%
Median household income (U.S. dollars)[(a)]	$54,493	$57,811	$57,356
Per capita income (U.S. dollars)[(a)]	$27,397	$29,698	$28,402

(a) In 2021 inflation-adjusted U.S. dollars.
Source: USCB 2021-TN9532.

3.6.1.2 *Demographics*

The 2020 population estimate for Taylor County was 143,208 (USCB 2020-TN8892). This is an 8.9 percent increase from the 2010 census (USCB 2010-TN8728) population of 131,506. Meanwhile, the 2020 population estimate for the Abilene MSA was 176,579 (USCB 2020-TN8892), which is a 6.9 percent increase from the 2010 census population of 165,252 (USCB 2010-TN8761).

3.6.1.3 *Population on Campus*

A total of 3,588 undergraduate and graduate students enrolled at the ACU Abilene campus in Fall 2022 for the 2022–2023 school year, which is three more students than enrolled in 2021 (ACU 2023-TN8893).

3.6.1.4 *Housing*

According to the USCB's 2017–2021 American Community Survey 5-Year Estimates, as represented in Table 3-4, there are 73,899 housing units in the Abilene MSA, with 64,331 being occupied and 9,568 being vacant. The percentages of homes that are owner- and renter-occupied are 63.1 and 36.9 percent, respectively. In Taylor County, there are 60,376 housing units, with 53,292 being occupied and 7,084 vacant. The percentages of homes that are owner- and renter-occupied are 59.3 and 40.7 percent, respectively (USCB 2021-TN9530).

Table 3-4 Housing in the Region of Influence

Parameter	City of Abilene	Taylor County	Abilene Metropolitan Statistical Area
Total housing units	51,501	60,376	73,899
Occupied housing units	45,504	53,292	64,331
Total vacant housing units	5,997	7,084	9,568
Percentage of owner-occupied units	54.5%	59.3%	63.1%
Percentage of renter-occupied units	45.5%	40.7%	36.9%

Source: USCB 2021-TN9530

3.6.1.5 *Community Services and Infrastructure*

3.6.1.5.1 Law Enforcement

ACU is authorized by Texas law to operate its own campus police department. The ACU Police Department (ACUPD) staff comprises 14 full-time police officers, two reserve police officers, and six part-time public safety personnel, in addition to office and clerical personnel. All ACUPD police officers have completed law enforcement academies approved by the State of Texas and are fully certified and licensed as Texas Peace Officers by the Texas Commission on Law Enforcement. ACUPD maintains a close working relationship with the City of Abilene Police Department (APD), the local office of the Texas Department of Public Safety, and the local field office of the Federal Bureau of Investigation. ACUPD meets regularly with APD to discuss crimes, incidents, and trends that may jointly affect the City of Abilene and ACU. As of 2022, the APD staffing has approximately 216 officers budgeted (ARN 2022-TN8764).

3.6.1.5.2 Fire Protection Services

The City of Abilene Fire Department operates eight fire stations in the Abilene area including Fire Station 5 located just east of the ACU Campus on East North 16th St. (City of Abilene Undated-TN8765). The City of Abilene Fire Department operates under the direction of the Fire Chief, appointed by the City Manager, and consists of a Support Services branch and an Emergency Services branch (City of Abilene Undated-TN8766).

3.6.1.5.3 Medical Services

Partnering with the community, the Abilene Taylor County Public Health District offers a variety of services to promote community health and prevent disease (City of Abilene 2023-TN8972). Various health services are available in the area, including the largest facility, the Hendrick Medical Center located in Abilene, a not-for-profit healthcare provider serving a 22-county region in the Texas Midwest (Hendrick Health 2023-TN8767).

3.6.1.5.4 Schools

There are three high schools with 1,509 students, four middle schools with 1,053 students, and 13 elementary schools with 2,527 students in the AISD (AISD 2023-TN8768).

3.6.1.5.5 Family Support Services

Within the City of Abilene, there are churches, chapels, family support centers, skills development centers, libraries, and adult literacy programs (Hendrick Health 2023-TN8973).

3.6.1.5.6 Recreation

Abilene State Park covers 500 ac and has a modern campground and recreational facility. Abilene operates five year-round recreation centers and two public swimming pools seasonally. There are seven golf courses in the area. Texas wildlife is abundant; however, many prime hunting and fishing areas are on private land and require permission to gain access. The Dyess AFB Visitor's Center features displays, videos, interactive computer programs, and handouts on the mission and history of Dyess AFB. The Dyess Linear Air Park is a 1.2 mi long outdoor exhibit showcasing over 30 aircraft (DAFB Undated-TN8770).

3.6.1.5.7 Water Treatment

Taylor County supplies water to community residents using different water systems and well types (ACU 2023-TN8909). There are 13 water utilities in Taylor County in total. The cities of Abilene, Buffalo Gap, Lawn, Merkel, Trent, and Tye provide municipal services. Other areas of Taylor County are mostly served by water supply corporations (PUCT 2023-TN8771). The City of Abilene is the only water utility supplier in Abilene. The wastewater in Taylor County is reclaimed and treated in the areas with access to municipal services (ACU 2023-TN8909).

3.6.1.5.8 Transportation

Within the 5 mi (8 km) vicinity of the SERC site are four major highways (I-20, U.S. Highway 83/84, Texas 322 loop, and Texas Highway 36), one major rail line (Union Pacific Railroad), one minor rail spur (Southern Switching Company Rail Spur), and three airports (Abilene Regional Airport, Abilene Executive Airpark, and Elmdale Airpark) (ACU 2023-TN8909).

The most significant highway near the SERC site is I-20, which runs northwest to southeast nearest the campus, and is one of the primary east–west travel routes across Texas. I-20 is the closest major highway to the proposed MSRR. At its closest point, a 2 mi stretch of I-20 is approximately 1 mi northeast of the site.

Texas State Highway 322 (Jake Roberts Freeway, TX-322 loop) joins I-20 in the northeast part of the city, and U.S. Route 83/84 connects to I-20 to the northwest to encompass a “loop” around Abilene. Texas Highway 36 is a State highway that connects Abilene to the coast of Texas, southwest of Houston, Texas. It enters Abilene southeast of the SERC site, near Abilene Regional Airport.

Table 3-5 below shows the annual average daily traffic (AADT) volume estimates for the four major highways near the SERC site. I-20 and TX-322 loop have a reported AADT of 22,300 and 20,500 respectively. U.S. Route 83/84 and Texas Highway 36 have a reported AADT of 33,876 and 13,311 respectively.

Table 3-5 Annual Average Daily Traffic Volume Estimates for Major Highways Near the SERC Site

Roadway	Location	Annual Average Daily Traffic Volume Estimates
I-20	On the section of highway east of the SERC site	22,300
TX-322 loop	On the southeast side of Abilene	20,500
U.S. Route 83/84	On the southeast side of Abilene, north of the 83/84–TX-322 interchange	33,876
Texas Highway 36	At the intersection with the TX-322 loop	13,311

Source: TXDOT 2022-TN8894.

3.6.2 Environmental Justice

In 1994, the President signed Executive Order 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations” (59 FR 7629 [TN1450]), establishing requirements for each Federal agency to identify and address, as appropriate, the disproportionately high and adverse human health and environmental effects of its programs, policies, and activities on minority and low-income populations. While the Executive Order did not identify specific minorities to be included in EJ assessments, further guidance in 1997 from the CEQ directed Federal agencies to assess the human health and environmental effects of agency actions on six races (CEQ 1997-TN452)—Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, some other race (not mentioned above), and Two or More Races (i.e., multiracial)—and the ethnic populations of Hispanic or Latino (of any race) individuals.

According to the 2020 census, the percentage of minorities (any nonwhite alone [including any Hispanic ethnicity] people) in the Abilene MSA is 37.5 percent, which is significantly lower compared to the Texas State average of 60.3 percent. The largest minority population in the ROI is Hispanic or Latino (23.5 percent of the total population). Table 3-6 summarizes these data.

Table 3-6 Races and Ethnicities for the Region of Influence

Parameter Race or Ethnicity	Taylor County	Jones County	Callahan County	Abilene Metropolitan Statistical Area	Texas
Total Population	143,208	19,663	13,708	176,579	29,145,505
White — Percentage of total population (not Hispanic or Latino)	61.0%	58.4%	84.3%	62.5%	39.7%
Black or African — Percentage of total population (not Hispanic or Latino)	7.7%	10.1%	0.9%	7.4%	11.8%
American Indian and Alaska Native — Percentage of total population (not Hispanic or Latino)	0.4%	0.3%	0.5%	0.4%	0.3%
Asian — Percentage of total population (not Hispanic or Latino)	2.0%	0.6%	0.4%	1.7%	5.4%
Native Hawaiian and Other Pacific Islander — Percentage of total population (not Hispanic or Latino)	0.1%	0.0%	0.1%	0.1%	0.1%
Some other race — Percentage of total population (not Hispanic or Latino)	0.3%	0.2%	0.4%	0.3%	0.4%
Two or more — Percentage of total population (not Hispanic or Latino)	4.3%	2.4%	4.0%	4.0%	3.0%
Total Hispanic or Latino population	34,756	5,504	1,306	41,566	11,441,717
Hispanic or Latino — Percentage of total population	9.5%	28.0%	24.3%	23.5%	39.3%
Total Hispanic, Latino, or Spanish ethnicity of any race population	55,892	8,178	2,153	66,223	17,560,908
Total Hispanic, Latino, or Spanish Ethnicity of any race — Percentage of total population	39.0%	41.6%	15.7%	37.5%	60.3%

Source: USCB 2020-TN8892.

Meanwhile, as shown in Table 3-7, 13.4 percent of the residents of the Abilene MSA reported living below the poverty level. This is slightly lower than that for the State of Texas (USCB 2021-TN8774).

Table 3-7 Poverty status for the Region of Influence

Parameter	Taylor County	Jones County	Callahan County	Abilene Metropolitan Statistical Area	Texas
People living below the poverty level	14.0%	12.4%	9.7%	13.4%	14.0%

Source: USCB 2021-TN8774.

In determining the locations of the minority and/or low-income populations (as defined below), the NRC staff used the Abilene MSA as the geographic area to perform a comparative analysis. The NRC staff compared the percentages of minority and/or low-income populations in each census block group to the average percentages of minority and/or low-income populations within the MSA.

3.6.2.1 Minority Population

According to the USCB's 2020 Census data, there are a total of 146 block groups within the Abilene MSA (including three counties: Taylor, Jones, and Callahan). Within the Abilene MSA, 37.5 percent of the population identifies as minority (USCB 2020-TN8892).

According to the CEQ definition, a minority population exists if the percentage of the minority population of an area (e.g., census block group) exceeds 50 percent or is meaningfully greater than the minority population percentage in the general population. The NRC staff's EJ analysis applied the meaningfully greater threshold in identifying higher concentrations of minority populations; wherein the meaningfully greater threshold is any percentage greater than the minority population within the Abilene MSA. Therefore, census block groups within the Abilene MSA were identified as minority block groups if the percentage of the minority population in the block group exceeded 37.5 percent, the average level within the Abilene MSA.

As shown in Figure 3-3, 74 block groups were identified as minority population block groups within the Abilene MSA. The SERC site is not located in a minority population block group.

3.6.2.2 Low-Income Population

The USCB's 2017–2021 American Community Survey 5-Year Estimates data identify approximately 13.4 percent of individuals residing within the Abilene MSA as living below the Federal poverty threshold (USCB 2021-TN8774).

Census block groups within the Abilene MSA were identified as low-income block groups if the percentage of the low-income population (i.e., below the Federal poverty threshold) in the block group exceeded 13.4 percent, the average level within the Abilene MSA.

As shown in Figure 3-4, 62 block groups were identified as low-income population block groups within the Abilene MSA. The SERC site is located in a low-income block group; thus, any high and adverse health or environmental impacts would be expected to affect a population with EJ concerns. However, noticeable adverse health or environmental impacts are not expected from the proposed action.

3.6.2.3 Environmental Impacts of Construction, Operation, and Decommissioning

3.6.2.3.1 Economic Development

The proposed action would result in a temporary, minor increase in jobs and spending in the area during construction of the MSRR. The workforce estimate during construction is about dozens up to 100 (ACU 2023-TN8909). Minor long-term economic development could possibly result from additional personnel relocating from other areas; however, the impact is expected to be SMALL, with a resulting employment total of 10–20 personnel during the operation of the MSRR. Decommissioning would require an estimated average of 10 or less workers.

3.6.2.3.2 Demographics

There are no long-term expected impacts on the demographics in the ROI. Only approximately 10–20 personnel are anticipated to work at the MSRR, with some being existing employees of ACU and residents of the Abilene area.

3.6.2.3.3 Housing

As presented in Section 3.6.1.4 of this EA, the NRC staff concludes that the combined total of 9,568 vacant housing units in the ROI will be adequate to support the construction workers (up to 100), operation workers (10–20), decommissioning workers (less than 10), and their families. The construction, operation, and decommissioning labor force would not place a burden on the rental/temporary housing.

3.6.2.3.4 Tax Revenues

The tax revenues associated with the construction, operation, and decommissioning of the MSRR would include payroll taxes on wages and the salaries of the construction, operation, and decommissioning workforces, and sales and use taxes on purchases made by the applicant and the construction, operation, and decommissioning workforces. ACU does not pay any property taxes or income taxes as a nonprofit educational institution. ACU does not make any community benefits payments or payments in lieu of taxes. The overall tax revenue implications are relatively small in comparison to the established tax base of the ROI.

3.6.2.3.5 Community Services and Infrastructure

The proposed action would have long-term, minor impacts by increasing the demand on law enforcement, medical services, family support services, recreation, or other special programs. Only minor impacts are expected in Abilene schools because of the small number of personnel that would work at the MSRR, and some of those would include existing ACU employees from within the ROI.

3.6.2.4 Environmental Justice Summary

Since no high and adverse health or environmental impacts would result from the proposed action and no pathways could be identified linking minority or low-income populations with any adverse impacts from the proposed action, the NRC staff concludes that the proposed action would not result in disproportionately high and adverse impacts to minority or low-income populations.

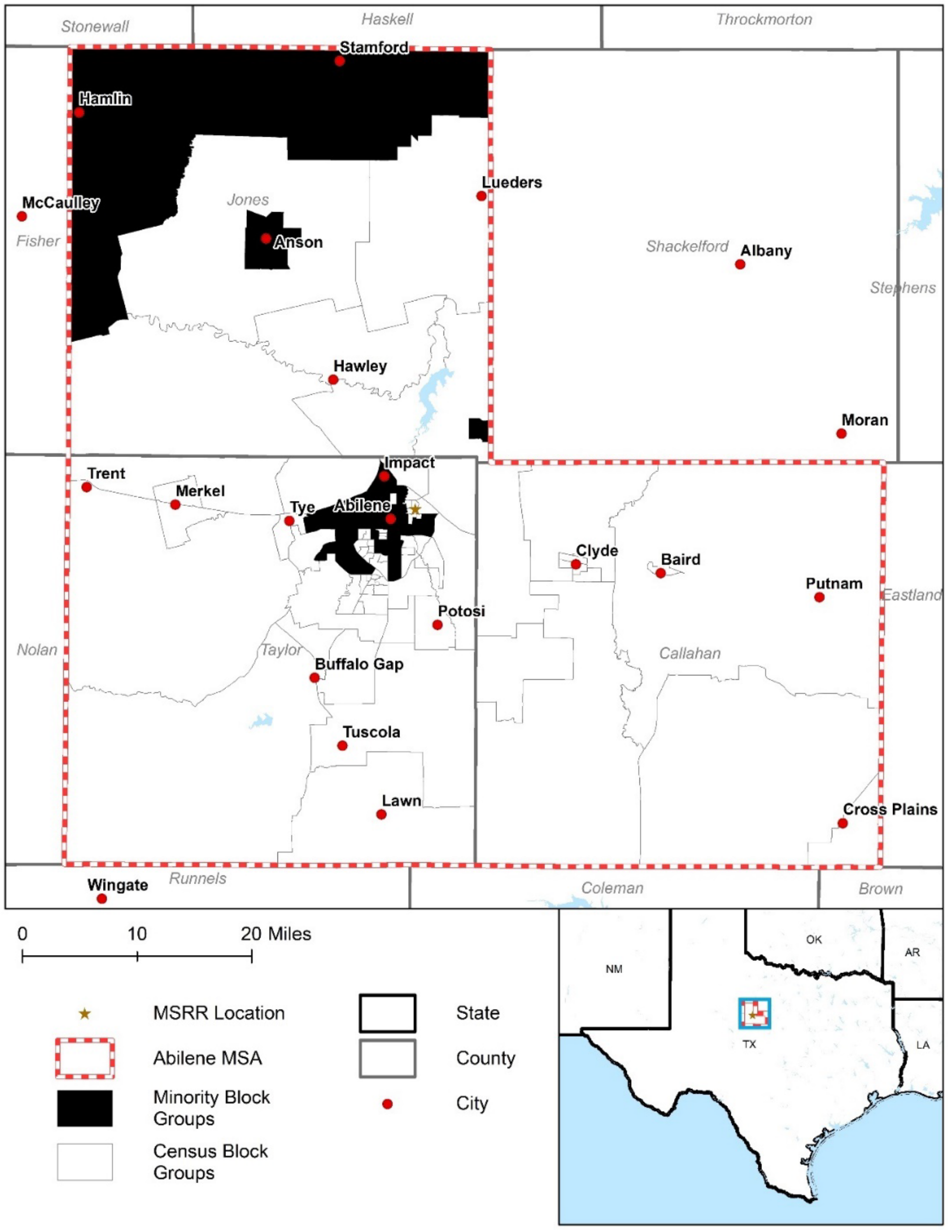

Figure 3-3 Seventy-Four Minority Population Block Groups Identified within the Abilene Metropolitan Statistical Area Compared to the Metropolitan Statistical Area Average Level. Source: USCB 2020-TN8892

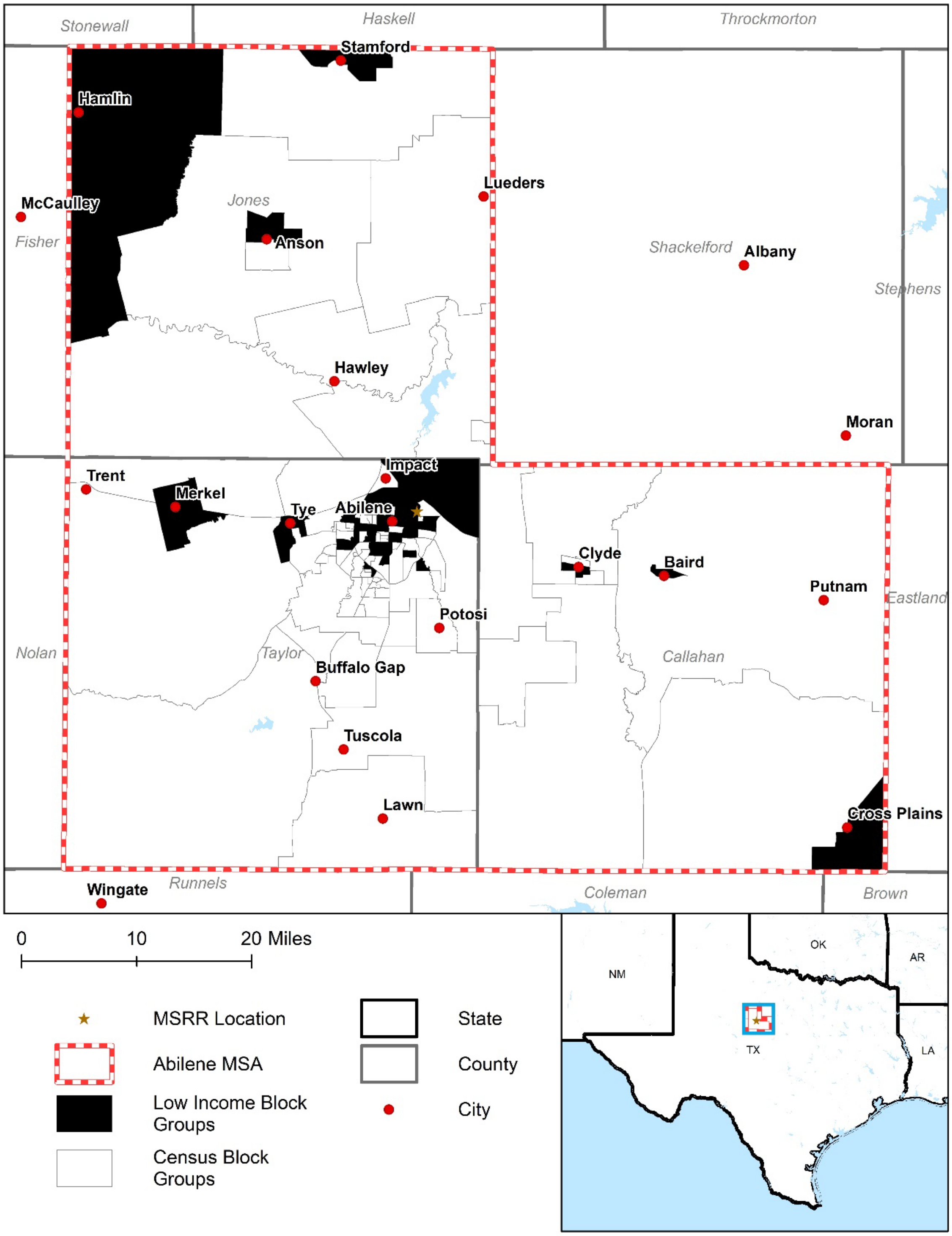

Figure 3-4 Sixty-Two Low-Income Population Block Groups Identified within the Abilene Metropolitan Statistical Area Compared to the Metropolitan Statistical Area Average Level. Source: USCB 2021-TN8993

3.6.3 Cumulative Impacts

Only minor impacts are expected because of the small number of personnel that would work at the MSRR and because the MSRR would be housed in the existing multiuse SERC building built for academic research purposes. The proposed action would not result in disproportionately high and adverse cumulative impacts to minority or low-income populations.

3.6.4 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative socioeconomic impacts of the proposed action would be SMALL because of the small number of personnel needed to construct, operate, and decommission the MSRR and because the MSRR would be housed within the existing SERC building. The NRC staff also concludes that the proposed action would not result in disproportionately high and adverse impacts on minority or low-income populations.

3.7 Human Health

3.7.1 Nonradiological Human Health

The following section of this EA addresses the potential direct, indirect, and cumulative impacts of nonradiological hazards on the health of people working on or near the SERC site as a result of the proposed action, including those caused by physical, electrical, and chemical sources. Nonradiological waste is addressed in Section 3.8 of this EA.

3.7.1.1 Affected Environment

The MSRR would be accommodated within the SERC building on the ACU campus. The SERC building would be operated as a research facility, and the applicant expects that it will experience many of the typical occupational hazards common at other laboratory research facilities (ACU 2023-TN8909 | PSAR Section 19.3.9.9|). The applicant provided a list of chemicals that would be used at the MSRR in Table 19.4-1 of the PSAR. As noted by the applicant, the types of chemicals used at a research laboratory can enter the human body through the skin, by inhalation, or by ingestion and can cause various acute and chronic effects, including cancer (ACU 2023-TN8909 | PSAR Section 19.3.9.8|).

3.7.1.2 Environmental Impacts of Construction, Operation, and Decommissioning

The applicant stated that wastes, discharges, and emissions over the life cycle of the MSRR would be managed in accordance with applicable Federal, State, and local laws and regulations (ACU 2023-TN8909 | PSAR Section 19.4.9.1|). The applicant stated that fuels, oils, solvents, and other nonradiological chemicals necessary to install the MSRR in the SERC building would be present on-site during construction and decommissioning (ACU 2023-TN8909 | PSAR Section 19.4.9.1|). Only small quantities of chemicals such as lubricating oil and cleaning and maintenance chemicals would be present on-site during operations (ACU 2023-TN8909 | PSAR Section 19.4.9.1|). The applicant provided an estimated inventory of chemicals that would be used at the MSRR in Table 19.4-1 of the PSAR. The applicant also acknowledged that there would be physical occupational hazards at the site, as listed in Table 19.4-2 of the PSAR, over the course of the MSRR life cycle, especially during construction and decommissioning (ACU 2023-TN8909 | PSAR Section 19.4.9.1.4|). The applicant would limit the potential for occupational hazards through the implementation of safety practices, training, and physical control measures and adhere to Occupational Safety and Health Administration (OSHA) regulations (ACU 2023-TN8909 │ PSAR Section 19.4.9.1.4|).

3.7.1.3 Cumulative Impacts

Table 19.4-7 of the PSAR identifies other past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts from the MSRR. Normal safety practices and compliance with OSHA regulations would limit the potential for cumulative impacts related to nonradiological health.

3.7.1.4 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative impacts from the proposed action on nonradiological health would be SMALL. The potential for risk from occupational hazards and nonradiological health hazards to people entering in or around the SERC building would be effectively limited by compliance with OSHA regulations and best practices such as training.

3.7.2 Radiological Human Health

3.7.2.1 Affected Environment

As discussed in the land use section of this EA (Section 3.1), the proposed MSRR would be constructed within the SERC building on the ACU campus. As a research reactor, radioactive material will not only be in the Research Bay with the systems and storage pits but also in designated laboratory radiation areas within the SERC building with appropriate access controls and radiological monitoring. With Abilene being a major city in West Texas, local hospitals would provide various medical imaging and nuclear medicine services utilizing radioactive materials. Hendrick Health is Abilene's largest medical imaging provider with two hospitals located in Abilene that provide radiation therapy and nuclear medicine, which could release radioactive material under normal operations. Such nonreactor operations are regulated by the State of Texas being an NRC Agreement State and have a negligible or very low radiological risk to the surrounding population.

Two main sources of natural background radiation exist—the cosmic radiation produced by the collisions of high-energy particles in the upper atmosphere and naturally occurring terrestrial radionuclides in rocks and soils. The cosmic radiation background varies with geomagnetic latitude and elevation; the cosmic radiation dose rate in the region surrounding the ACU campus (elevation 1733 ft [528 m]) averages between 27 and 31 millirems per year (mrem/yr) (ACU 2023-TN8909 and EPA 2023-TN8797). The dose rates from uranium, thorium, potassium, radon, and related natural radionuclides depend on the underlying geology; the terrestrial dose rates in the region surrounding the ACU campus average between 46 and 90 mrem/yr (EPA 2023-TN8797). When combined with the cosmic radiation contribution, direct natural radiation in this area of Texas ranges from 73 to 121 mrem/yr. Therefore, the naturally occurring background radiation dose rates at the ACU campus should be in the anticipated range of 73 to 121 mrem/yr, which is consistent with the United States average of about 100 mrem/yr from direct radiation (NCRP 2009-TN420). The breathing of radon gas typically adds an additional natural background dose of approximately 180 mrem/yr in the State of Texas (EPA 2023-TN8797) for an average total natural background of approximately 301 mrem/yr (3.01 millisieverts [mSv]/yr).

3.7.2.2 Environmental Impacts of Construction

At certain times during construction, ACU or a designated construction contractor would be licensed to receive, possess, and use specific radioactive byproduct, source, and special nuclear material in support of construction and preparations for operation, such as radiography (ACU 2023-TN8909 | PSAR Section 19.4.9.2|). These sources of low-level radiation are required to be controlled by the Radiation Protection Program of the holder of the radioactive material license and have very specific uses under controlled conditions. The controlled conditions would include restricting access to an area when a device using a byproduct sealed source is in use, to prevent radiological exposure of the general construction workforce along with possession controls to the radioactive material. The required radiation protection procedures and monitoring of the radioactive material would ensure that doses to construction workers from such uses of sources of radiation would be well below the annual dose limits for members of the public set forth in 10 CFR 20.1301 (TN283), if not negligible. Therefore, based on the controls required for the use of radioactive devices or radioactive material during construction, the NRC staff concludes that the radiological impacts during construction would not be significant.

3.7.2.3 Environmental Impacts of Operation

This section discusses the estimated annual doses to facility workers and members of the public from the operation of the MSRR along with radiological environmental monitoring over its anticipated 20-year operating period. Based on the design of the MSRR, the expected exposure pathways to members of the public would principally be from radiological gaseous effluent releases. Small quantities, anticipated to be approximately a few liters over the facility lifetime, of liquid radioactive waste are generated as a byproduct of radiochemistry lab operations. The quantities of liquid radioactive waste from radiochemistry laboratory operations involving the fuel salt would be appropriately collected, stored, packaged, and disposed of as described in Section 3.9.2 of this EA. Thus, as a “zero liquid release” facility, there is not an exposure pathway to members of the public from such radiochemistry lab operations, and the only exposure pathway would be by radiological gaseous effluent releases. Sections 19.3.9 and 19.4.9.2 of the PSAR provide information for and discusses an analysis of the potential annual radiation doses to members of the public located nearby from such radiological gaseous effluent releases.

The annual dose limits for members of the public are provided in 10 CFR 20.1301 (TN283), specifically 10 CFR 20.1301(a)(1) (TN283), which limits their dose to 0.1 rem/yr (1 mSv/yr). The Atomic Safety and Licensing Board Panel determined that the limits in 40 CFR 190.10 (TN739)—and hence 10 CFR 20.1301(e) (TN283)—and 10 CFR Part 50, Appendix I (TN249) do not apply to non-light-water reactors (non-LWRs) (ASLB 2007-TN6826). Additionally, these regulations are also specifically applicable to operations associated with the production of electrical power for public use or for light-water-cooled nuclear power reactors. Therefore, because the MSRR is a research reactor and based on molten salt cooling (therefore, a non-LWR), the MSRR would not be subject to the requirement in 10 CFR 20.1301(e) (TN283) to adhere to the applicable environmental radiation standards in 40 CFR 190.10 (TN739) and 10 CFR Part 50, Appendix I (TN249). However, other portions of 10 CFR Part 20 (TN283) apply to any users of radioactive material and are applicable to the MSRR. Regulations such as the dose limits in 10 CFR 20.1301(a) and the as low as is reasonably achievable (ALARA) requirements and regulations for radiation protection programs under 10 CFR 20.1101 (TN283) are applicable to non-LWR and non-power reactor licensees and would ensure that radioactive effluent releases from non-LWRs and non-power reactors remain below applicable regulatory limits.

3.7.2.3.1 Occupational Doses

Dose rate targets will be set to limit the doses to radiation workers to less than 5 rem/yr, even if they worked all 2,000 hrs during a year at the location with the maximum dose rate, and the dose rate at the Research Bay perimeter would be less than 1 mrem/yr to satisfy dose requirements for general public occupancy per 10 CFR Part 20 (ACU 2023-TN9099 | RCI-[RH-7]|). However, the reactor is not expected to operate 24 hrs per day for 7 days per week at full power. Studies have shown that it is relatively straightforward to reduce the dose rate by up to two orders of magnitude by installing additional shielding in relatively limited regions over the Top Plug of the reactor cell. The dose rate will be confirmed by measurement at low power reactor operation and additional shielding may be installed if needed, or other measures will be implemented to guarantee compliance with the requirements of 10 CFR Part 20.

If an OL is issued to ACU, occupational doses to workers will be required to be controlled to the 5 rem annual limit as specified in 10 CFR 20.1201 and incorporate the ALARA provisions of 10 CFR 20.1101 (TN283) to ensure that occupational doses would always be below this limit. At the OL stage, the NRC staff will review the application for new and significant information, if any, that may alter the staff's conclusions made for the CP application.

3.7.2.3.2 Doses from Radiological Gaseous Effluent Releases

Following the guidance in ORNL/TM-2020/1478 (Belles et al. 2020-TN8974) and in NUREG-1537, Part 1, ACU presented an analysis of the radiological protection and human health impacts in PSAR Sections 11.1 and 19.4.9.2, respectively (ACU 2023-TN8909). These sections discuss the various sources of radiation (gaseous, liquid, and solid) and the baseline radiation levels within the MSRR before providing a detailed analysis of off-site doses based on radiological gaseous effluent releases with no anticipated need for holding time to allow for decay. Only a limited amount of radiological liquid effluents would be generated at the MSRR and, as discussed in Section 3.9 of this EA for liquid radiological waste management, these effluents would be disposed of via the ACU campus sewerage per 10 CFR 20.2003 (TN283) with no exposure pathway to nearby residents.

The ACU radiological gaseous effluent release analysis in Section 19.4.9.2.2.2 of the PSAR is based on the application of the CAP88-PC (EPA 2023-TN8798). This program computes radionuclide concentrations in air, rates of deposition on ground surfaces and plants, and concentrations in food. It uses intake rates to people from the ingestion of food produced in the assessment area and the inhalation of airborne radionuclides. Estimates of the radionuclide concentrations in produce, leafy vegetables, milk, and meat consumed by humans are made by coupling the output of the atmospheric transport models with the terrestrial food chain models in NRC Regulatory Guide 1.109 (NRC 1977-TN90). CAP88-PC was selected for use by ACU because of its consideration of the pathways listed in Regulatory Guide 1.109 and has been utilized by other NRC-licensed research reactors and the DOE. Also, the CAP88-PC calculation assumes a local food source grown directly in the path of the effluent plume that could result in the majority of the radiological doses. The ACU analysis is based on meteorological wind rose data from the Abilene Regional Airport located 1 mi from the SERC site (ACU 2023-TN8909).

During its environmental audit of the PSAR the NRC staff examined the input and output files of the CAP88-PC calculations. ACU calculated the gaseous pathway doses to the maximally exposed individual (MEI) at a location with the greatest modeled concentration and deposition from airborne emissions (i.e., 200 m [656 ft.] north). The nearest full-time resident is located approximately 120 m (394 ft.) west of the MSRR. The nearest students are housed in dormitories approximately 125 m (410 ft.) north of the MSRR, outside the site boundary of 100 m (ACU 2023-TN8909 | PSAR Section 19.3.9.1|). The following activities were considered in the CAP88-PC dose calculations: (1) direct radiation from submersion in the gaseous effluent cloud and exposure to particulates deposited on the ground, (2) inhalation of gases and particulates, (3) ingestion of meat from animals eating grass affected by gases and particulates deposited on the ground, and (4) ingestion of foods (e.g., vegetables) affected by gases and particulates deposited on the ground. ACU did not identify any nearby milk production or any agricultural properties within the boundary of the ACU campus. However, since CAP88-PC includes the dose contributions from milk cattle, beef cattle, and agricultural crop areas automatically, the ACU dose calculation is conservative (ACU 2023-TN8909).

ACU's development of the estimated annual radiological effluent releases, reproduced as Table 3-8 of this EA, is based on certain assumptions on the release mechanisms and pathways. First, ACU assumed that any tritium generated in the fuel salt, being able to diffuse through the structural material of the reactor system into the reactor cell, or by air activation in the reactor cell, would eventually be released to the surrounding environment. Second, besides tritium, other elements in air in the reactor cell can become activated. All of the generated tritium and activated air are noted in Table 3-8 of this EA as being completely released to the environment. The other radionuclide releases are estimated as leakage from various points in the reactor system and the reactor enclosure that surrounds the reactor, such as the reactor pump gasket, the piping and welds of the reactor, and the steel reactor enclosure vessel (ACU 2023-TN9099 | RCI-[RH-1]|). While the gases in the reactor enclosure are pumped out by the gas management system (GMS) to assure a negative differential pressure in the enclosure (ACU 2023-TN8909 | PSAR Section 9.6|), ACU assumed that these radionuclides would have an associated leakage rate into the reactor cell. Then, all of the radionuclides in the reactor cell air enclosure would be swept away by the auxiliary heat removal system and the Research Bay heating, ventilation, and air conditioning system to the Research Bay and into a SERC building stack during normal operations (ACU 2023-TN8909 | PSAR Sections 4.4.16 and 9.7|).

Gaseous pathway doses, including a hypothetical ingestion pathway, to the MEI, at the site boundary, and to the nearest full-time resident, as calculated by ACU using CAP88-PC, are as follows:

- MEI (200 m north of the MSRR): 0.493 mrem/yr,
- Site boundary (100 m north of the MSRR): 0.26 mrem/yr, and
- Nearest full-time resident (120 m west of the MSRR): less than 0.1 mrem/yr.

Table 3-8 Anticipated Radioactive Gaseous Effluent Production and Emissions

Nuclide	Production Rate (Curies per second) at 1 Megawatt	Steady-State Emission Rate (Curies per second)	Total Yearly Emissions (Curies per year)
Hydrogen-3 (H-3)	1.75×10^{-5}	1.75×10^{-5}*	2.79×10^{2}
Carbon-14 (C-14)	6.78×10^{-12}	6.78×10^{-12}*	1.07×10^{-4}
Nitrogen-16 (N-16)	1.77×10^{-6}	1.77×10^{-6}*	2.79×10^{1}
Argon-37 (Ar-37)	1.67×10^{-11}	1.67×10^{-11}*	2.63×10^{-4}
Argon-41 (Ar-41)	2.86×10^{-7}	2.86×10^{-7}*	4.51×10^{0}
Krypton-83m (Kr-83m)	4.72×10^{-1}	5.97×10^{-13}	9.42×10^{-6}

Nuclide	Production Rate (Curies per second) at 1 Megawatt	Steady-State Emission Rate (Curies per second)	Total Yearly Emissions (Curies per year)
Krypton-85m (Kr-85m)	4.81×10^{-1}	3.64×10^{-12}	5.74×10^{-5}
Krypton-85 (Kr-85)	6.27×10^{-6}	5.76×10^{-11}	9.08×10^{-4}
Krypton-87 (Kr-87)	3.27×10^{0}	2.00×10^{-12}	3.15×10^{-5}
Krypton-88 (Kr-88)	1.99×10^{0}	6.06×10^{-12}	9.56×10^{-5}
Xenon-131m (Xe-131m)	1.91×10^{-4}	8.86×10^{-12}	1.40×10^{-4}
Xenon-133m (Xe-133m)	2.00×10^{-3}	7.14×10^{-12}	1.13×10^{-4}
Xenon-133 (Xe-133)	8.60×10^{-2}	1.00×10^{-9}	1.58×10^{-2}
Xenon-135m (Xe-135m)	5.04×10^{0}	1.50×10^{-12}	2.37×10^{-5}
Xenon-135 (Xe-135)	1.12×10^{0}	9.15×10^{-11}	1.44×10^{-3}
Xenon-138 (Xe-138)	4.30×10^{1}	8.98×10^{-13}	1.42×10^{-5}
Iodine-130 (I-130)	5.11×10^{-5}	2.92×10^{-15}	4.61×10^{-8}
Iodine-131 (I-131)	2.40×10^{-2}	2.92×10^{-10}	4.60×10^{-3}
Iodine-132m (I-132m)	1.10×10^{-2}	7.99×10^{-15}	1.26×10^{-7}
Iodine-132 (I-132)	3.03×10^{0}	6.02×10^{-12}	9.50×10^{-5}
Iodine-133 (I-133)	5.17×10^{-1}	8.33×10^{-11}	1.31×10^{-3}
Iodine-134 (I-134)	1.44×10^{1}	4.17×10^{-12}	6.57×10^{-5}
Iodine-135 (I-135)	1.54×10^{0}	2.50×10^{-11}	3.95×10^{-4}

Source: PSAR Table 19.4-4 (ACU 2023-TN8909).
* Emission where the nuclide is assumed to immediately escape into the environment.

ACU stated in PSAR Section 11.1.2 that a Radiation Protection Program will be created for the MSRR, as required by 10 CFR 20.1101 (TN283). Therefore, the total body and organ dose estimates for the MEI from gaseous effluents at the MSRR would not exceed the 10 CFR 20.1101(d) constraint, which is a total effective dose equivalent (TEDE) of 10 mrem (0.1 mSv) per year and the 10 CFR 20.1301(a)(1) TEDE limit of 100 mrem (1 mSv) per year (10 CFR Part 20-TN283). The TEDE annual doses from all gaseous radiological effluent release locations is estimated to be 0.493 mrem (4.93×10^{-3} mSv) per year. The MSRR itself would be in a heavily shielded area within the SERC Research Bay and below grade in the Systems Pit and enclosed in the reactor cell such that direct radiation dose rates in the vicinity are expected to be generally undetectable and less than 1 mrem/yr. For this EA, the NRC staff completed an independent evaluation of ACU's CAP88-PC calculations by reviewing the inputs and subsequent results and found that they were adequate. As indicated above, the resulting annual doses are in compliance with 10 CFR Part 20, Subparts B and D (TN283) for annual doses and a very small fraction of the annual natural background radiation exposure level of approximately 301 mrem/yr.

3.7.2.3.3 Radiological Environmental Monitoring

ACU discussed radiological environmental monitoring in accordance with 10 CFR 20.1302 (TN283) in PSAR Sections 11.1.7 and 19.4.9.3 to demonstrate compliance with the dose limits for individual members of the public in 10 CFR 20.1301 (ACU 2023-TN8909). ACU would implement a radiological environmental monitoring program to perform the necessary monitoring for assessing the following exposure pathways—direct radiation, airborne, waterborne, and ingestion. Monitoring sites would be determined prior to operation for on-site, site perimeter, and off-site locations (ACU 2023-TN8909).

In the SERC building, there would be area radiation monitors alongside a continuous air monitoring system in the Research Bay, reactor cell, reactor cell air outlet, fuel handling system (FHS) enclosure, primary heat removal system enclosure, helium GMS enclosure, and the radiochemistry laboratories. While the stack airway intake has a continuous air monitoring system, it does not have an area radiation monitor, as it is not accessible. Additionally, ACU would support State monitoring requirements and expects that thermoluminescent dosimeters would be placed at the MSRR fence line, as is done at other nuclear facilities within the State of Texas (ACU 2023-TN9099 | RCI-[RH-8]|). ACU would also have exterior thermoluminescent dosimeters, stack detection capabilities, and periodic exterior building surveys to cover the primary exposure pathways of concern, such as exposure to airborne radionuclides and streaming paths from within the SERC building structures (such as the reactor cell).

The NRC staff will review the finalized monitoring locations and other monitoring requirements provided with any OL application. During the OL application phase, the NRC staff will determine whether the operational radiological environmental monitoring program will be adequate for the evaluation of environmental impacts related to the operation of the MSRR. The NRC staff will also review the application for new and significant information, if any, that may alter the staff's conclusions made for the CP application.

3.7.2.3.4 Conclusions

The NRC staff performed an independent review of the radiological gaseous effluent releases and finds that the expected annual doses to members of the public as previously described are well below the appropriate dose limits specified in 10 CFR Part 20 (10 CFR Part 20-TN283). Additionally, at the OL stage, the NRC staff will perform an independent safety review of ACU's plans for exposure control and radiological effluent monitoring and its compliance with the applicable regulatory requirements of 10 CFR Part 20, such as 10 CFR 20.1301 (10 CFR Part 20-TN283). The NRC staff's independent safety review will be documented in a Safety Evaluation Report. Based upon the above discussion and the NRC staff's completion of a thorough independent safety review and an evaluation of the applicant's information that states that ACU will comply with applicable requirements, the staff concludes that the environmental impacts from radiological gaseous effluent releases would not be significant, and that further mitigation would not be warranted.

3.7.2.4 Environmental Impacts of Decommissioning

Upon cessation of operations, all radioactive material would be transferred to various types of storage containers based on the type of material (e.g., molten salts, LLRW, and radioactive material from decontamination operations) and shipped to a licensed disposal site such as the WCS LLRW disposal site or, in the case of the fuel and coolant salts, to DOE facilities. While some trace amounts of tritium could be expected to diffuse out of such storage containers, monitoring of the radiation area would continue to ensure the SAFSTOR of the radioactive material until it is removed from the site or placed in a specifically designed and certified dry cask storage system, if necessary. The NRC Decommissioning Generic Environmental Impact Statement (GEIS), NUREG-0586, Supplement 1, "Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities Regarding the Decommissioning of Nuclear Power Reactors," discusses the expected radiological impacts that could occur during the decommissioning of a large LWR (a 1,130 MWe pressurized-water reactor or 1,100 MWe boiling-water reactor), including the appropriate practices to minimize radiological exposure to workers, and found that the impacts would be small and that no additional mitigation measures are likely to be sufficiently beneficial or warranted (NRC 2002-TN7254). The thermal power level of the MSRR is a small fraction of a large LWR (1 MWt versus approximately 3,300 MWt for a typical LWR) and would have a proportionally small fraction of the radiological impacts discussed in the Decommissioning GEIS (e.g., from having a significantly smaller decommissioning workforce). Additionally, only the MSRR systems, structures, and components in the research pit; the material also in the storage pit; and potentially MSRR-specific laboratory equipment would undergo decommissioning. The rest of the SERC building would remain for future research efforts, including the decontaminated research and storage pits. Based on the small size of the MSRR and the limited quantity of decommissioning material and based on the radiological impact controls, the radiological decommissioning impacts discussed in the Decommissioning GEIS would bound the MSRR decommissioning impacts. Therefore, the NRC staff concludes that the radiological environmental impacts of the MSRR during decommissioning would be negligible.

3.7.2.5 Cumulative Impacts

Table 19.4-7 of the PSAR identifies past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts of the proposed action (ACU 2023-TN8909). In addition to impacts from the construction, operation, and decommissioning of the MSRR, this cumulative analysis also considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative radiological impacts. For the purposes of this analysis, the geographic area of interest is the area within a 5 mi radius of the SERC site. The NRC staff finds this metric to be acceptable because the NRC has historically used a 5 mi radius as a standard bounding geographic area to evaluate population doses from routine releases from research reactors.

Hendrick Health operates two hospitals in Abilene that provide imaging services to patients to include radiation therapy and nuclear medicine. The Hendrick Medical Center is approximately 2 mi southwest of the SERC site, and Hendrick Medical Center South is outside the 5 mi radius at 10 mi from the SERC site. These facilities have the potential to contribute to cumulative radiation exposures in conjunction with the MSRR. However, given the small radiological doses from the MSRR and the fact that the radiation doses from the facilities in the affected environment discussed above in this section have been shown to be low, the NRC staff concludes that there would not be a noticeable increase in the cumulative radiological impacts of the above facilities because of the construction, operation, and decommissioning of the MSRR for the geographic area of interest.

3.7.2.6 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative radiological human health impacts of the proposed action during construction, operation, and decommissioning, along with the cumulative impacts, would be SMALL. This conclusion is based primarily on the fact that the proposed MSRR is estimated to have radiological effluent releases well below the NRC requirements for potential doses to members of the public (e.g., the nearest resident) with appropriate radiological environmental monitoring, occupational doses would be less than annual dose limits under 10 CFR Part 20 (TN283), and the quantity of decommissioning materials would be a small fraction of what would result from decommissioning an LWR.

3.8 Nonradiological Waste Management

3.8.1 Affected Environment

The MSRR would be installed within the SERC building on the ACU campus in the City of Abilene, Texas. The SERC building is an existing, large multidisciplinary research and educational facility. The SERC building contains several laboratory spaces, classrooms, office spaces, and a large Research Bay. The MSRR would comprise the Research Bay and associated heating, ventilation, and air conditioning systems; an electrical power supply; a control room; and a radiochemistry lab.

A detailed description of the SERC site and its surrounding vicinity is provided in Section 3.1 of this EA. Figure 19.3-1 of the PSAR provides a map detailing the main land use categories within a 5-mi radius of the site, which includes the ACU campus, residential neighborhoods, open fields, and agricultural areas. Areas with a special land use or mineral resources are not affected by the construction, operation, and decommissioning of the MSRR (ACU 2023-TN8909). Nearby military installations include Dyess AFB, which is approximately 12 mi away. Prior to the construction of the SERC building, the site consisted of well-manicured, grassy fields used for sports activities (ACU 2023-TN8909). Since the MSRR will be housed within a multipurpose science and engineering research laboratory, the applicant indicated that the presence of nonradioactive chemicals is anticipated. Chemicals associated with non-MSRR laboratory activities are not addressed by this EA.

The management of nonradiological solid, liquid, gaseous, and hazardous waste streams associated with the construction, operation, and decommissioning of the MSRR are addressed in the following subsections. The management of radiological waste is discussed in Section 3.9 of this EA. Hydrogeology and water resources are addressed in Section 3.3 of this EA, air quality is addressed in Section 3.2 of this EA, and human health is addressed in Section 3.7 of this EA.

3.8.2 Environmental Impacts of Construction

The applicant anticipates nonradiological waste generation from normal, planned construction activities (ACU 2023-TN8909). The applicant identified the anticipated nonradiological solid wastes in Sections 19.2.5.2 and 19.4.10.1 of the ER. Examples of such wastes include, but are not limited to, the following: scrap lumber, bricks, sandblast grit, glass, wiring, non-asbestos insulation, scrap metal, concrete with reinforcing steel, nails, wood, electrical wiring, rebar, concrete, rubble, packaging, paper, used personal protective equipment, air filters, expired lights and fixture, hoses, empty plastic containers, and expired ink cartridges. Waste items such as scrap metal, batteries, mercury-containing equipment and bulbs, and used oil are collected, stored temporarily, and then recycled or recovered at an appropriate off-site permitted recycling or recovery facility.

Nonradiological liquid wastes including lubricating oil, hydraulic oil, and grease are also anticipated during construction for assembling various pieces of equipment and systems. The applicant stated that only small amounts of hazardous waste (e.g., acids and degreasers) are anticipated to be generated during construction. No radioactive waste is anticipated.

Construction activities create dust and other emissions such as vehicle exhaust, but impacts are expected to be minor, localized, and short-term (ACU 2023-TN8909).

3.8.3 Environmental Impacts of Operation

Throughout the operational phase of the MSRR, it is anticipated that a variety of nonradiological solid wastes will be generated. In addition to some of the waste examples identified in Section 3.8.2 of this EA that would also be anticipated during operations, this includes municipal solid waste consisting of food and food product packaging waste, paper waste and other general office supply waste, and industrial supply waste. Nonradiological solid wastes are collected and stored temporarily on-site prior to disposal or recycling at an appropriate local off-site facility (ACU 2023-TN8909).

The primary liquid wastes include sanitary wastes that are discharged to the City of Abilene Water Reclamation Facility (ACU 2023-TN8909). The applicant stated that insignificant volumes of nonradioactive liquid chemical wastes would be generated during operations, including hazardous waste, such as certain chemicals. During the operation of the MSRR, routine facility maintenance activities and routine laboratory analytical procedures will result in releases of small amounts of nonradioactive chemicals into the city sewer system. All releases must comply with acceptance requirements for the City of Abilene wastewater treatment facility. The applicant stated that administrative controls are in place to ensure that the nonradioactive effluents of the MSRR meet requirements to be considered acceptable by the City of Abilene wastewater treatment facility (ACU 2023-TN8909). In addition, the applicant stated that there is waste associated with the purification of reactor coolant salts. This purification results in an aqueous solution of sodium hydroxide, a universal indicator, and sodium fluoride resulting from the neutralization of hydrofluoric acid. Additionally, there is liquid waste from laboratory chemical analyses. Chemical waste is bottled and disposed of using a chemical waste disposal contractor in accordance with the ACU Chemical Hygiene Plan (ACU 2023-TN8909).

In Section 19.4.10.2 of the ER, the applicant stated that no significant sources of hazardous waste are expected during facility operations. However, any hazardous wastes will be managed in accordance with a written waste management plan that conforms to State and Federal regulations regarding the storage and disposal of hazardous waste. SERC location(s) designated as a hazardous waste accumulation area(s) will be identified in the waste management plan (HRP 2022-TN9073 and ACU 2023-TN8909). Because of the small quantities generated by ACU as a whole, ACU is currently identified and operating as a Conditionally Exempt Small Quantity Generator of hazardous waste and a Small Quantity Handler of Universal Waste. ACU's documented waste management program identifies compliance with the following Federal and State requirements (HRP 2022-TN9073):

- Code of Federal Regulations, Title 40, Protection of Environment, Subchapter I, Solid Wastes
- Texas Commission of Environmental Quality, Administrative Code Title 30, Part 1, Chapter 335, Industrial Solid Waste and Municipal Hazardous Waste, Subchapter C, Standards Applicable to Generators of Hazardous Waste, which also references the adoption of 40 CFR Parts 260–268, with few exceptions and changes.

During operations, the generation of gaseous effluents resulting from process operations and ventilation of operating areas is anticipated. The applicant stated that these activities result in very low levels of gaseous pollutants and particulates released from the facility into the air (ACU 2023-TN8909). Effluent from the reactor off-gas system is mixed with room air and ventilated through a stack to the roof with only small concentrations of active species expected in that stream. This effluent is monitored prior to release (ACU 2023-TN8909). The nonradioactive gaseous waste produced as a result of MSRR operations does not require a separate TCEQ permit or registration (ACU 2023-TN8909).

3.8.4 Environmental Impacts of Decommissioning

The applicant anticipates that nonradiological solid waste, liquid waste, and air emissions generated during decommissioning activities will be similar to wastes generated during construction and limited operations activities, as described in the above sections.

3.8.5 Cumulative Impacts

Table 19.4-7 of the PSAR identifies other past, present, and reasonably foreseeable future projects and other actions considered in the cumulative effects analysis. These projects include ongoing construction and operational effort with small impacts to waste management associated with the MSRR. Because of its relatively small size and operating staff, the potential waste impacts from the construction, operation, and decommissioning of the MSRR are not expected to substantially contribute to waste impacts in the area (ACU 2023-TN8909).

3.8.6 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative nonradiological waste impacts from the construction, operation, and decommissioning of the MSRR would be SMALL. This conclusion is based on the limited quantities of waste expected and the applicant's established waste management program.

3.9 Uranium Fuel Cycle and Radiological Waste Management

3.9.1 Uranium Fuel Cycle

As presented in 10 CFR 51.51(a) (TN250), a light-water-cooled nuclear power reactor can use Table S-3 as the basis for uranium fuel cycle environmental effects. While the MSRR is not a light-water-cooled nuclear power reactor, ACU will rely upon obtaining uranium from the DOE, which originally relied upon portions of the same uranium fuel cycle addressed by Table S-3. Thus, this section presents the MSRR's contribution to the environmental effects of the current uranium fuel cycle with respect to Table S-3. There are no impacts from the construction of the MSRR related to the uranium fuel cycle.

The License Renewal (LR) GEIS, NUREG-1437, Revision 1, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants," in Section 4.12.1.1, "Uranium Fuel Cycle," describes the current state of the uranium fuel cycle for the current nuclear fleet and is incorporated by reference in this EA (NRC 2013-TN2654). The LR GEIS denotes several technological changes in the various fuel cycle operations that reduce the uranium fuel cycle impacts shown in Table S-3, such as: in situ mining of uranium rather than open pit or deep mining; use of more efficient isotopic enrichment processes through the gaseous centrifuge process rather than the energy-intensive gaseous diffusion process; and less use of coal-powered electrical generation.

Two aspects of the front end of the uranium fuel cycle are different for the MSRR. First, the MSRR is designed to use a maximum enrichment of 19.75 weight percent (wt%) uranium-235 (U-235) (ACU 2023-TN8909 | PSAR Section 4.2.1.1 and 19.2.2|). Uranium enriched to this level is known as high-assay low-enriched uranium or HALEU. Additionally, ACU has indicated that the HALEU fuel will be owned by the U.S. government and loaned to ACU by the DOE (ACU 2023-TN8909 | PSAR Section 1.2.3.2, RCI-[FC-1]|). ACU is expecting to need no more than approximately 500 kilograms (kg) (1102 pounds [lb]) of uranium tetrafluoride (UF_4) (ACU 2023-TN8909 | PSAR Section 1.2.3.2, PSAR Table 19.4-1, RCI-[FC-1]|) compared to an average of 20 to 33 metric tons of uranium per year (MTU/yr) for current LWRs. Thus, due to the much lower quantity of uranium needed, the impacts from uranium recovery and uranium conversion would be much less than the impacts presented in WASH-1248, "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants" (AEC 1974-TN23), and Table S-3 would be bounding. The NRC staff notes that the DOE is supporting efforts regarding the availability of HALEU for civilian domestic research, development, demonstration, and commercial use in the United States to prevent reliance on foreign suppliers to fuel the next generation of nuclear power reactors (86 FR 71055-TN7945).

The second aspect of the front end of the uranium fuel cycle that is different for the MSRR concerns the MSRR fuel type, which is liquid fuel, a type of fuel that is not used in large LWRs. The manufacturing process for this liquid fuel involves two components to be provided by a DOE facility or with a commercial company contracted by the DOE, such as BWX Technologies, Inc. (BWXT) or Centrus Energy Corp. (Centrus), to produce the HALEU (BWXT 2023-TN8895, DOE 2022-TN8896). First, the molten salt is in the form of lithium-fluorine and beryllium-fluorine salts, known as FLiBe, where the molten salt is 67.2 percent lithium fluoride (LiF) and 27.8 percent beryllium fluoride (BeF_2). ACU expects that the DOE would be able to provide approximately 2,400 kg of FLiBe for use as fuel and coolant salts with the lithium in the fuel salt being enriched to greater than 99.99 percent lithium-7 (Li-7) (ACU 2023-TN8909 | PSAR Section 1.2.3.2|). Second, as mentioned above, the HALEU to be used in the MSRR would be in the form of UF_4 and anticipated to be approximately 19.75 wt% U-235. ACU expects approximately 500 kg of UF_4 would be obtained through the HALEU supply being developed by the DOE (ACU 2023-TN8909 | PSAR Section 1.2.3.2|). Once both materials are brought on-site as either separate materials or already combined, the HALEU UF_4 would be dissolved in the fuel salt for a nominal fuel salt composition of 95 percent FLiBe (approximately 67 percent LiF and 28 percent BeF_2) and 5 precent HALEU UF_4 (ACU 2023-TN8909 | PSAR Section 4.1, Section 1.2.3.2|). ACU is expecting the liquid fuel salt to be a thoroughly mixed combination of approximately 550 liters (L) of the fuel salt within the reactor system with approximately 500 L in the reactor loop and approximately 50 L in the drain tank (ACU 2023-TN8909 | PSAR Section 1.2.3.2; Section 4.2.1.1|). Additional HALEU UF_4 salt would be added in small incremental loadings as necessary to compensate for the depletion of fissile material during operation based on the reactor's power history (ACU 2023-TN8909 | PSAR Section 5.4|). Because of the difference in chemical processes for liquid fuel fabrication from the chemical processes described in Appendix E of WASH-1248 (AEC 1974-TN23), the ACU liquid fuel manufacturing would have fewer impacts since the process of mixing the uranium and FLiBe salts together is simpler for off-site manufacturing and involves significantly less uranium. Specifically, the MSRR would implicate a one-time amount of approximately 500 kg of UF_4 (ACU 2023-TN8909 | PSAR Table 19.4-1|) versus the annual fuel fabrication of 900 MTU/yr of low-enriched uranium for LWRs, as assessed in Appendix E of WASH-1248 (AEC 1974-TN23). Thus, the liquid fuel fabrication process associated with the MSRR would have fewer impacts than a more traditional LWR fuel fabrication process and Table S-3 would also be bounding for the MSRR's liquid fuel fabrication.

ACU has no plans for reprocessing the cooled and solidified spent liquid fuel and would store this radioactive material on site upon cessation of 20 years of operation until final removal and disposition by the DOE (ACU 2023-TN8909 | PSAR Section 19.4.10.2|). ACU would have enough spent liquid fuel storage capacity within the MSRR Drain Tank at the lowest point in the reactor system along with two fresh fuel tanks and two effluent tanks as part of the FHS [ACU 2023-TN8909 | PSAR Section 9.2 and Figure 9.2-1|) within the Research Bay to support the radioactive material from 20 years of licensed reactor operation (ACU 2023-TN8909 | PSAR Section 9.2|). The NRC staff notes that the requirements in 10 CFR Part 72 (10 CFR Part 72-TN4884), “Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Wastes, and Reactor-Related Greater Than Class C Waste,” do not apply to non-power reactor spent fuel. However, in accordance with the Nuclear Waste Policy Act of 1982, ACU has initiated good faith negotiations with the DOE on a contract for the disposition of high-level waste and nuclear fuel (ACU 2023-TN9078). Depending on other nuclear industry and DOE actions in the future, the DOE could have the spent liquid fuel transported off site for processing and subsequent reuse, interim storage, or disposal as determined by the DOE.

ACU stated in PSAR Section 19.4.10.2 that storage systems associated with the continued storage of liquid fuel would be bounded by the environmental impacts for continued storage of LWRs described in NUREG-2157, “Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel” (ACU 2023-TN8909 | Section 19.4.10.2|). The NRC staff notes that NUREG-2157 evaluates the continued storage of commercial spent fuel and advanced reactors like the MSRR are not within the scope of this GEIS (NRC 2014-TN4117). However, the spent liquid fuel from the Molten Salt Reactor Experiment (MSRE) has been stored at Oak Ridge National Laboratory (ORNL) for several decades since the MSRE ceased operations in December 1969 (McMillan 2019-TN8960). During the time that the MSRE’s spent liquid fuel has been safely stored at ORNL, a series of remediation steps have been taken to maintain the spent liquid fuel in a safe configuration and to address radiolysis of the fluoride salts that could result in the formation of fluorine gas (F_2) and uranium hexafluoride (UF_6) (DOE 1998-TN8904, DOE 2006-TN8906, DOE 2013-TN9076). The MSRR spent fuel salt can be maintained safely in a similar manner as ORNL’s long-term storage of spent liquid fuel and disposition options, for example, as presented in DOE/OR/01-2496&D1, “Engineering Evaluation of Options for Molten Salt Reactor Experiment Defueled Coolant Salts, Oak Ridge, Tennessee” (DOE 2010-TN8907). The MSRR spent liquid fuel storage environmental impacts after cessation of operations would be bounded by or similar to the documented impacts for spent MSRE fuel at the ORNL site. While the radionuclides in either LWR or MSRR spent fuel would be similar, the material and the long-term MSRR spent fuel management are different from the long-term management of LWR spent fuel as discussed in NUREG-2157. For example, by using the FHS for long-term storage, the impacts related to building and operating an independent spent fuel storage installation on or offsite after cessation of operations are avoided. Additionally, the amount of MSRR spent liquid fuel is significantly less than the amount of LWR spent fuel assessed in NUREG-2157 (1.6 MT of MSRR spent liquid fuel versus 1,600 MTU of on-site spent fuel and 40,000 MTU at an away-from-reactor independent spent fuel storage installation in NUREG-2157). Therefore, while NUREG-2157 specifically does not address molten salt reactors, the environmental impacts from the long-term MSRR spent fuel management based on the MSRE long-term storage would be less than the environmental impacts provided in NUREG-2157.

3.9.2 Radiological Waste Management

Gaseous, liquid, and solid radioactive waste management systems would be used for the collection, processing, packaging, and storage of the radioactive materials produced as byproducts during the operation and decommissioning of the MSRR. Waste processing systems would be designed to meet the design objectives of 10 CFR Part 50 (TN249) and 10 CFR Part 20 (TN283). There are no impacts from the construction of the MSRR related to radiological waste management.

ACU described aspects of radiological waste management in various PSAR sections as follows (ACU 2023-TN8909 | PSAR|):

- Section 19.4.9.2, "Radiological Impacts," discusses the sources and management of gaseous, liquid, and solid radioactive wastes along with related human health impacts (e.g., gaseous effluent releases);
- Section 19.2.5, "Waste Systems," and Section 19.4.10, "Waste Management," discuss ACU's radiological waste management; and
- Section 11.2, "Radioactive Waste Management," provides additional information regarding the MSRR waste systems to collect, process, store, and appropriately address the handling of the radioactive waste.

Regarding a gaseous radioactive waste system, PSAR Table 19.4-4 lists the estimated types and quantities of gaseous effluent radioactive wastes to be generated and released to the environment (ACU 2023-TN8909 | PSAR Table 19.4-4|).

Radioactive wastes from NEXT Laboratory academic research activities involving the MSRR can be difficult to quantify at this stage of MSRR development due to the variable and irregular research activities yet to be fully developed. Based on existing university research reactors that engage in radiochemical research and linearly extrapolating from such activities at the Texas A&M University and the University of Texas, it is anticipated that over 20 years, research activities at the MSRR will produce approximately 100 L (26 gal), or 5 liters per year (L/yr) (1.3 gal per year) of liquid waste and approximately 1,200 L (317 gal or approximately 60 L per year [16 gal per year]) of solid waste in the form of contaminated reagents/aliquots, beakers and glassware, resins used in radiochemical separations, gloves, Tyvek, and other miscellaneous radiological laboratory waste. These wastes will most likely be Class A LLRW easily suited for commercial disposal.

Operational wastes from direct MSRR activities, such as managing salt chemistry health, are harder to predict at this stage of MSRR development (ACU 2023-TN9099 | RCI-[WM-1]|). Once initial operations have begun, there is no need for FLiBe replenishment. The approximately 1100 kg of FLiBe fuel salt present at the beginning of operations will remain throughout the life of the reactor (ACU 2023-TN9099 | RCI-[WM-2]|). During operations, the depletion of UF_4 will require the addition of small amounts of HALEU UF_4. This UF_4 will likely be added as small slugs. The final design is yet to be determined. Before initial operations, the FHS will receive the salt from the DOE. After cleaning and purification of the reactor system and the salt, the salt will be transferred to the reactor system. Occasionally during operations (less than once per year), the fueled salt will be transferred from the reactor system to the storage system. These operations will not need the addition of fresh salt.

Current estimates consider a sampling run of 5 samples at 0.1 g per sample and 3 dissolutions per sample into 25 mL of solution per dissolution. The dissolved solid samples are in an acidic, aqueous solution prior to their neutralization and/or concretion, but, in short, each salt sampling run demanded by the technical specifications would yield a total of 375 mL of radioactive waste per sampling run. These radioactive wastes are expected to be below the concentration limits of 10 CFR 61.55 (TN252) for near surface disposal, especially regarding transuranic nuclide concentration levels after neutralization and potential concretion. The radioactive waste management plan will be explicitly included in the ALARA program. ACU intends that the internal reviews of the waste management plan will also include provisions to keep waste volumes and activities to a minimum (ACU 2023-TN9099 | RCI-[WM-1]|).

Radiological and hazardous materials will be managed in accordance with both facility-level procedures, applicable radiation work permits, and the radioactive waste management plan to be detailed in the FSAR, while mixed/purely hazardous materials will also be managed under ACU's "Chemical Hygiene Plan" and "Waste Management Plan" (HRP 2022-TN9077, HRP 2022-TN9073). The WCS LLRW disposal site is suited to accept Class A, B, and C LLRW. ACU anticipates that almost all LLRW that is generated, including structural materials diffused with tritium, and not deemed scientifically useful will be disposed of at the WCS LLRW disposal site (ACU 2023-TN9099 | RCI-[WM-4]|).

3.9.2.1 Liquid Radiological Waste

Because the MSRR design does not depend on water cooling in any of the engineering systems, only small quantities, anticipated to be approximately a few liters over the facility lifetime, of liquid radioactive waste would be generated as a byproduct of radiochemistry laboratory operations (ACU 2023-TN8909 | PSAR Section 19.4.9.2.3|). ACU's intent is to have a "zero liquid release" facility (ACU 2023-TN9099 | RCI-[WM-3]|). Liquid waste accumulation will be formed in accordance with ACU's status as a Conditionally Exempt Small Quantity Generator. It is likely that the generated waste will be quickly neutralized into regular aqueous radioactive waste rather than mixed waste in order to ensure compliance with accumulation times (ACU 2023-TN9099 | RCI-[WM1]|). Any radioactive liquid from any part of the facility would be collected in a separate piping/collection system for disposal processing. Disposal would involve placing the liquid radioactive waste into approved transport packaging for removal by a commercial waste broker for shipment to the WCS LLRW disposal site or using evaporation/absorption to remove the liquid and only have solid or gaseous radioactive waste streams placed into approved transport packaging for removal and disposal at the WCS LLRW disposal site by a waste broker (ACU 2023-TN9099 | RCI-[WM-3]|).

Based in part on the expected research activities, the quantity and radiological content are expected to be low enough such that this liquid radiological waste stream could be managed as LLRW. Liquid waste accumulation will be performed in accordance with ACU's status as a Conditionally Exempt Small Quantity Generator. It is likely that the generated liquid radiological waste will be quickly neutralized into regular aqueous radioactive waste rather than mixed waste in order to ensure compliance with accumulation times (ACU 2023-TN9099 | RCI-[WM-1]|). Because of the low quantity of the expected liquid radiological waste stream, the management of this radiological waste stream would be performed within the limits in 10 CFR Part 20 (TN283) and the environmental impacts would be negligible.

3.9.2.2 Solid Radiological Waste

The solid radiological waste system would manage typical nuclear research facility operational wastes, originating as dry or wet wastes. The waste stream would be from the following activities (ACU 2023-TN8909 | PSAR Section 11.2.2; PSAR Section 19.4.10.2|): reactor operations; experiment byproducts (e.g., material coupons); laboratory activities (e.g., gloves, pipette tips); maintenance activities (e.g., replacing absorbing media such as off-gas charcoal, ion exchange resins, and air filters); and decontamination activities.

The collection of solid waste would be performed using specially marked and labeled trash cans and with marked and labeled liners for hot waste. Once a bag is full, the bag would be transferred to the storage pit with a capacity of eight 55-gal waste drums (ACU 2023-TN9099 | RCI-[WM-1]|). Solid radioactive waste would be packaged to be stored temporarily on site in a designated cell in the Research Bay for eventual shipping to an LLRW disposal site or to a DOE facility (ACU 2023-TN8909 | PSAR Section 11.2.2|). The estimated annual amount of solid radioactive waste expected to be generated by MSRR operations is approximately 10 L (0.35 cubic feet [ft^3]) annually (ACU 2023-TN9099 | RCI-[WM-1]|), suitable for disposal at a commercial LLRW disposal site. This amount of solid radioactive waste would be much less than the LLRW volume generated by an operational nuclear power plant, which is on average approximately 10,600 cubic feet per year (ft^3/yr) (NRC 2013-TN2654). The LR GEIS determined for operational nuclear power plants that the environmental impacts from this form of radiological waste management are small (NRC 2013-TN2654). Currently operating LLRW disposal facilities available to ACU (i.e., the WCS LLRW disposal site in Andrews County, Texas) have adequate capacity to accommodate the quantity of LLRW expected to be generated by the 20-year operation of the MSRR (TCEQ 2020-TN7967). Thus, the associated radiological impacts on the environment from solid radiological waste generated by MSRR operations would also be SMALL.

3.9.2.3 Spent Fuel Salt Management

The other solid radiological waste stream at the MSRR would involve the cooled spent fuel salt that would have its own radiological waste system. Regarding spent fuel salt management, safe enclosure of the reactor is obtained with the reactor siting in the Reactor Bay, such that delayed decommissioning would allow shorter lived nuclides to decay away (ACU 2023-TN9099 | RCI-[WM-1]|). The FHS located in the Systems Pit below grade is designed to ensure that fuel is enclosed in a manner such that radionuclides are functionally contained during handling and manipulation (ACU 2023-TN8909 | PSAR Section 9.2|). It has the capability for appropriate periodic inspection and testing of components important to safety, with suitable shielding for radiation protection with passive residual heat removal. Containment is provided by the fuel salt, the off-gas system, and the FHS salt boundary. The FHS is equipped to enable final salt purification, fuel chemistry modifications, and other salt manipulations over the course of MSRR operations. In addition, the FHS is capable of handling used salt.

At the end of its use, the spent fuel salt would be collected in containers, solidified as the salts cool during storage (ACU 2023-TN9099 | RCI-[WM-1]|). Because the fuel and coolant salts would be the property of the DOE, ACU is in good faith negotiations with the DOE on a spent fuel contract (ACU 2023-TN9078), wherein the DOE would reclaim them at the end of the MSRR's lifetime. The fuel and coolant salts are not waste and could be reused by the DOE for other projects. There would be approximately 1600 kg of fuel salt (500 kg of UF_4 mixed with 1100 kg of FLiBe) and 1100 kg of FLiBe coolant salt. Based on the knowledge gained from the long-term storage of spent fuel salt from the MSRE at ORNL (e.g., ORNL/TM-13142), the conditions should not be present for significant production of F_2 by radiolysis during the storage of the spent fuel salt. The MSRR spent fuel salt can be safely stored and monitored until the DOE takes possession and ships the spent fuel off site to a designated DOE facility (ACU 2023-TN9099 | RCI-[WM-1]|). Additionally, given that the biological shielding would be adequate for the operating reactor, the residual activation products would also be sufficiently shielded by the biological shield outer layer (Systems Pit floor and walls, and the top plug).

3.9.2.4 Gaseous Radiological Waste

ACU stated that gaseous radiological waste would be from tritium, along with some fission and air activation products (ACU 2023-TN8909 | PSAR Section 11.2 and Section 19.4.9.2|). Tritium is generated within the fuel salt, coolant salt, and the air flowing through the reactor cell. Fuel salt dominates in the generation of tritium more than any tritium generated in the coolant salt and from air activation in the reactor cell. Tritium may diffuse into a variety of components, with the most likely candidates being diffusion into reactor structural materials, the GMS, and through the heat exchanger to the coolant salt where it may diffuse through the radiator tubes to the atmosphere (ACU 2023-TN9099 | RCI-[WM-4]|).

The GMS handles those gases which directly interface with salts across multiple subsystems. Helium is the primary gas, although nitrogen, hydrogen, and anhydrous hydrofluoric acid will also be used (ACU 2023-TN8909 | PSAR Section 9.6.2|). For example, nitrogen may be used in the off-gas system to flush the charcoal beds and will be used to inert the reactor enclosure. Gases will contain trace quantities of radioactive species. The GMS touches every salt-bearing component throughout the reactor. The off-gas system cleans the radioactive gases from the reactor GMS using a holdup container and two charcoal beds, along with necessary piping and valves (ACU 2023-TN8909 | PSAR Section 9.6.2|). Radioactive gases are released to the atmosphere through the bay exhaust. Two air-cooled charcoal beds hold up the fission gases until they either decay away or decay into solids, which remain in the charcoal.

ACU assumed that any generated tritium within the facility would be released to the environment. This annual amount of gaseous tritium released to the environment is listed in Table 3-8 of this EA. This gaseous radiological effluent, such as tritium gas that diffuses through various reactor system materials, would be discharged via the Research Bay's ventilation and air conditioning system and would be monitored prior to release from one of the two SERC stacks (ACU 2023-TN8909 | PSAR Sections 9.6.2 and 19.4.9.3|). Impacts related to such gaseous radiological effluent releases during normal operations are addressed in Section 3.7.2 of this EA.

3.9.3 Decommissioning

LLRW from MSRR decommissioning activities would be viable for disposal with a waste broker to the WCS LLRW disposal site. Because the fuel and coolant salts would be the property of the DOE (ACU is in good-faith negotiations with the DOE on a spent fuel contract [ACU 2023-TN9078]) the DOE would reclaim them at the end of the MSRR's lifetime. The fuel and coolant salts are not waste and could be reused by the DOE on other projects. There will be approximately 1600 kg of fuel salt (500 kg of UF_4 mixed with 1100 kg of FLiBe) and 1100 kilograms of FLiBe coolant salt at the time of MSRR decommissioning.

Regarding radioactive waste during decommissioning, safe enclosure of the reactor would be obtained with the reactor siting in the Reactor Bay for delayed decommissioning to allow shorter-lived nuclides to decay away. Based on the knowledge gained from the long-term storage of spent fuel salt from the MSRE at ORNL (e.g., ORNL/TM-13142 and other ORNL MSRE documents), the conditions should not be present for significant production of F_2 by radiolysis during the storage of the spent fuel salt. The MSRR spent fuel salt can be safely stored and monitored until the DOE takes possession and ships the spent fuel off site to a designated DOE facility. Additionally, given that the biological shielding would be adequate for the operating reactor, the residual activation products would also be sufficiently shielded by the biological shield outer layer (Systems Pit floor and walls, and the top plug). The SERC building would remain for future research activities after the permanent cessation of operations of the MSRR. Only the MSRR equipment in the Systems Pit and any related support equipment in the Research Bay (see Figure 2.1-9 of the PSAR) would undergo decontamination and decommissioning. Thus, given the size difference between the MSRR and an LWR, there would not be a significant volume of material to be transported off site for the decommissioning of the MSRR as there would be for an LWR. Therefore, the Decommissioning GEIS would bound the MSRR decommissioning impacts.

3.9.4 Cumulative Impacts

Table 19.4-7 of the PSAR identifies other past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts from the proposed action of the construction, operation, and decommissioning of the MSRR. None of these projects substantially influence the environmental impacts from the proposed action with respect to the uranium fuel cycle and radiological waste management.

3.9.4 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative uranium fuel cycle impacts and radiological waste management impacts from the construction, operation, and decommissioning of the MSRR would be SMALL. This conclusion is based on the following:

- The HALEU material incorporated into the FLiBe molten fuel salt would be loaned from the DOE and the generation of this HALEU material by the DOE would be bounded by Table S-3;
- The amount of liquid and solid radioactive waste would be appropriately managed and the quantity of LLRW is a very small fraction of the annual LLRW sent to the WCS LLRW disposal site;
- The management of gaseous radioactive waste would be appropriately addressed as discussed in Section 3.7.2 of this EA;
- The on-site storage and management of spent fuel salt would be similar to the ORNL's MSRE and must meet the NRC's regulatory safety requirements until the DOE takes procession of it and removes it for recycling, reuse, or disposal; and
- The Decommissioning GEIS would bound the environmental impacts of the MSRR decommissioning activities.

Additionally, at the OL stage and at the decommissioning stage, the NRC staff will review the application for new and significant information, if any, that may alter the staff's conclusions made for the CP application.

3.10 Transportation of Radioactive Material

This section addresses the radiological and nonradiological environmental impacts from normal operating (radiological) and accident conditions (radiological and nonradiological) resulting from the shipment of unirradiated fuel to the MSRR, shipment of LLRW and mixed waste to off-site disposal facilities during operations, and shipment of spent fuel. For the purposes of these analyses, the NRC staff considered the involvement of the DOE loaning fresh research reactor fuel and removing spent research reactor fuel in support of university research reactors. There are no impacts from the construction of the MSRR related to the transportation of radioactive materials.

3.10.1 Environmental Impacts of Operation

The NRC performed a generic analysis of the environmental effects of the transportation of fuel and waste to and from LWRs in WASH-1238 (AEC 1972-TN22) and in Supplement 1 to WASH-1238 (NRC 1975-TN216) and found the impact to be small. These documents summarize the environmental impacts of the transportation of fuel and waste to and from one LWR of 3,000 to 5,000 MWt (1,000 to 1,500 MWe). Impacts are provided for normal conditions of transport and accidents in transport for a reference 1,100 MWe LWR. Dose to transportation workers during normal transportation operations was estimated to result in a collective dose of 4 person-rem per reference reactor-year (RRY). The combined dose to the public along the route and the dose to onlookers were estimated to result in a collective dose of 3 person-rem per RRY. Radiological effects from transportation accidents were assessed as being SMALL.

In NUREG-0170, “Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes” (NRC 1977-TN417, NRC 1977-TN6497), the NRC evaluated the shipment of radioactive material, including shipments of unirradiated fuel, spent nuclear fuel, and radioactive waste to and from nuclear power plants. The NRC concluded in NUREG-0170 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 general public from all sources of radiation other than natural and medical sources and is a small fraction of the natural background dose. In addition, the NRC determined that the radiological risk from accidents in transportation is small, amounting to about 0.5 percent of the normal transportation risk on an annual basis. The NRC also determined in NUREG-0170 that the environmental impacts of normal transportation of radioactive materials and the risks attendant to accidents involving radioactive material shipments are sufficiently small to allow continued shipments by all modes. The doses from radioactive waste accidents were negligible when compared to the doses from accidents involving spent fuel shipments. WASH-1238 (NRC 1975-TN216), NUREG-0170 (NRC 1977-TN417), and other LWR transportation assessments by the NRC form the basis of the assessment of the environmental impacts of the transportation of radioactive material to and from the MSRR.

3.10.1.1 Fresh Fuel Shipments

Over the proposed 20 years of operation, ACU expects to receive approximately 500 kg of UF_4 HALEU with 2,200 kg of FLiBe (1,100 kg as fuel salt and 1,100 as coolant salt) with additional UF_4 HALEU if necessary. Section 4.1 of the PSAR provides details about the isotopic content of liquid fueled molten salt. Since ACU expects that both the UF_4 HALEU and FLiBe materials are to be provided by the DOE (ACU 2023-TN9099 | RCI-[FC-1]|), the DOE would be responsible for the shipments of this material to the MSRR in either a DOE- or NRC-certified transportation package. The source of fresh UF_4 HALEU may be shipped from a DOE facility or with a commercial company contracted by the DOE to produce HALEU, such as BWXT or Centrus (BWXT 2023-TN8895, DOE 2022-TN8896).

Normal conditions, sometimes referred to as “incident-free” transportation, are transportation activities during which shipments reach their destination without releasing any radioactive material to the environment (i.e., not being involved in a vehicular accident) (DOE 2002-TN418). Impacts from these shipments would be from the low levels of radiation that penetrate the shielding provided by unirradiated fuel shipping containers. Very low radiation exposures at some level would occur to the following individuals: (1) persons residing along the transportation corridors between the fuel source facility and the MSRR or alternative sites; (2) persons in vehicles traveling on the same route as an unirradiated fuel shipment; (3) persons present at vehicular stops for refueling, rest, and vehicle inspections; and (4) transportation crew workers.

The NRC staff has performed a number of environmental evaluations of the shipment of fresh uranium fuel for LWRs operating at significantly higher power levels and with far more (on the order of tons of) uranium than for the MSRR. Incident-free, or normal operation, transportation impact analysis assumed that the transportation package meets the regulatory maximum dose rate of 10 CFR 71.47, “External radiation standards for all packages” (TN301). The total number of shipments of the fuel and coolant salt over the operational lifetime of the MSRR is expected to be less than the previously evaluated 15 annual LWR fresh fuel shipments of Table 6-6 in the Clinch River Early Site Permit Final Environmental Impact Statement (EIS) (NRC 2019-TN6136) and with shorter shipping distances. Thus, the normal conditions and accident impacts involving unirradiated fuel and coolant salt shipments would be bounded by the radiological doses and nonradiological fatalities and injuries resulting in SMALL impacts as in this LWR Final EIS.

Therefore, based on the small impacts identified in the DOE programmatic EIS and the Clinch River Early Site Permit Final EIS, the low-level of radioactivity found in unirradiated enriched uranium no matter the form or enrichment level, and the fact that the MSRR would only need a limited number of fresh fuel shipments for the required 500 kg of UF_4 HALEU, the NRC staff finds that these prior transportation evaluations are applicable and demonstrate that the MSRR fresh fuel transportation impacts would be SMALL.

3.10.1.2 Low-Level Radioactive Waste Shipments

Currently, four operating disposal facilities in the United States are licensed to accept LLRW from commercial facilities (NRC 2017-TN6518). They are located at Clive, Utah; Andrews County, Texas; Barnwell, South Carolina; and near Richland, Washington. The WCS LLRW disposal site in Andrews County, Texas, is approximately 205 mi from the SERC site and is licensed to accept Class A, B, and C LLRW from the Texas Compact generators (Texas and Vermont) and would be utilized by ACU. In 2020, there was a total of approximately 24,935 ft^3 (706 cubic meters [m^3]) of Class A LLRW shipped and 4,008 ft^3 (114 m^3) of Class B and 2,344 ft^3 (66 m^3) of Class C LLRW shipped to the WCS LLRW disposal site in 2022 (DOE 2023-TN7991).

As discussed in Section 3.9.2 of this EA, ACU estimated that each year of operation of the MSRR would result in approximately 5 L (0.005 m^3) of liquid and 10 L (0.01 m^3) of solid LLRW to be shipped to the WCS LLRW disposal site (ACU 2023 | RCI-[WM-1]|). This volume of LLRW from MSRR operation would be a small fraction of the annual shipments of LLRW, no matter the waste classification, to the WCS LLRW disposal site. ACU anticipates that, in the same manner as how LLRW is handled at Texas A&M University and at the University of Texas, all LLRW generated by MSRR activities could be shipped out via a licensed commercial waste broker (ACU 2023-TN9099 | RCI-[WM-1, RCI-[TR-1]|). If ACU is granted an OL, a waste broker would likely be selected to optimize the waste disposal process and ensure that waste quantities produced are ALARA (ACU 2023-TN9099). This commercial waste broker could remove LLRW from the MSRR as needed. However, LLRW generators like ACU can often combine their LLRW shipments with other nearby LLRW generators. While the initial waste determination is made by ACU, a commercial waste broker may perform additional investigations or assaying. All shipments will be packaged in accordance with U.S. Department of Transportation (DOT) and NRC regulatory requirements, including those for transport indices. Given that no exclusive use shipments during operation are expected, this means that the dose rate at 30 cm from any given package will likely not exceed 10 mrem per hour (mrem/hr). Combined with the relatively few shipments that would be required, MSRR waste shipments would not create substantial amounts of dose to the public.

As discussed in Section 3.9.2 of this EA, the waste neutralization, concretion, and determination of waste class would be performed in accordance with “Concentration Averaging and Encapsulation Branch Technical Position, Revision 1” (NRC 2015-TN8908). ACU would optimize the transport packaging processing to ensure that waste quantities produced are

ALARA and below the transuranic limits specified in 10 CFR 61.55 (ACU 2023-TN9099 | RCI-[TR-1]|) to allow near surface disposal at the WCS LLRW disposal site.

The NRC has previously evaluated the environmental impact of the transportation of radioactive materials on public roads and by air. The NRC concluded in 1977 that when radioactive material transportation is performed in compliance with all Federal regulations, the impact of such transportation is small (NRC 1977-TN417). The NRC determined that the environmental impacts, radiological and nonradiological, of normal (incident-free) transportation of radioactive materials and the risks and consequences of accidents involving radioactive material shipments in packages for which the NRC has issued design approvals meeting the performance standards of 10 CFR Part 71 were small (49 FR 9375-TN7951). Regulations, shipping practices, and package designs for transporting radioactive material have remained essentially unchanged since 1977. Since transportation performed in conjunction with the operation of the MSRR would be a small fraction of the annual volume of LLRW shipped to the WCS LLRW disposal facility and performed in compliance with DOT and NRC regulations, the NRC staff concludes that the impacts from the transportation of LLRW during MSRR operation would be SMALL.

3.10.2 Environmental Impacts of Decommissioning

Spent fuel salt would be stored in the FHS of the MSRR over the life span of the facility (ACU 2023-TN8909 | PSAR Chapter 4 and Section 9.2|). Following cessation of operations, the spent fuel salt would have to be further stored at the MSRR or shipped off site to a DOE facility. There would also be quantities of LLRW to be addressed during decommissioning for disposal at a commercial LLRW disposal site in the same manner as previously discussed during the operational lifetime of the MSRR. For the decommissioning of the MSRR, the spent fuel salt could be safely stored until the DOE takes possession of it and ships it off site to a DOE or contracted commercial nuclear facility in either a DOE- or NRC-certified transport package.

In DOE/OR/01-2496&D1, the DOE discussed alternatives for the MSRE spent fuel salt to be removed from the site and potentially shipped to the Waste Isolation Pilot Plant (DOE 2010-TN8907). Under this plan, one option would be that each MSRE fuel drain tank would be placed in a container large enough to receive the entire tank. Other options would be to cut an intact tank to a size that would fit in an existing licensed Type-B, Ten Drum Over Pack container or the spent fuel salt could be processed and placed into a RH TRU 72B package with a payload capacity of 8,000 kg. In Section 6 of this evaluation, the DOE discussed how the MSRE spent fuel salt could be packaged and shipped to the Waste Isolation Pilot Plant. Such a plan for shipping MSRE spent fuel salt off site could be applied to the MSRR spent fuel salt after the MSRR's cessation of operations.

Regarding the number of spent fuel salt shipments during decommissioning, ACU would need to package and ship the 1,600 kg of irradiated, or spent, fuel salt after 20 years of MSRR operation. For comparison purposes, the analysis used to support Table S-4 in 10 CFR 51.52 assumed 60 normalized annual spent LWR shipments for a greater quantity of spent fuel than would exist from MSRR operation. As noted in the DOE evaluation (2010-TN8907) for the RH TRU 72B package payload capacity, there is the potential that the MSRR spent fuel salt could be shipped in one package. Therefore, since the number of shipments from the MSRR would be significantly less than the number in the Table S-4 transportation analysis, Table S-4 is conservative and bounds the impacts of the expected spent fuel salt shipments during the decommissioning of the MSRR.

As discussed above for fresh HALEU shipments to support the operation of the MSRR, incident-free impacts from the shipment of fresh fuel salt are determined based on the assumption that the transportation package meets the regulatory maximum dose rate of 10 CFR 71.47 (TN301). For this analysis, the NRC staff is also applying the same assumption for spent fuel salt shipments. As such, with the number of spent fuel salt shipments being significantly less than the number assessed for Table S-4, both the incident-free and the nonradiological accident impacts of the MSRR spent fuel salt shipments would be SMALL.

For the consideration of the radiological impacts from potential transportation accidents, the structure of the package is assumed to meet NRC regulations in 10 CFR Part 71 and the spent fuel salt being transported is assumed to be solid. Thus, a transportation accident would not only have to breach the package but somehow liquefy the spent fuel salt before a significant release of radioactive material from a shipping package could become possible. The melting point of the fuel salt is about 500 °C (932 °F) and it would have to stay at this temperature or higher for an extended period of time for there to be a significant release of the spent fuel salt from the package. Because of the nature of the spent fuel salt before a significant release of radioactive material could occur versus that of a spent LWR fuel assembly shipment, it would be more difficult for a transportation accident involving spent fuel salt to have the same environmental impact as from accidents involving spent LWR fuel assembly shipments. Therefore, the impacts of spent LWR fuel assembly shipment transportation accidents provided by Table S-4 (which had impacts of SMALL) are conservative and would bound the MSRR spent fuel salt shipment transportation accidents.

Decommissioning activities would also address the disposal of all remaining LLRW with shipments to the WCS LLRW disposal site since this site can accept all three classes of LLRW. Outside of the contaminated systems, structures, and components, such as the reactor vessel and fuel handling equipment, the same LLRW generated during operations would also be present at the time of cessation of operations and would be handled and shipped to LLRW disposal sites or to a DOE facility in the same manner as was previously described for LLRW during operations. Thus, as is noted for LLRW shipments during operations, since this volume of material is a small fraction of the total annual volume of LLRW shipped to licensed disposal or storage facilities and is performed in compliance with DOT and NRC regulations, the NRC staff concludes that the impacts from the transportation of LLRW during MSRR decommissioning would be SMALL.

Because the SERC building would remain for future research activities after the cessation of MSRR operation, only the MSRR equipment in the Systems Pit and any related support equipment in the Research Bay (see Figure 2.1-9 of the PSAR) would undergo decommissioning. Thus, there would not be a significant volume of material to be transported off site for decommissioning the MSRR as there would be for an LWR. The impacts associated with transporting decommissioned equipment and resulting materials (radiological and nonradiological) off site during the decommissioning of an LWR are analyzed in Section 4.3.17 of the Decommissioning GEIS and are found to be small (NRC 2002-TN665). As is the case for LWRs, the materials to be transported off site for the MSRR would include all contaminated wastes generated on site from the decommissioning of the MSRR. Radiological impacts would include some exposure of transportation workers and the general public along the transportation routes. Nonradiological impacts would include increased traffic volume, additional wear and tear on roadways, and potential traffic accidents. It was concluded in the Decommissioning GEIS that the transportation impacts would not be destabilizing. The MSRR is significantly smaller than the LWR evaluated in the Decommissioning GEIS and would have significantly less, if any, contaminated decommissioning material to be shipped to LLRW disposal sites. The nonradiological decommissioning transportation impacts would also be less than those presented in the Decommissioning GEIS also due to the significantly smaller amount of material from the MSRR. Therefore, the potential transportation impacts during decommissioning of the MSRR would also be SMALL.

3.10.3 Cumulative Impacts

Table 19.4-7 of the PSAR identifies other past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts from the proposed action of the construction, operation, and decommissioning of the MSRR. None of these projects substantially influence the environmental impacts from the proposed action with respect to the transportation of radioactive material.

3.10.4 Conclusions

Based on the quantity of nuclear material to be sent to the MSRR, the radioactive waste that would be acceptable for disposal at the WCS LLRW disposal site, the volume of spent fuel and coolant salts that would be sent back to the DOE, and the required employment of certified transport packages in accordance with NRC and DOT regulations, the NRC staff concludes that the potential direct, indirect, and cumulative transportation of radioactive material impacts from the construction, operation, and decommissioning of the MSRR would be SMALL.

3.11 Postulated Accidents

3.11.1 Environmental Impacts of Operation

This section discusses the potential off-site radiological consequences of the maximum hypothetical accident (MHA) that could only occur during operations. There are no impacts from the construction or decommissioning of the MSRR related to postulated accidents. ACU applied the guidance in Appendix A of ORNL/TM-2020/1478 (Belles et al. 2020-TN8974) and NUREG-1537, Part 1, Section 13, as augmented by Interim Staff Guidance (NRC 2012-TN5527), for the postulated accident analysis. As discussed in these guidance documents, the MHA usually assumes conditions that are not considered credible but that are bounding and demonstrate that under the most extreme conditions and assumptions, the radiological consequences at a non-power reactor could not exceed previously used acceptance criteria (e.g., 10 CFR Part 20 [TN283]). The MHA is a conservative evaluation and represents the bounding consequences for potential design basis accidents at the MSRR.

The MHA is an event that could result in radiological consequences exceeding those of any credible accident. It is a bounding calculation of the radiological consequences of postulated design basis accidents at the proposed NEXT Laboratory facilities. The MHA is based on events unique to the design of the MSRR that hypothetically could release radioactive materials into the environment. ACU provided an analysis of postulated accidents and the resulting MHA dose in PSAR Chapter 13 (ACU 2023-TN8909 | PSAR Chapter 13|). A summary of the postulated events and consequences, consistent with PSAR Chapter 13, is provided in PSAR Section 19.4.12 (ACU 2023-TN8909 | PSAR Section 19.4.12|).

The dominant contributors to the MHA doses at the MSRR site boundary are from gaseous radionuclides and PM (ACU 2023-TN8909 | PSAR Section 19.4.12.1.1|). The material-at-risk for release from a postulated accident could be the liquid fuel molten salt or from the on-site buildup of radioactive waste. The material-at-risk exists in only a few locations within the SERC building, such as in the Systems Pit. Such locations would include the reactor pit with the MSRR for the events described in Chapter 13 of the PSAR and the storage pit for the long-term decay-in-storage or waste awaiting collection by a waste broker (see Section 3.9.2 of this EA), as well as radioactive waste generated from the analyses of liquid fuel molten salt samples in the health physics, salt chemistry, and radiochemistry laboratories. The liquid fuel molten salt samples would contain fission products and a certain quantity of transuranic radionuclides, depending on the power history of the molten salt samples. When a sample analysis has been completed, ACU would suspend the salt samples in concrete to neutralize the hazardous (acidic) component of the sample aliquots and to stabilize the waste form as a solid (ACU 2023-TN8909 | RCI-[AC-1]|). Once the salt samples are in this waste form, the chance for any accident condition (e.g., fire, hydrogen buildup and deflagration, etc.) that could result in a release from the resulting radioactive waste is negligible.

The calculated dose from the MHA assessed by ACU for a release of liquid fuel molten salt for the MEI staying at the site boundary (a distance of 100 m shown in PSAR Figure 19.4-1) full time for 60 days would be less than 81 mrem (0.81 mSv), as discussed in PSAR Chapter 13 (ACU 2023-TN8909 | PSAR Sections 13.2 and 19.4.12.1.1|). This MHA dose would be in compliance with the dose limits in 10 CFR Part 20, Subpart D, specifically the 100 mrem limit for an individual member of the public of 10 CFR 20.1301 (10 CFR Part 20-TN283). Since the nearest resident is located beyond the site boundary (ACU 2023-TN8909), anyone beyond the site boundary would receive a lower dose than the 81 mrem (0.81 mSv). Thus, the dose at the site boundary would bound the dose that could potentially be received by any other member of the public further away from the site. Therefore, the NRC staff concludes that the environmental impacts from potential radiological accidents would be SMALL and that further mitigation would not be warranted.

The NRC staff is conducting a thorough independent safety review of the CP application, which it will document in a Safety Evaluation Report. As part of that review, the NRC staff will determine whether the safety-related structures, systems, and components of the MSRR will be designed, implemented, and maintained to ensure that they are available and reliable to perform their preventive or mitigative functions when needed so that the likelihood of serious consequences is SMALL. If the NRC staff determines through this review that ACU has met all of the NRC regulatory requirements in order to demonstrate that the MSRR would meet the regulatory standard of demonstrating adequate protection of public health and safety, then the likelihood of accidents would be reliably controlled.

3.11.2 Cumulative Impacts

Table 19.4-7 of the PSAR identifies past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts from the proposed action (ACU 2023-TN8909 | PSAR Table 19.4-7|). The cumulative analysis considers risk from potential severe accidents at all other existing and proposed nuclear facilities that have the potential to increase risks at any location within 5 mi of the MSRR. The 5 mi radius as the geographic area of interest was selected to encompass the magnitude and nature of expected impacts of the proposed activity, such as to cover any potential radiological release overlaps from two or more nearby nuclear facilities. As noted in Table 19.4-7 of the PSAR, there are no significant nuclear facilities near the MSRR that could add to the risks from severe accidents.

Given the small doses from any postulated accident at the MSRR, as bounded by the MHA, the small inventory of material-at-risk for release from a postulated accident at the MSRR, and the lack of nearby nuclear facilities, the NRC staff concludes that the cumulative risks of severe accidents from any location that would overlap within 5 mi of the MSRR site likely would not be significant, and further mitigation would not be warranted.

3.11.3 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative postulated accident impacts of the proposed action would be SMALL. This conclusion is based primarily on the fact that the bounding MHA for the MSRR would not result in a dose to the public that would challenge any dose limits for individual members of the public in 10 CFR 20.1301 (10 CFR Part 20-TN283) and, therefore, adequate protection of the public health and safety would be maintained. Additionally, the MHA dose is a small fraction of the annual dose from natural background radiation.

3.12 Climate Change

3.12.1 Affected Environment

The NRC has determined that it is reasonably foreseeable that climate change may alter the affected environment described in Section 3 of this EA during the period of the construction, operation, and decommissioning of the MSRR. Climate change is a global phenomenon that the construction, operation, and decommissioning of the MSRR will not appreciably alter. However, climate change will likely provide a new environment that may result in changed impacts from the proposed action. This section documents the NRC staff's assessment of the potential effects of climate change on its evaluation of the environmental impacts of the proposed action.

The interagency U.S. Global Change Research Program (GCRP) was established under the Global Change Research Act of 1990 (P.L. 101-606) (15 U.S.C. § 2921 et seq. [Global Change Research Act of 1990-TN3330]) "to understand, assess, predict, and respond to human-induced and natural processes of global change" and is the authoritative U.S. government source on likely climate change impacts in the United States. The NRC staff references the 4th National Climate Assessment reports (USGCRP 2017-TN5848, USGCRP 2018-TN5847) and other supporting documents (e.g., Runkle et al. 2022-TN8674) to provide the basis for likely climate change impacts in the U.S. and in the region of the SERC site.

Climate change projections in the latest GCRP reports cover the period though 2100 and are generally expressed as a change expected for the mid-21st century (e.g., 2036–2065) or late 21st century (e.g., 2071−2099) relative to average conditions existing in the near-present (e.g., 1975−2005). Projected changes in the GCRP reports are dependent on future emissions of heat-trapping gases. The GCRP's climate change impacts reports include projections for scenarios in which such emissions continue increasing throughout the 21st century (higher scenario), increase somewhat before decreasing midcentury (lower scenario), and rapidly decrease to a negative value before the end of the century (even lower scenario). Unless otherwise indicated, climate change projections described below are for the higher scenario of continued increasing emissions.

A CP is only valid for a particular site and is not an authorization to operate a nuclear reactor at full capacity. It may allow for low power testing, no more than 1 percent of the rated thermal power of the design. The NRC will issue an OL, upon review and approval of an OL application, of no more than 40 years when converting a CP into an OL (10 CFR 50.51 and 10 CFR 50.56 [10 CFR Part 50-TN249]). ACU intends to a submit an OL application requesting authorization to operate the MSRR, when its construction is completed, for 20 years. The NRC permits, upon review and approval of a renewal application, such OL licenses to be renewed for additional 20-year terms (10 CFR Part 54-TN4878). ACU's CP application states that construction is expected to be completed, at the latest, 48 months following the issuance of the CP. Under the anticipated timeline, following the conversion of the CP to a 20-year OL, the OL would potentially authorize operations of the MSRR until the year 2047. Changes in ACU's anticipated schedule (e.g., construction delays) and the potential for LR could extend the authorization to operate the MSRR beyond 2047. Based on this timeline, the NRC staff considers the GCRP projections for the mid-21st century to be representative and the GCRP projections for the late-21st century to be bounding for assessing the effects of climate change on the resource area impacts presented in this EA.

The main expected outcomes of climate change in the ACU region include an increase in average temperatures, an increase in the frequency, duration, and intensity of extreme heat events, and a reduction in extreme cold events. Temperatures in Texas have risen 1.5 °F since the beginning of the 20th century (USGCRP 2018-TN5847, Runkle et al. 2022-TN8674). Projected average annual temperatures across the Southern Great Plains are expected to increase by 3.6 to 5.1 °F by the mid-21st and 4.4 to 8.4 °F by the late-21st century compared to the 1976–2005 average (USGCRP 2018-TN5847). By the late-21st century, central Texas is projected to experience an increase of 60 days or more per year with temperatures higher than 100 °F as compared to the 1976–2005 average (USGCRP 2018-TN5847). More intense heat events are likely to exacerbate aridity in the region, leading to more intense naturally occurring droughts. Over the next 50 years in Texas, a 17-percent increase in water demand is expected due to municipal use, manufacturing, and power generation (USGCRP 2018-TN5847). The Texas Water Development Board projected that by mid-21st century, municipal water use will increase to 41 percent of available supply, significantly increasing the risk of water supply shortages during severe drought conditions (USGCRP 2018-TN5847).

Annual average precipitation is projected to decrease by 0 to 5 percent by mid-21st century as compared to the 1976–2005 average (Runkle et al. 2022-TN8674), with the largest projected decrease occurring in winter (USGCRP 2017-TN5848). An increase in extreme precipitation events is also likely, which will result in stress on existing water infrastructure such as dams, reservoirs, and drainage networks. Intense flood events, such as 100-year floods (high magnitude flood events that have historically had a 1 percent probability of occurring in any given year), are also likely to become more common (USGCRP 2018-TN5847).

3.12.2 Environmental Impacts of Construction, Operation, and Decommissioning

The potential effects of climate change were considered for all resources areas using the assessment methodology described in NUREG-2226, Appendix L (NRC 2019-TN6136). Starting from the master table (NRC 2018-TN5405) that identifies plausible connections between nuclear power station resource area concerns and likely climate change-caused alterations to the existing environment, the NRC staff generated a resource table specific to the SERC site region by removing irrelevant GCRP climate impacts and NRC resource area issues from the master table. For example, climate impacts related to sea level rise were removed because of the site's inland location. The NRC staff used the site-specific resource table (NRC 2023-TN9071) to assess whether the potential effects of climate change would alter the environmental impacts of the proposed action as described in Section 3 of this EA.

The NRC staff determined that the expected impacts of the construction, operation, and decommissioning of the MSRR described in Section 3 of this EA would not be altered by the projected effects of climate change. The siting of the MSRR in an existing building on an established urban college campus prevents potential climate change effects from altering the MSRR's small impacts to land use, terrestrial and aquatic ecology, historical and cultural resources, and nonradiological waste management.

The NRC staff also determined that no change in the water resources impact assessment would occur as a result of climate change. The SERC building uses municipal water and discharges to municipal sewer and climate change won't affect the supply or water treatment provided to the facility. The SERC building is a multiuse facility that has already been constructed and is not within defined flood plains. Additionally, no substantive changes to the building are anticipated during the life of the facility. As such, no persistent impacts from building activities are anticipated.

The NRC staff determined that, while increased temperatures may lead to a very slight change to ozone, the impacts to air quality are anticipated to be minimal.

The NRC staff determined that impacts to the transportation of radioactive materials and to nonradiological health hazards are mitigated through compliance with DOT and OSHA regulations, respectively. Additionally, the shipments of radioactive wastes will be infrequent, and the quantities of chemicals held on site will be small due to the size of the facility. Therefore, no changes to these assessments made in Section 3 of this EA are anticipated.

The radiological human health impacts and socioeconomic impacts determined in Section 3 of this EA were SMALL to negligible due to the very low radiological effluent releases expected from the MSRR and the small number of personnel needed to maintain and operate the MSRR. The NRC staff determined that climatological changes are not likely to change these releases or significantly impact the small size of the required workforce.

The NRC staff could not identify any pathways linking minority or low-income populations (i.e., populations addressed under EJ) with any adverse impacts to the proposed action and the staff determined that potential climatological changes are not applicable to this assessment.

3.12.3 Conclusions

Based on the above, the NRC staff concludes that the potential effects of climate change would not alter the impact determinations made in this EA with respect to the construction, operation, and decommissioning of the MSRR.

4 ALTERNATIVES

The NRC regulations at 10 CFR 51.30 state that an EA shall include, among other things, a brief discussion of alternatives as required by Section 102(2)(E) of NEPA. The CEQ NEPA regulations at 40 CFR 1501.5 similarly state that an EA shall, among other things, briefly discuss alternatives as required by Section 102(2)(E) of NEPA. With respect to alternatives, the CEQ NEPA regulations at 40 CFR 1502.14 (TN2123) state, in part, that an alternatives analysis should:

- Evaluate reasonable alternatives to the proposed action, and, for alternatives that the agency eliminated from detailed study, briefly discuss the reasons for their elimination.
- Discuss each alternative considered in detail, including the proposed action, so that reviewers may evaluate their comparative merits.
- Include the no-action alternative.
- Identify the agency's preferred alternative, if one exists, unless another law prohibits the expression of such a preference.
- Include appropriate mitigation measures not already included in the proposed action or alternatives.
- Limit the consideration to a reasonable number of alternatives.

Accordingly, the following sections briefly discuss alternatives to the proposed action of the construction, operation, and decommissioning of the MSRR.

4.1 No-Action Alternative

The no-action alternative establishes a baseline against which this EA compares the proposed action. For the purposes of this document, the no-action alternative would mean that the MSRR would not be constructed, operated, and decommissioned. Under the no-action alternative, the NRC would not issue the applied-for CP, and, thus, there would be no subsequent construction, operation, and decommissioning of the MSRR.

Consistent with the guidance in the Final Interim Staff Guidance Augmenting NUREG-1537 (NRC 2012-TN5528), Chapter 19, the environmental impacts of the no-action alternative are assumed to be the status quo. If the MSRR is not constructed, operated, and decommissioned, the environmental impacts discussed in Section 3 of this EA would be avoided. However, the no-action alternative would also result in the beneficial impacts of the MSRR being avoided. These beneficial impacts include employment associated with construction, operation, and decommissioning, as well as beneficial impacts associated with the planned research activities and educating and training engineers and scientists to be prepared to contribute to the advancement and deployment of molten salt reactors and applications. Programmatic benefits supporting deployment of advanced nuclear technologies that result in less reliance on carbon fuel-based forms of energy production would not be realized.

4.2 Alternatives Considered but Eliminated from Detailed Analysis

Reasonable alternatives to the proposed action may include, but are not limited to, alternative sites technologies and alternative sites.

The proposed action involves the demonstration and testing of new technology. Therefore, alternative technologies are not considered further. Two alternative sites to the SERC building were considered, the Rhoden Farm Site and the Sherrod Site. The Rhoden Farm site is an ACU facility located approximately 10 mi (16 km) north of the main ACU campus. It is an active research farm of approximately 300 ac. Rhoden Farm is used by the ACU Agriculture and Environmental Sciences Department for sustainable agriculture and environmental systems. The Sherrod site is an area less than 1 mi (1.6 km) southwest of the main ACU campus. It is presently a disc golf park and contains student housing units that are no longer in use ("Sherrod Apartments"). The housing units would need to be removed if the site were used for the MSRR.

ACU's application analyzed and ranked these alternative sites, using factors for environmental impacts, financial impacts, and mission impacts. The results of those site rankings are included in Table 4-1, 4-2, and 4-3 below.

Table 4-1 Candidate Site Ranking for Environmental Impacts

Environmental Impact	Rhoden Farm Site	Sherrod Site	Science and Engineering Research Center (SERC)
1) Site preparation	3rd	2nd	1st
2) Facility construction	3rd	2nd	1st
3) Reactor construction	1st	1st	1st
4) Reactor operations	1st	1st	1st
5) Reactor decommissioning	1st	1st	1st
6) Facility decontamination (DECON) and remediation	2nd	2nd	1st

Table 4-2 Candidate Site Ranking for Financial Impacts

Financial Impact	Rhoden Farm Site	Sherrod Site	Science and Engineering Research Center (SERC)
1) Site preparation	2nd	3rd	1st
2) Facility construction	3rd	2nd	1st
3) Reactor construction	2nd	1st	1st
4) Reactor operations	2nd	1st	1st
5) Reactor decommissioning	2nd	1st	1st
6) Facility decontamination (DECON) and remediation	3rd	2nd	1st

Table 4-3 Candidate Site Ranking for Mission Impacts

	Mission Impact	Rhoden Farm Site	Sherrod Site	Science and Engineering Research Center (SERC)
1)	Timeline to Criticality — Site Preparation	2nd	2nd	1st
2)	Timeline to Criticality — Facility Construction	2nd	2nd	1st
3)	Timeline to Criticality — Reactor Construction	2nd	1st	1st
4)	Proximity — Education	3rd	2nd	1st
5)	Proximity — Security	3rd	2nd	1st
6)	Proximity — Emergency Response	2nd	1st	1st

Based on the factors and impacts considered above, neither the Rhoden Farm nor the Sherrod sites are superior locations to the preferred alternative of siting the MSRR at the SERC. While the environmental impacts of operating the MSRR would be similar at all three sites, at both the Rhoden Farm and Sherrod sites, a new facility to house the MSRR would need to be constructed. As such, these siting alternatives would result in new environmental impacts to various resources that do not exist at the SERC site. Other factors include the remoteness of the sites in terms of proximity to the central ACU campus, along with increased security posture and emergency response times that increase with distance from the central ACU campus and first responders.

For the reasons briefly discussed above, the Rhoden Farm and Sherrod sites were eliminated from detailed study.

4.3 Cost-Benefit Analysis

Section 102(B) of NEPA requires that all Federal agencies “identify and develop methods and procedures, in consultation with the [CEQ], which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations” (42 U.S.C. § 4332(B); TN4880). However, neither NEPA nor the CEQ requires the benefits and costs of a proposed action to be quantified in dollars or any other common metric. The intent instead is to focus on the benefits and costs of such magnitude or importance that their inclusion in this analysis can inform the decision-making process rather than the identification and quantification of all of the potential societal benefits of the proposed action and comparing them to the potential costs of the proposed action.

The proposed action of issuing a CP to ACU to authorize the construction of the MSRR in the SERC building is expected to result in overall socioeconomic and programmatic benefits, including the creation of construction, operations, and decommissioning jobs as well as beneficial impacts associated with educating and training engineers and scientists to operate and maintain molten salt reactors, and benefits associated with supporting the development and deployment of advanced nuclear technologies. Costs include the environmental impacts of constructing, operating, and decommissioning the MSRR, although, as discussed in this EA, all such impacts are expected to be SMALL. Costs also include the financial impacts associated with the construction, operation, and decommissioning of the MSRR; however, these costs are expected to be offset by the benefits of demonstrating molten salt reactor technologies for potential future deployment.

Based on the above, the NRC staff concludes that the preferred alternative is the proposed action and that mitigation measures not already included in the proposed action would not be warranted.

5 CONCLUSIONS AND FINDING OF NO SIGNIFICANT IMPACT

This EA describes the environmental review conducted by the NRC staff for an application by ACU for a CP under 10 CFR Part 50 (TN249) to authorize the construction of the MSRR in the SERC building on the ACU campus in Abilene, Texas. The EA follows the requirements in 10 CFR Part 51 (TN250), which are the NRC's regulations that implement NEPA (TN661). Specifically, the EA identifies the proposed action; includes a brief discussion of the need for the proposed action, alternatives as required by Section 102(2)(E) of NEPA, and the environmental impacts of the proposed action and alternatives as appropriate; and includes a list of agencies and persons consulted, and identification of sources used. This section of the EA presents the conclusions of the NRC staff's environmental review and a finding of no significant impact. Specifically, Section 5.1 summarizes the environmental impacts of the proposed action; Section 5.2 compares the environmental impacts of the proposed action to the environmental impacts of the reasonable alternatives identified by the NRC staff; and Section 5.3 discusses the unavoidable impacts of the proposed action and identifies resource commitments. Finally, Section 5.4 presents the NRC staff's finding of no significant impact with respect to the proposed action, which identifies the proposed action, states that the NRC staff has determined not to prepare an EIS for the proposed action, briefly presents the reasons why the proposed action will not have a significant effect on the quality of the human environment, incorporates the EA by reference, notes related environmental documents, and states that the finding and the related environmental documents are available for public inspection and where the documents may be inspected.

5.1 Environmental Impacts of the Proposed Action

The proposed action before the NRC is whether to issue a CP to ACU authorizing the construction of the MSRR within the SERC building on the ACU campus in Abilene, Texas. Section 1 of this EA presents the need for the proposed action, which is to conduct research on molten salt reactor technology. Section 2 of this EA describes the design of the MSRR and its siting within the SERC building. Section 3 of this EA summarizes the potential direct, indirect, and cumulative impacts of the proposed action. The NRC staff concludes therein that these impacts would be SMALL for each potentially affected environmental resource, meaning that the environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. This conclusion is based on the NRC staff's review of ACU's CP application and associated responses to requests for supplemental information and requests for clarifying information, the staff's communications with Federal, State, and local agencies, as well as Tribal officials, and the staff's independent environmental review. Table 5-1 summarizes the environmental impacts of the proposed action and the NRC staff's conclusions for each resource considered and where that impact is discussed in this EA.

Table 5-1 Summary of the Environmental Impacts of the Construction, Operation, and Decommissioning of the Molten Salt Research Reactor

Resource	Environmental Assessment Section	Summary of Impact	Impact Level
Land Use and Visual Resources	3.1	The proposed MSRR is accommodated within an academic research building (the SERC) on the ACU campus. The MSRR would be compatible with other uses of the building and with	SMALL

Resource	Environmental Assessment Section	Summary of Impact	Impact Level
		surrounding land uses. The SERC is in an area zoned for commercial use. No effects on prime or unique farmland, mineral resources, forestry or agricultural resources, floodplains, wetlands, parks, preserves, or other special land uses. The site is not in a coastal zone. The MSRR would not change the external appearance of the academic building, which is typical of a college campus.	
Air Quality and Noise	3.2	Air emissions of criteria pollutants would be below 100 tons per year (TPY), and hazardous air pollutants would be below 10 TPY individually and 25 TPY combined. Emissions would comply with non-Title V permitting requirements. Standard control measures would mitigate fugitive dust releases.	SMALL
Hydrogeology and Water Resources	3.3	There would be no disturbance of geological features of economic or natural value. Disturbances limited to previously disturbed soils. Best management practices (BMPs) for soil erosion and sediment control would be employed. Water demands would be met by municipal suppliers. There would be no use of groundwater and no direct use of surface water. There would be no use of cooling towers, ponds, or reservoirs. Wastewater would be treated by municipal wastewater treatment facilities. Stormwater would be managed using BMPs.	SMALL
Ecological Resources	3.4	The MSRR would be built in an existing academic building (the SERC) and would not involve temporary or permanent losses of natural habitat. No disturbances to forest or other natural vegetation, natural soils, wetlands, surface waters, shorelines, or riparian lands. No Section 404 permit required. BMPs to control stormwater runoff that might reach wetlands or aquatic habitats. Local wildlife already acclimated to campus noise. No Federally endangered species would be affected.	SMALL
Historic and Cultural Resources	3.5	No historic properties are in direct effects area of potential effects. No ground disturbance would occur as part of the undertaking. Two National Register of Historic Places-listed ACU buildings (Administration Building and Luce Hall) are over 400 meters from the area of potential effects. The proposed undertaking would not adversely affect either historic property.	SMALL
Socioeconomics and Environmental Justice	3.6	Small numbers of workers would not substantially affect employment levels in the surrounding area, but the demand for some skilled labor might	SMALL

Resource	Environmental Assessment Section	Summary of Impact	Impact Level
		compete with other planned technology projects. The small size of the MSRR and its distance from the closest census blocks with populations meeting EJ criteria indicate little potential for EJ effects.	
Human Health	3.7	Radiological releases, doses to the public, and occupational doses would be less than the limits established for protection of human health and the environment in 10 CFR Part 20 (TN283). ACU would implement normal safety practices contained in Occupational Safety and Health Administration regulations in 29 CFR Part 1910 (TN654) to protect occupational health. Emissions would comply with the Resource Conservation and Recovery Act (TN1281), Clean Air Act (TN1141), and other environmental regulations.	SMALL
Nonradiological Waste Management	3.8	ACU would manage wastes generated consistent with the university's current waste management plan. Management of solid waste, including construction and demolition waste, would involve waste reduction efforts, recycling, and BMPs. Liquid wastes would be trucked off-site for proper disposal. Gaseous emissions would comply with the Texas Commission on Environmental Quality regulations.	SMALL
Uranium Fuel Cycle and Radiological Waste Management	3.9	A low quantity of uranium is used during operations. Fuel processes are bounded by Table S-3 of 10 CFR 51.51 (TN250), developed by the NRC to protect human health and the environment. Environmental impacts from storage of spent fuel would be less than the environmental impact provided by the Continued Storage Generic EIS (TN1141). The estimated volume of LLRW is less than or comparable to that of an LWR, and the NRC staff determined that there is adequate capacity for LLRW disposal. The on-site storage of spent fuel would have to meet the same regulatory requirements as currently licensed LWRs.	SMALL
Transportation of Radioactive Material	3.10	Transportation of radioactive fuels and wastes to and from the MSRR would be performed in compliance with DOT and NRC regulations and constitutes only a small percentage of the total materials of these types shipped each year.	SMALL

Resource	Environmental Assessment Section	Summary of Impact	Impact Level
Postulated Accidents	3.11	The NRC staff is conducting an independent review of the consequences of accidents in its Safety Evaluation Report for the CP application. The MSRR would have to meet the NRC requirements for postulated accidents. The nearest resident dose from accidents would also be below the radiation dose limits for individual members of the public.	SMALL
Climate Change	3.12	Climate change is a global phenomenon that the MSRR would not appreciably alter. None of the impact conclusions in this EA for the MSRR would change as a result of climate change.	SMALL

5.2 Comparison of Alternatives

As described in Section 4 of this EA, the NRC staff considered three alternatives to the proposed action:

- not authorizing construction of the MSRR (the no-action alternative);
- siting the MSRR at the Rhoden Farm site, approximately 10 mi north of the main ACU campus (the Rhoden Farm alternative); and
- siting the MSRR at the Sherrod site, less than 1 mi southwest of the main ACU campus (the Sherrod alternative).

The NRC staff independently determined that there were no other reasonable alternatives warranting evaluation in the EA. Because the MSRR is intended for research and education involving a specific nuclear energy generation technology, alternatives involving other energy generation processes would not meet the need for the proposed action and were not considered. Table 4-1 presents the comparative potential environmental impacts of each alternative site. The NRC staff determined that the potential environmental impacts of each of these alternatives would be SMALL and not significant. The use of either the Rhoden Farm or the Sherrod sites would require building a new building to accommodate the MSRR, whereas the MSRR would be built within an existing building (the SERC building) under the proposed action. Building a new building would result in increased environmental impacts related to site disturbance and resource usage, even though these impacts at either alternative site would still not be significant. However, because of those incremental impacts, the NRC staff concludes that the preferred alternative site is the proposed action. The proposed action would result in fewer environmental impacts than would either the Rhoden Farm site or the Sherrod site alternatives. Finally, both because all of the environmental impacts of the proposed action would be SMALL and because the no-action alternative would maintain the status quo and would not provide the research and educational opportunities related to the need for the proposed action, the NRC staff concludes that the preferred alternative is the proposed action.

5.3 Resource Commitments

The following sections address issues related to resource commitments contributing to the cost-benefit analysis presented in Section 4.3 of this EA.

5.3.1 Unavoidable Adverse Environmental Impacts

Unavoidable adverse environmental impacts are predicted adverse environmental impacts that cannot be avoided and that have no practical means of further mitigation. As noted in Section 3 of this EA, the NRC staff concluded that the impacts on all relevant environmental resources from the construction, operation, and decommissioning of the MSRR within the existing SERC building would be SMALL. This means that the environmental effects would not be detectable or would be so minor that they would neither destabilize nor noticeably alter any important attribute of the resource. However, a SMALL conclusion does not necessarily indicate that there would not be any adverse effects that could be offset or minimized through mitigation. The NRC staff therefore presents the unavoidable adverse environmental impacts of the construction, operation, and decommissioning of the MSRR in Table 5-2, including mitigation and control measures intended to lessen adverse effects.

Table 5-2 Unavoidable Adverse Environmental Impacts of the Molten Salt Research Reactor

Resource Area	Unavoidable Adverse Impact	Mitigation Measures
Land Use and Visual Resources	Use of portion of existing academic building (the SERC). Possible need for staging area and temporary parking adjacent to the SERC during the construction of the MSRR.	ACU proposes restoration of any affected lands using native plants or landscaping (ACU 2023-TN8909 | PSAR Section 19.6.1.1|).
Air Quality and Noise	Low emissions of air pollutants, possible fugitive dust, limited construction noise.	Best management practices.
Hydrogeology and Water Resources	Minor demands for water and wastewater treatment.	No mitigation proposed.
Ecological Resources	Impacts localized to urban areas of a college campus.	No mitigation proposed.
Historic and Cultural Resources	Limited soil disturbance in area of previously disturbed soils.	No mitigation proposed.
Socioeconomics and Environmental Justice	Small increases in employment.	No mitigation proposed.
Human Health	Physical and chemical hazards typical of any industrial facility.	Compliance with NRC and OSHA regulations.
Nonradiological Waste Management	Small quantities.	Compliance with waste management regulations.
Uranium Fuel Cycle and Radiological Waste Management	A small quantity of uranium would be used. Impacts bounded by Table S-3 in 10 CFR 51.51 (TN250), developed by the NRC to protect human health and the environment.	On-site storage of spent fuel must meet the same regulatory requirements as for currently licensed reactors.
Transportation of Radioactive Material	Transportation of small amounts of radioactive fuels and wastes.	Compliance with DOT and NRC regulations.
Postulated Accidents	Low risks of accidents and low consequences.	Compliance with NRC regulations.
Climate Change	Minimal contribution.	No mitigation proposed.

5.3.2 Relationship Between Local Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity

The MSRR would result in short-term uses of environmental resources. “Short-term” is the period of time during which the construction, operation, and decommissioning would take place. The MSRR would occupy a portion of an existing academic building (the SERC building). Once the MSRR is decommissioned, that space in the building would be available for other uses. Air emissions from the MSRR would introduce small amounts of criteria pollutants, GHG emissions, HAPs, and radiological emissions to the environment. However, the emissions are not expected to affect air quality to the extent that they would impair public health and the long-term productivity of the environment, and they would be below all regulatory thresholds. Noise from the proposed action would increase ambient noise levels on site and in adjacent off-site areas. However, noise increases are not expected to be noticeable, other than for temporary periods during construction and decommissioning. Any noticeable increases would be brief and temporary.

The MSRR would use only small amounts of water supplied by municipal sources, which would not place substantial short-term demands on surface water or groundwater. The MSRR would be built within the SERC building, which itself has been built in an already developed area of the ACU main campus. Any short-term ecological effects would be minor and would cease prior to the completion of decommissioning. Increased employment, expenditures, and tax revenues generated during construction, operation, and decommissioning would directly benefit local, regional, and State economies over the short term. Worker vehicles and delivery and shipment of materials would increase the volume of traffic on local roads. There may also be small increases in demand for housing and services in Abilene and surrounding areas. But the demands and traffic increases would be short-term and mostly during peak construction and decommissioning work and, therefore, would not affect long-term productivity.

Management and disposal of LLRW, hazardous waste, and nonhazardous waste would require a small short-term increase in energy usage and consume space at treatment, storage, or disposal facilities. Regardless of the location of those facilities, the use of land to meet waste disposal needs would reduce the long-term productivity of the land. However, the contribution of the MSRR to these reductions would be minimal.

While effects on environmental resources would be minimal over the short term, the long-term benefits from the MSRR could be substantial. Research conducted at the MSRR could contribute to future development of molten salt reactors for deployment of advanced nuclear power plants and development of medical isotopes throughout the world. Successful future deployment of the technology could help the United States develop another economically viable source of energy and medical isotope production. Use of the technology may help the United States meet climate change goals with less reliance on more land-intensive energy generation processes, such as large complexes of solar photovoltaic cells or wind turbines, that require larger commitments of land and have a greater potential for aesthetic impacts on landscapes and seascapes and physical injury to terrestrial or aquatic wildlife.

5.3.3 Irreversible and Irretrievable Commitment of Resources

Resource losses or degradation are irreversible when primary or secondary impacts limit future options for the resource. An irretrievable commitment refers to the use or consumption of resources that are neither renewable nor recoverable for future use. Irreversible and irretrievable commitments of resources for a research reactor such as the MSRR include the commitment of water, energy, raw materials, and other natural and human-made resources. Constructing, operating, and decommissioning the MSRR would entail the irreversible and irretrievable commitment of energy, water, chemicals, fossil fuels, and other natural and human-made resources. Constructing the MSRR would consume building materials such as concrete and steel that would be irretrievable unless recycled during decommissioning. Water demands would be minimal and readily met by municipal and commercial sources. Occasionally, a bird or other wildlife individual might be killed or injured by collision with the SERC building or with vehicles accessing the SERC building, but the losses would be too small to irreversibly affect wildlife populations in the surrounding area. Only small amounts of unskilled and skilled labor would be necessary to construct, operate, and decommission the MSRR. Designed as only a 1 MWt reactor, nuclear fuel usage and energy usage as electricity and fuel would be irreversible but small.

5.3.4 Unresolved Conflicts

NEPA Section 102(2)(E) (TN661) requires that the NRC staff study, develop, and describe appropriate alternatives to recommended courses of action in any proposal that involves unresolved conflicts concerning alternative uses of available resources. In reviewing the potential impacts associated with the proposed action, the NRC staff did not identify any unresolved conflicts concerning alternative uses of available resources.

5.4 Finding of No Significant Impact

The proposed action before the NRC is whether to issue a CP to ACU to authorize the construction of the MSRR in the SERC building. The NRC staff's EA of the proposed action is based on the following:

- the NRC staff's review of the ACU CP application (ACU 2023-TN8909) and associated responses to requests for supplemental information (ACU 2022-TN9529) and requests for clarifying information (ACU 2023-TN9099);
- the NRC staff's communications with Federal, State, and local agencies, as well as Tribal officials (listed in Appendices B and D of this EA); and
- the NRC staff's independent environmental review.

On the basis of this EA, incorporated by reference in this finding, and its determination that the environmental impacts would be SMALL for each potentially affected resource area, the NRC staff concludes that the proposed action will not have a significant effect on the quality of the human environment. Accordingly, the NRC staff has determined not to prepare an environmental impact statement for the proposed action. This finding and the related environmental documents referenced throughout the EA are available for public inspection as discussed in the EA.

6 REFERENCES

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10 CFR Part 50. *Code of Federal Regulations*, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities." TN249.

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10 CFR Part 54. *Code of Federal Regulations*, Title 10, *Energy*, Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants." TN4878.

10 CFR Part 61. *Code of Federal Regulations*, Title 10, *Energy*, Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste." TN252.

10 CFR Part 71. *Code of Federal Regulations*, Title 10, *Energy*, Part 71, "Packaging and Transportation of Radioactive Material." TN301.

10 CFR Part 72. *Code of Federal Regulations*, Title 10, *Energy*, Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste." TN4884.

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APPENDIX A

LIST OF PREPARERS

Members of the U.S. Nuclear Regulatory Commission's (NRC's) Office of Nuclear Material Safety and Safeguards prepared this environmental assessment with assistance from other NRC organizations and Pacific Northwest National Laboratory (PNNL). Table A-1 identifies each contributor's name, professional background, and function or expertise.

Table A-1 List of Preparers

Name	Education and Experience	Function or Expertise
U.S. Nuclear Regulatory Commission (NRC)		
Peyton Doub	MS Plant Physiology (Botany) BS Plant Sciences (Botany) Duke NEPA Certificate; Professional Wetland Scientist; Certified Environmental Professional 31 years of experience in terrestrial and wetland ecology and NEPA	Ecology Land Use/Visual Non-Rad Human Health
Joseph Giacinto	MS Hydrology BS Geology/Geophysics Certified Professional Geologist Duke NEPA Certificate 31 years of combined industry and governmental experience including performing and managing NEPA reviews for power plants and Superfund sites	Project Management Surface Water Hydrology
Brian Glowacki	BS Environmental Engineering 2 years relevant experience	Cultural Resources
Donald Palmrose	BS Nuclear Engineering MS Nuclear Engineering PhD Nuclear Engineering 34 years of experience including operations on U.S. Navy nuclear powered surface ships, technical and NEPA analyses, nuclear authorization basis support for DOE, and NRC project management	Accidents/Transportation Fuel Cycle/Health Physics Radiological Waste
Patricia Vokoun	BS Civil Engineering Professional Engineer 40 years of combined industry and governmental experience including analyses and managing NEPA and related legal reviews for power plants, transportation projects, and Air Force activities	Lead Project Management
Pacific Northwest National Laboratory (PNNL)		
Dave Anderson	MS Life Science BS Life Science	Environmental Justice
	30+ years of experience in the environmental assessment of energy development projects in the areas of economics, land use,	

Name	Education and Experience	Function or Expertise
	demographics, environmental justice and power planning	
Saikat Ghosh	PhD Chemical Engineering MS Environmental Engineering 12 years of experience in air quality modeling, emission modeling, air monitoring, environmental transport modeling, and data analyses and visualization	Air Quality Meteorology Noise
Dave Goodman	JD BS Economics 12 years of experience including NEPA environmental impact assessments, ecological restoration, Endangered Species Act, land use and visual resources, and environmental law and policy	Alternatives
Kimberly Leigh	BS Environmental Science 22 years of experience in nuclear power regulation, NEPA environmental impact assessments, and nonradiological public and occupational health issues	Nonradiological Waste
Hayley McClendon	BS Environmental Science 7 years of experience in environmental compliance and document development	Nonradiological Waste References Lead
Phil Meyer	PhD Civil Engineering MS Civil Engineering BA Physics 30+ years of experience in applied groundwater and unsaturated zone research; 15+ years of experience in groundwater resource assessment and environmental impact evaluation	Climate Change
Paul Michalak	MS Hydrology BS Education 30+ years of experience including NEPA environmental impact assessments, project management, uranium recovery, and materials decommissioning	Technical Team Lead
Michelle Niemeyer	MS Agricultural Economics BS Agricultural Economics 15+ years of experience including NEPA environmental impact assessments, project management, economics, and stakeholder engagement	Socioeconomics
Mike Parker	BS English Literature and Creative Writing 25 years of relevant experience	Technical Editing Document Architecture
Lindsey Renaud	MA Anthropology BA Anthropology 10 years in cultural resource management, NEPA environmental impact assessments and Section 106 and 110 compliance. SOI qualified Registered Professional Archaeologist. Experience in Tribal	Historic and Cultural Resources

Name	Education and Experience	Function or Expertise
	engagement and Native American Graves Protection and Repatriation Act compliance	
Kacoli Sen	PhD Cancer Biology MS Zoology (Ecology) BS Zoology Diploma in Environmental Law 6 years of relevant experience	Production Editor
Isaiah Steinke	PhD Electrical Engineering MS Data Analytics BS Materials Science and Engineering 10+ years of technical and scientific editing	Technical Editing Formatting
Kenneth Thomas	MS Math Science BS Mathematics More than 20 years of combined U.S. Navy surface ships and commercial nuclear power operations and instruction, and leading and performing licensing reviews and rulemaking for power plants and sites while in government service	Technical Team Lead
Katie Wagner	BS Biology MS Biology 13 years of experience in project management and aquatic ecology; 9 years of experience in NEPA compliance and ecological resources	Project Management
Lin Zeng	PhD Environmental Science and Engineering BE Civil Engineering 10 years of experience in socioeconomic analysis and environmental impact assessment	Socioeconomics

APPENDIX B

AGENCIES, ORGANIZATIONS, TRIBES, AND INDIVIDUALS CONSULTED

The U.S. Nuclear Regulatory Commission (NRC) is providing electronic copies of the Abilene Christian University (ACU) Molten Salt Research Reactor (MSRR) Environmental Assessment (EA) to the agencies, organizations, Tribes, and individuals that were consulted, as listed in Table B-1 below. The NRC will also provide electronic copies to other interested organizations and individuals upon request. The NRC staff previously shared its National Historic Preservation Act of 1966, as amended, Section 106 finding that the proposed action (authorizing the construction of the MSRR in the existing Gayle and Max Dillard Science and Engineering Research Center building on the ACU campus in Abilene, Texas) will result in no historic properties affected with the public and shared the initial draft of this EA with this finding with Tribes, the Texas Commission on Environmental Quality, the Advisory Council on Historic Preservation, and the Texas Historical Commission for comment over a 30-day period ending on February 26, 2024. The NRC did not receive any comments.

Table B-1 List of Agencies, Organizations, Tribes, and Individuals Consulted

Contact	Agency, Organization, or Tribe	Address	Consultation Letter ADAMS Accession No.
M. Wolfe Caitlin Brashear	Texas Historic Commission	1511 Colorado St. Austin, TX 78701	ML23009B607 ML23241A826 ML23241A819 ML23241A831
Reid Nelson LaShavio Johnson	Advisory Council on Historic Preservation	401 F Street, NW. Suite 308 Washington, DC 20001	ML23009B614 ML23241A849
Ricky Sylestine	Alabama-Coushatta Tribe of Texas	571 State Park Road 56 Livingston, TX 77351	ML23009B617
Durell Cooper	Apache Tribe of Oklahoma	P.O. Box 1330 Anadarko, OK 73005	ML23122A284
Bobby Gonzalez	Caddo Nation of Oklahoma	NEPA Program Office USEPA Region 4 61 Forsyth Street SW Atlanta, GA 30303 long.larry@epa.gov	ML23122A281 ML23241A786
Reggie Wassana	Cheyenne and Arapaho Tribes of Oklahoma	100 Red Moon Cir. Choncho, OK 73022	ML23122A287
Teresa Patingo	Chitimacha Nation	P.O. Box 661 155 Chitimacha Loop Charenton LA 70523	ML23241A793

Contact	Agency, Organization, or Tribe	Address	Consultation Letter ADAMS Accession No.
Debbie Dotson	Delaware Nation of Oklahoma	P.O. Box 825 Anadarko, OK 73005	ML23122A283 ML23241A814
Brad Killscrow	Delaware Tribe	5100 Tuxedo Blvd Bartlesville, OK 74006	ML23122A282
Juan Garza	Kickapoo Tribe of Oklahoma	105365 OK-102 McLoud, OK 74851	ML23122A286 ML23241A817
Russell Martin	Tonkawa Tribe of Indians of Oklahoma	1 Rush Buffalo Road Tonkawa, OK 74653	ML23122A288
Terri Parton	Wichita and Affiliated Tribes of Oklahoma	P.O. Box 729 Anadarko, OK 73005	ML23122A289
E. Michael Silvas	Ysleta del Sur Pueblo	9241 Socorro Rd El Paso, TX 79907	ML23122A285
Karen Meyer	U.S. Department of Interior Fish and Wildlife Service	1505 Ferguson Lane Austin, TX 78754	ML23013A259

APPENDIX C

REGULATORY COMPLIANCE AND LIST OF FEDERAL, STATE, AND LOCAL PERMITS AND APPROVALS

This appendix contains a list of the environmental-related authorizations, permits, and certifications potentially required by Federal, State, regional, local, and affected Native American Tribal agencies related to construction and operation of the Abilene Christian University (ACU) Molten Salt Research Reactor. Table C-1 was adapted from Table 19.1-1 of Chapter 19 of the Preliminary Safety Analysis Report submitted to the U.S. Nuclear Regulatory Commission by ACU (ACU 2023-TN8909).

Table C-1 Regulatory Compliance and List of Federal, State, and Local Permits and Approvals

Agency	Regulatory Authority	Requirement	Activity Covered
U.S. Nuclear Regulatory Commission	Atomic Energy Act of 1954 10 CFR 50.50	Construction Permit	Construction of the research reactor
U.S. Nuclear Regulatory Commission	10 CFR 50.57	Operating License	Operation of the research reactor
U.S. Nuclear Regulatory Commission	10 CFR Part 40	Source Material License	Receipt, possession, use, and transfer of radioactive source material
U.S. Nuclear Regulatory Commission	10 CFR Part 30	Byproduct Material License	Receipt, possession, use, and transfer of radioactive byproduct material
U.S. Nuclear Regulatory Commission	10 CFR Part 70	Special Nuclear Material License	Receipt, possession, use, and transfer of special nuclear material
U.S. Nuclear Regulatory Commission	National Environmental Policy Act (NEPA) 10 CFR Part 51	Environmental Assessment	Approval for construction and operation of the research reactor
Environmental Protection Agency	Resource Conservation and Recovery Act (RCRA) 40 CFR Part 261 and 40 CFR 262	Acknowledgement of Notification of Hazardous Waste Activity	Generation of hazardous waste
Environmental Protection Agency	Clean Water Act 40 CFR Part 112, Appendix F	Spill Prevention and Control and Countermeasures Plans for Construction	Storage of oil during construction and operation

Agency	Regulatory Authority	Requirement	Activity Covered
U.S. Department of Transportation	Hazardous Material Transportation Act	Certificate of Registration	Transportation of hazardous material
Texas Department of State Health Services	Texas Radiation Control Act	Shipping Registration	Shipment of low-level radioactive waste
U.S. Department of Energy	Nuclear Waste Policy Act of 1982 Research Reactor Infrastructure Program	Contract	Fuel cycle services including disposal of high-level radioactive waste streams and spent nuclear fuel
Texas Historical Commission	Section 106 of the National Historic Preservation Act	National Historic Preservation Act Section 106 compliance and consultation, which includes State Historic Preservation Office/Tribal Historic Preservation Officers	Protection of archaeological and historical resources

APPENDIX D

CHRONOLOGY OF ENVIRONMENTAL REVIEW CORRESPONDENCE

This appendix contains a chronological list of correspondence between the U.S. Nuclear Regulatory Commission (NRC) and external parties as part of its environmental review of the Abilene Christian University (ACU) Molten Salt Research Reactor construction permit application. These documents are available electronically on the NRC's website at https://www.nrc.gov/reading-rm.html. From this website, members of the public can gain access to the NRC's Agencywide Documents Access and Management System (ADAMS), which provides text and image files of the NRC's public documents in the Publicly Available Records component of ADAMS. The ADAMS accession numbers for each document are included below. Some of the ADAMS accession numbers below lead to a folder containing several documents. If you need assistance in accessing or searching in ADAMS, contact the NRC Public Document Room staff at 1-800-397-4209.

August 12, 2022	Letter to NRC from Russell Kruzelock, Abilene Christian University, Submitting the Construction Permit Application for the ACU Molten Salt Research Reactor (Revision 0). (Package Accession No. ML22227A201)
October 14, 2022	Federal Register Notice - NRC Receipt of Abilene Christian University Molten Salt Research Reactor Construction Permit Application. (87 FR 62463)
November 28, 2022	Federal Register Notice - Abilene Christian University (ACU) Molten Salt Research Reactor (MSRR) Construction Permit Application Acceptance. (87 FR 73051)
December 16, 2022	Letter to R. Towell, Abilene Christian University, Abilene Christian University (ACU) Molten Salt Research Reactor (MSRR) Construction Permit Application Review Schedule Letter. (Accession No. ML22341A615)
May 5, 2023	Letter to Brad Killscrow, Chief, Delaware Tribe of Indians, Re ACU Molten Salt Research Reactor Construction Permit Application. (Accession No. ML23122A282)
May 5, 2023	Letter to Russell Martin, President, Tonkawa Tribe of Indians of Oklahoma, Re ACU Molten Salt Research Reactor Construction Permit Application. (Accession No. ML23122A288)
May 5, 2023	Letter to Debbie Dotson, President, Delaware Nation of Oklahoma, Re ACU Molten Salt Research Reactor Construction Permit Application. (Accession No. ML23122A283)
May 5, 2023	Letter to Juan Garza, Chairman, Kickapoo Tribe of Texas, Re ACU Molten Salt Research Reactor Construction Permit Application. (Accession No. ML23122A286)

May 5, 2023	Letter to Durell Cooper, Chairman, Apache Tribe of Oklahoma, Re ACU Molten Salt Research Reactor Construction Permit Application. (Accession No. ML23122A284)
May 5, 2023	Letter to Ricky Sylestine, Chairman, Alabama-Coushatta Tribe of Texas, Re ACU Molten Salt Research Reactor Construction Permit Application. (Accession No. ML23009B617)
May 5, 2023	Letter to Reggie Wassana, Governor, Cheyenne and Arapaho Tribes of Oklahoma, Re ACU Molten Salt Research Reactor Construction Permit Application. (Accession No. ML23122A287)
May 5, 2023	Letter to Terri Parton, President, Wichita and Affiliated Tribes of Oklahoma, Re ACU Molten Salt Research Reactor Construction Permit Application. (Accession No. ML23122A289)
May 5, 2023	Letter to Bobby Gonzalez, Chairman, Caddo Nation of Oklahoma, Re ACU Molten Salt Research Reactor Construction Permit Application. (Accession No. ML23122A281)
May 5, 2023	Letter to E. Michael Silvas, Governor, Ysleta del Sur Pueblo, Re ACU Molten Salt Research Reactor Construction Permit Application. (Accession No. ML23122A285)
May 8, 2023	Letter to M. Wolfe, Texas Historic Commission, Request To Initiate Section 106 Consultation For Abilene Christian University Molten Salt Research Reactor Construction Permit Application (Docket No. 05000610). (Accession No. ML23009B607)
May 8, 2023	Letter to S. C. Bronin, Advisory Council On Historic Preservation, Request to Initiate Section 106 Consultation for Abilene Christian University Non-Power Molten Salt Research Reactor Construction Permit Review in Abilene, TX. (Accession No. ML23009B614)
May 9, 2023	Letter to K. Meyers, U.S. Dept of Interior, Fish & Wildlife Service, Request To Initiate Section 7 Consultation For Abilene Christian University Molten Salt Research Reactor Construction Permit Application (Docket No. 05000610). (Accession No. ML23013A259)
May 16, 2023	Email to NRC, from Caddo Nation of Oklahoma, Response Regarding Section 106 Consultation. (Accession No. ML23241A786)
May 23, 2023	Email to NRC, from Kickapoo Tribe of Oklahoma, Response Regarding Section 106 Consultation. (Accession No. ML23241A817)
June 12, 2023	Letter to NRC from L. Johnson, Advisory Council On Historic Preservation, Response Regarding Section 106 Consultation. (Accession No. ML23241A849)
June 12, 2023	Email to NRC from M. Wolfe, Texas Historic Commission, Response Regarding Section 106 Consultation. (Accession No. ML23241A826)

June 12, 2023	Email to NRC, from Delaware Nation of Oklahoma, Response Regarding Section 106 Consultation. (Accession No. ML23241A814)
August 11, 2023	Email to NRC from M. Wolfe, Texas Historic Commission, Final Response Regarding Section 106 Consultation. (Accession No. ML23241A819)
August 11, 2023	Email to C Brashear, Texas Historic Commission. (Accession No. ML23241A831)
August 14, 2023	Email to NRC, from Chitimacha Tribe of Louisiana, Response Regarding Section 106 Consultation. (Accession No. ML23241A793)
September 27, 2023	Email to NRC, from B. Beasley, Abilene Christian University, Response Regarding Environmental Review Requests for Confirmatory Information - Closure Confirmation. (Aession No. ML23271A020)