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NUREG-2263

Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor

Final Report

Office of Nuclear Material Safety and Safeguards

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ABSTRACT

The U.S Nuclear Regulatory Commission (NRC) has prepared this environmental impact statement (EIS) in response to an application submitted by Kairos Power, LLC (Kairos) for a construction permit (CP) for a non-power test reactor termed Hermes at a site in Oak Ridge, Tennessee. Kairos plans to build and operate Hermes to demonstrate key elements of the Kairos Power Fluoride Salt-Cooled, High Temperature Reactor technology for possible future commercial deployment. This EIS includes the analysis that evaluates the environmental impacts of the proposed action and considers the following two alternatives to the proposed action: (1) the no-action alternative (i.e., the CP is denied) and (2) building the proposed Hermes non-power test reactor at a site near Idaho Falls, Idaho.

After weighing the environmental, economic, technical, and other benefits against environmental and other costs, and considering reasonable alternatives, the NRC staff recommends, unless safety issues mandate otherwise, that the NRC issue the CP to Kairos once the NHPA Section 106 process is complete. The NRC staff based its recommendation on the following factors:

- the NRC staff's review of Kairos's environmental report (included as part of the CP application and revised in March 2023) and associated responses from Kairos to requests from the NRC staff for clarifying information;
- the NRC staff's review of comments received as part of the scoping process;
- the NRC staff's review of comments received on the draft EIS;
- the NRC staff's communications with, and comments received from, Federal, State, and local agencies, as well as Tribal officials; and
- the NRC staff's independent environmental review.

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EXECUTIVE SUMMARY

BACKGROUND

By letter dated September 29, 2021, Kairos Power, LLC (Kairos) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for a construction permit (CP) pursuant to Title 10 of the *Code of Federal Regulations* Part 50 (10 CFR Part 50, TN249) that would allow construction of a non-power test reactor termed Hermes on a 185-ac site in Oak Ridge, Tennessee (Kairos 2021-TN7879). The Atomic Energy Act of 1954 (42 U.S.C. 2011 *et seq*. TN663) authorizes the NRC to issue CPs for nuclear testing facilities. To issue a CP, the NRC is required to consider the environmental impacts of the proposed action under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq*., herein referred to as NEPA, TN661). The NRC's environmental protection regulations that implement NEPA in 10 CFR Part 51 (TN250) describe several types of actions that require an environmental impact statement (EIS). Issuing a CP for a nuclear testing facility is identified in 10 CFR 51.20 (TN250) as one type of action that requires an EIS.

Upon acceptance of the application, the NRC staff began the environmental review process described in 10 CFR Part 51 (TN250) by publishing a Notice of Intent in the *Federal Register* (87 FR 9394-TN7885) to prepare an EIS and to conduct scoping activities. In preparation of this EIS, the NRC staff performed the following:

- considered public comments received during a 60-day scoping process that began on February 18, 2022, and conducted a virtual public outreach and EIS scoping meeting on March 23, 2022;
- reviewed Kairos's environmental report submitted as part of the application (revised in March 2023) using guidance in Final Interim Staff Guidance Augmenting NUREG-1537, Part 1, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Format and Content," for Licensing Radioisotope Production Facilities and Aqueous Homogeneous Reactors; and Part 2, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Standard Review Plan and Acceptance Criteria" (NRC 2012-TN5527 and NRC 2012-TN5528);
- contacted Federal, State, and local agencies, as well as Tribal officials;
- conducted a virtual full scope environmental audit in March 2022 addressing proposed and alternative sites;
- consulted with Tribal Nations and other agencies such as the National Park Service, Tennessee Historical Commission, Advisory Council on Historic Preservation, and U.S. Fish & Wildlife Service;
- conducted an in-person meeting on the draft EIS on November 16, 2022, in Oak Ridge, Tennessee with the option for virtual attendance;
- considered comments received during a 60-day comment period starting on October 7, 2022 (87 FR 61014-TN8174; and
- prepared responses to public comments received during the comment period (see Appendix G to this EIS) and made changes to the draft EIS text as appropriate.

PROPOSED ACTION

The proposed Federal action is for the NRC to decide whether to issue a CP to Kairos under 10 CFR Part 50 (TN249) that would allow construction of the Hermes non-power test reactor. If the NRC were to issue a CP, Kairos could build the proposed reactor on a 185-acre site in the Heritage Center Industrial Park of the East Tennessee Technology Park in the City of Oak Ridge, Tennessee. The East Tennessee Technology Park is an industrial park established by the City of Oak Ridge on land formerly owned by the U.S. Department of Energy (DOE). The site was formerly occupied by DOE Buildings K-31 and K-33, which were both part of the former Oak Ridge Gaseous Diffusion Plant. DOE ceased operation of the Oak Ridge Gaseous Diffusion Plant in 1986. Both DOE buildings were since razed, and DOE has remediated the land environmentally and released it for industrial reuse, subject to restrictions.

Issuance of a CP is a separate licensing action from issuance of an operating license (OL), which allows operation of facilities built pursuant to a CP. If the NRC issues a CP, then Kairos would still have to obtain an OL before being able to operate the Hermes reactor. To obtain an OL, Kairos would have to submit a separate application pursuant to NRC requirements and receive the license before operating the reactor. To conduct a complete and effective environmental review, this EIS addresses the potential environmental impacts from the full life cycle of the Hermes reactor, including its construction, operation, and decommissioning. If, however, Kairos were to apply for an OL, the NRC staff would still have to prepare a supplement to this EIS in accordance with 10 CFR 51.95(b) (TN250).

PURPOSE AND NEED FOR ACTION

The purpose and need of this proposed Federal action is to allow Kairos to build and operate a non-power test reactor to demonstrate key elements of the Kairos Power Fluoride Salt-Cooled, High Temperature Reactor technology for possible future commercial deployment. Operation of the Hermes reactor would not generate any power for sale or distribution. The technology is an advanced nuclear reactor technology that leverages TRI-structural ISOtropic (TRISO) particle fuel in pebble form combined with a low-pressure fluoride salt coolant. The Hermes reactor would support Kairos's reactor development program, which relies on learning and risk reduction by narrowing the design space through progressive test cycles. Construction and operation of the Hermes reactor would also provide validation and qualification data to support potential future commercial reactors using the Kairos Power Fluoride Salt-Cooled, High Temperature Reactor technology.

The determination of need and the decision to build a test reactor such as Hermes are at the discretion of applicants such as Kairos. This definition of purpose and need reflects the NRC's recognition that, unless there are findings in the safety review required by the Atomic Energy Act of 1954 (TN663), as amended, or findings in the environmental analysis under NEPA that would lead the NRC to reject a CP application, the agency does not have a role in the planning decisions as to whether a particular test reactor should be constructed and operated.

ENVIRONMENTAL IMPACTS OF CONSTRUCTION, OPERATIONS, AND DECOMMISSIONING

The EIS evaluates the potential environmental impacts of the proposed action. The environmental impacts from the proposed action are designated as SMALL, MODERATE, and LARGE, as presented in the final interim staff guidance to NUREG-1537 (NRC 2012-TN5527 and NRC 2012-TN5528):

SMALL: Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. In assessing radiological impacts, the NRC has concluded that those impacts that do not exceed permissible levels in the agency's regulations are considered SMALL.

MODERATE: Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE: Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Table ES-1 summarizes the NRC's staff's findings on the level of direct, indirect, and cumulative impacts on environmental resources from the construction, operation, and decommissioning of the proposed Hermes project.

ALTERNATIVES

The NRC staff considered the environmental impacts associated with the following alternatives to constructing the Hermes non-power test reactor project at the proposed site in Oak Ridge:

- the no-action alternative; and
- construction, operation, and decommissioning of the Hermes non-power test reactor at an alternative site, termed the Eagle Rock alternative site, near Idaho Falls, Idaho.

The NRC staff considered possible alternative sites, alternative layouts of proposed facilities within a site, modification of existing facilities instead of building new facilities, alternative technologies, and alternative transportation methods. The NRC staff determined that there were no other reasonable alternatives that warranted detailed consideration in the EIS.

The NRC staff evaluated each alternative using the same resource areas that were used in evaluating impacts from the proposed action. The NRC staff determined that the no-action alternative would result in SMALL impacts to all resource areas. However, the no-action alternative does not fulfill the action's purpose and need. The NRC staff determined that construction, operation, and decommissioning of the Hermes non-power test reactor project at the Eagle Rock alternative site would result in only SMALL impacts for most affected resources, but that it would result in MODERATE impacts to land use and visual resources, ecological resources, and historic and cultural resources. The proposed action, which would also meet the purpose and need but result in only SMALL environmental impacts to all affected resources, would therefore be the environmentally preferrable action. The proposed site in Oak Ridge allows for siting the Hermes non-power test reactor project while disturbing only previously disturbed soils with a history of past industrial development, while avoiding natural vegetation, wetlands, surface water features, agricultural land, and shallow subsurface cultural resources.

RECOMMENDATION

After weighing the environmental, economic, technical, and other benefits against environmental and other costs, and considering reasonable alternatives, the NRC staff recommends, unless safety issues mandate otherwise, that the NRC issue the CP to Kairos once the NHPA Section 106 process is complete. The NRC staff based its recommendation on the following factors:

- the NRC staff's review of Kairos's environmental report (included as part of the CP application), information gathered during the environmental audit, and responses from Kairos to requests from the NRC staff for clarifying information;
- consideration of public comments received during the environmental review;
- the NRC staff's communications with, and comments received from, Federal, State, and local agencies, as well as Tribal officials; and
- the NRC staff's independent environmental review and assessment summarized in this EIS.

Table ES-1 Summary of Environmental Impacts from Construction, Operation, and Decommissioning of Proposed Hermes Facilities

Resource Area	Summary of Impact	Impact Level
Land use and visual resources	Temporary disturbance of 138 ac of land previously occupied by industrial DOE buildings. Permanent occupation of 30 ac of the same land. Limited land use options for the entire 185-ac Hermes site, which would be designated as an exclusion area throughout operations. Site is within established industrial park. DOE has cleaned up the site to support industrial redevelopment, subject to restrictions, and privatized ownership. DOE currently restricts use of groundwater within the Heritage Center and continues to pursue remediation of groundwater contamination. Setting is already industrial and of low scenic quality. Facilities would have an industrial appearance compatible with an existing industrial park. Hermes project is compatible with existing City of Oak Ridge zoning.	SMALL
Air quality and noise	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 be used to mitigate fugitive dust releases.	SMALL
Hydrogeology and water resources	No disturbance of geological features of economic or natural value. Disturbances limited to previously disturbed soils. Best management practices (BMPs) would be employed for soil erosion and sediment control. Water demands would be met through municipal or commercial suppliers. Kairos does not propose any use of groundwater and does not propose any direct use of surface water. No cooling towers, ponds (other than for stormwater management), or reservoirs. Wastewater discharged for treatment to municipal wastewater treatment facilities. Limited, temporary dewatering of building excavations for construction. Dewatering water would be dispositioned in accordance with DOE requirements per the quit claim deed for the site. Stormwater would be managed using BMPs. DOE currently restricts use of groundwater within the Heritage Center and continues to pursue remediation of groundwater contamination.	SMALL

Table ES-1 Summary of Environmental Impacts from Construction, Operation, and Decommissioning of Proposed Hermes Facilities (Continued)

Resource Area	Summary of Impact	Impact Level
Ecological resources	Ground disturbance would be limited to areas of previously disturbed soils that are unvegetated or support only ruderal early successional vegetation. No disturbances to forest cover or other natural vegetation growing on 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. Localized, minor increases in noise may affect wildlife, but area wildlife already experiences industrial noise. Limited potential for wildlife to collide with new structures or be injured by vehicles. The Federally endangered gray bat (*Myotis grisescens*) and Indiana bat (*M. sodalis*) and Federally threatened northern long-eared bat (*M. septentrionalis*) are known to occur in the Oak Ridge area and may forage transiently on the site, but no potential roosting or breeding habitat would be disturbed and foraging individuals can be expected to avoid areas of human activity. The U.S. Fish and Wildlife Service (FWS) concurred on January 27, 2023 with the NRC staff's conclusions that the licensing action would not adversely affect resources protected under the Endangered Species Act.	SMALL
Historic and cultural resources	No adverse effects to historic properties as none are known to exist in direct effects area of potential effects. Kairos is developing an Archaeological Resources Monitoring and Unanticipated Discovery Plan establishing stop work and notification procedures to address unexpected discovery of human remains or archaeological material in compliance with Quitclaim deed requirements and Tennessee State law. The National Register of Historic Places eligible Manhattan Project National Historical Park is located in the indirect effects area of potential effects but will not be adversely affected, because the setting of the proposed Kairos project is in keeping with the current setting of the Manhattan Project National Historical Park.	SMALL
Socioeconomics and environmental justice (EJ)	Construction of Hermes would involve an average of 212 site workers per year over a two-year period, with an estimated peak of 425 workers. Staffing during the four-year operation would average 38 workers per weekday (68 full time positions). Decommissioning would involve an estimated peak employment level of 340 workers. These 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 Hermes project and the distance of the site from the closest census blocks with populations meeting EJ criteria (over 8 mi away) indicate little potential for EJ effects.	SMALL
Human health	Site was formerly occupied by buildings part of the DOE Oak Ridge Gaseous Diffusion Plant used to enrich uranium, but DOE has already razed the buildings and remediated the site for industrial reuse subject to restrictions. DOE retains responsibility for remediation following any unanticipated discovery of legacy wastes. Based on information in the CP application, the NRC staff expects that radiological releases, doses to the public, and occupational	SMALL

Table ES-1 Summary of Environmental Impacts from Construction, Operation, and Decommissioning of Proposed Hermes Facilities (Continued)

Resource Area	Summary of Impact	Impact Level
	doses would be less than the limits established for protection of human health and the environment in 10 CFR Part 20 (TN283). Applicant 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.	
Nonradiological waste management	Kairos would develop and implement a plan to manage wastes generated by the Hermes facilities. Management of solid waste, including construction and demolition waste, would involve waste reduction efforts, recycling, and BMPs. Liquid wastes would be discharged for municipal treatment at a wastewater treatment plant or trucked offsite for proper disposal. Gaseous emissions would comply with Tennessee Department of Environment and Conservation regulations.	SMALL
Uranium fuel cycle and radiological waste management	Low quantity of uranium used during the four-year operational period. TRISO fuel processes (including enrichment and fuel fabrication) are bounded by Table S-3, developed by NRC to protect human health and the environment. Environmental impacts from storage of spent TRISO fuel from Hermes is bounded by the analysis in the Continued Storage Generic EIS. Estimated volume of low-level radioactive waste (LLRW) is less than or comparable to that from a light water reactor, and the NRC staff determined that there is adequate capacity at LLRW disposal sites and that LLWR sites would accept the LLRW from Hermes. Onsite storage of spent TRISO fuel would have to meet the same regulatory requirements as currently licensed light water reactors.	SMALL
Transportation	Transportation of radioactive fuels and wastes to and from Hermes would be performed in compliance with U.S. Department of Transportation and NRC regulations and constitute only a small percentage of the total materials of these types shipped each year.	SMALL
Accidents	NRC staff is conducting an independent review of the consequences of accidents and has documented it in its Safety Evaluation (SE). To receive a CP, the Hermes test reactor would have to meet the NRC requirements for postulated accidents, where potential doses at the exclusion area boundary and in the low population zone are below the dose reference values of 10 CFR Part 100 (TN282) for test reactor siting. Additionally, as another indication of the low-level of environmental impacts, the nearest resident dose from accidents is also below the radiation dose limits for individual members of the public in 10 CFR 20.1301(a) (TN283).	SMALL
Climate change	Climate change is a global phenomenon that the construction, operation, and decommissioning of the proposed Hermes test reactor would not appreciably alter. None of the impact conclusions in this EIS for the Hermes facilities would change as a result of climate change.	SMALL

ABBREVIATIONS AND ACRONYMS

°F	degree(s) Fahrenheit
%	percent
ac	acre(s)
µCi/mL	micro-curie(s) per milliliter
ACS	American Community Survey
ADAMS	Agencywide Document Access and Management Systems
AECOM	AECOM Technical Services, Inc.
APE	Area of potential effects
ARDP	Advanced Reactor Demonstration Program
Atlas facility	Kairos Atlas Fuel Fabrication Facility
BA	biological assessment
BMP	best management practice
C	pyrolytic carbon
CAA	Clean Air Act
CBG	Census Block Group
CEQ	Council on Environmental Quality
CFPP	Carbon Free Power Project
CFR	*Code of Federal Regulations*
CH_4	methane
Ci/m^3	curie(s) per meter cubed
Ci/yr	curie(s) per year
cm	centimeter(s)
CO	carbon monoxide
CO_2	carbon dioxide
CO_2eq	carbon dioxide equivalent
CO_2eq/kWh	carbon equivalent per kilowatt hour
CP	construction permit
CRN	Clinch River Nuclear
cy or yd^3	cubic yard(s)
dB	decibel(s)
dBA	A-weighted sound levels
DBA	design basis accidents
DHRS	Decay Heat Removal System
DOE	U.S. Department of Energy
EA	environmental assessment
EAB	exclusion area boundary
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ER	environmental report
ESA	Endangered Species Act
ETTP	East Tennessee Technology Park

FR	*Federal Register*
ft	foot/feet
ft^3	cubic foot
ft^3/yr	cubic foot per year
FWS	U.S. Fish & Wildlife Service
g	gram(s)
g/MT-km	gram per metric ton-kilometer
g/T-mi	gram per ton-mile
gal	gallon(s)
GCRP	U.S. Global Change Research Program
GHGs	greenhouse gases
gpd	gallon(s) per day
gpm	gallon(s) per minute
GWd/MTU	gigawatt-day(s) per metric ton of uranium
GWP	global warming potential
HALEU	High-Assay Low Enriched Uranium
HAP	hazardous air pollutant
Heritage Center	Heritage Center Industrial Park
Horizon Center	Horizon Center Industrial Park
hr/yr	hour(s) per year
in	inch(s)
IpaC	Information for Planning and Consultation
ISFSI	Independent Spent Fuel Storage Installations
Kairos	Kairos Power, LLC
km	kilometer(s)
km/L	kilometer(s) per liter
lb	pound(s)
lb/MWh	pound(s) per megawatt-hour
LLRW	low-level radioactive waste
LOS	Level of Service
LPZ	Low Population Zone
LR	License Renewal
LWR	Light water reactors
m	meter(s)
m^3	cubic meter(s)
MEI	maximally exposed individual
mg	million gallon
mgd	million gallon(s) per day
MHA	maximum hypothetical accident
mi	mile(s)
mi/gal	mile(s) per gallon
mi^2	square miles
MOA	Memorandum of Agreement
mph	mile(s) per hour

mrem	millirem (s)
mrem/yr	millirem (s) per year
MT CO_2eq	metric ton(s) of carbon dioxide equivalent
MT	metric ton(s)
MTU	metric ton(s) of uranium
MTU/yr	metric ton(s) of uranium per year
MWd/MT	megawatt(s)-day per metric ton
Mwe	megawatt(s) electric
MWh	megawatt-hour
MWt	megawatt(s) thermal
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NHP	National Historical Park
NHPA	National Historic Preservation Act
NIOSH	National Institute of Occupational Safety and Health
NO_2	nitrogen dioxide
NPDES	National Pollutant Discharge Elimination System
NPP	nuclear power plant
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
O_3	ozone
OL	operating license
ORGDP	Oak Ridge Gaseous Diffusion Plant
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSHA	U.S. Occupational Safety and Health Administration
Pb	lead
PCB	polychlorinated biphenyl
PHSS	pebble handling and storage system
PM	particulate matter
PSAR	preliminary safety analysis report
PSD	Prevention of Significant Deterioration
ROI	region of interest
RRY	reference reactor-year
SAFSTOR	SAFe STORage
scf	standard cubic feet
SE	safety evaluation
Sequoyah	Sequoyah Nuclear Plant
SF_6	sulfur hexafluoride
SiC	silicon carbide
SO_2	sulfur dioxide
SOI	Secretary of the Interior
SR	State Route

SWPP	Storm Water Pollution Prevention Plan
TDEC	Tennessee Department of Environment and Conservation
TEDE	total effective dose equivalent
THC	Tennessee Historical Commission
THPO	Tribal Historic Preservation Officer
TMS	tritium management system
TPY	ton(s) per year
TRISO	TRI-structural ISOtropic
TVA	Tennessee Valley Authority
U-235	uranium-235
UC	uranium carbide
UC_2	uranium dicarbide
UF_6	uranium hexafluoride
UO_2	uranium dioxide
VOC	volatile organic compounds
VP	Versa-Pac
Watts Bar	Watts Bar Nuclear Plant
WCS	Waste Control Specialists, LLC
WWTP	Wastewater Treatment Plant
µm	micrometer(s)

1.0 INTRODUCTION

By letter dated September 29, 2021, Kairos Power, LLC (Kairos) submitted Part 1 of a two-part application to the U.S. Nuclear Regulatory Commission (NRC) for a construction permit (CP) pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50 (TN249), that would allow construction of a non-power test reactor termed Hermes on a 185 acre (ac) site located in Oak Ridge, Tennessee (Kairos 2021-TN7879). Section 104 of the Atomic Energy Act of 1954, as amended, (42 U.S.C. 2011 *et seq*. TN663) and its implementing regulations authorize the NRC to issue CPs for testing facilities. To issue a CP, the NRC is required to consider the environmental impacts of the proposed action under the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq*. TN661, herein referred to as NEPA). The NRC's environmental protection regulations that implement NEPA in 10 CFR Part 51 (TN250) describe several types of actions that would require an environmental impact statement (EIS). CPs and operating licenses (OLs) for test facilities are identified in 10 CFR 51.20 (TN250) as actions that require an EIS.

Applicants for NRC licenses are required under 10 CFR 51.45 (TN250) to submit an environmental report (ER) containing a description of the proposed project, a statement of its purposes, a description of the affected environment, and specific information needed for by the NRC staff to evaluate the potential environmental impacts. After initially submitting Part 1 of the Kairos Hermes application (consisting of its preliminary safety analysis report [PSAR]), on October 31, 2021, Kairos submitted an ER with information needed to assess potential environmental impacts from the CP licensing action (Kairos 2021-TN7880). On March 30, 2023, Kairos submitted Revision 1 of its ER to the NRC (Kairos 2023-TN8172). Unless stated otherwise, any reference to the ER in this final EIS refers to Revision 1.

The NRC staff also made frequent use of the final EIS recently completed as part of the environmental review for an application submitted by the Tennessee Valley Authority for an early site permit for a small modular reactor project (the Clinch River Nuclear [CRN] project) on a site also located within the City of Oak Ridge, situated approximately 2 miles (mi) south of where Hermes would be built (NRC 2019-TN6136). The CRN and Hermes projects are separate and unrelated actions, but because of the proximity of the CRN site to the Hermes site and the recency of the CRN EIS, the staff determined that the CRN EIS contains useful information about the environmental resources in the Oak Ridge region. The CRN project is also considered among the other projects proposed in the Oak Ridge region that might contribute to the cumulative impacts of the Hermes project on environmental resources in the region. Cumulative impacts are addressed in Section 3.0 of this EIS in separate sections addressing each environmental resource considered.

1.1 The Proposed Federal Action

The proposed action is for the NRC to issue a CP to Kairos authorizing construction of the Hermes reactor. The site is situated in the Heritage Center Industrial Park of the East Tennessee Technology Park, an industrial park established by the City of Oak Ridge, on land formerly owned by the U.S. Department of Energy (DOE) for the Oak Ridge Gaseous Diffusion Plant (ORGDP). The site was formerly occupied by DOE Buildings K-31 and K-33, which were both part of the ORGDP (Figure 1-1). DOE ceased operation of the ORGDP in 1986. Both DOE buildings were since razed, and the land has been environmentally remediated and released for industrial reuse with restrictions.

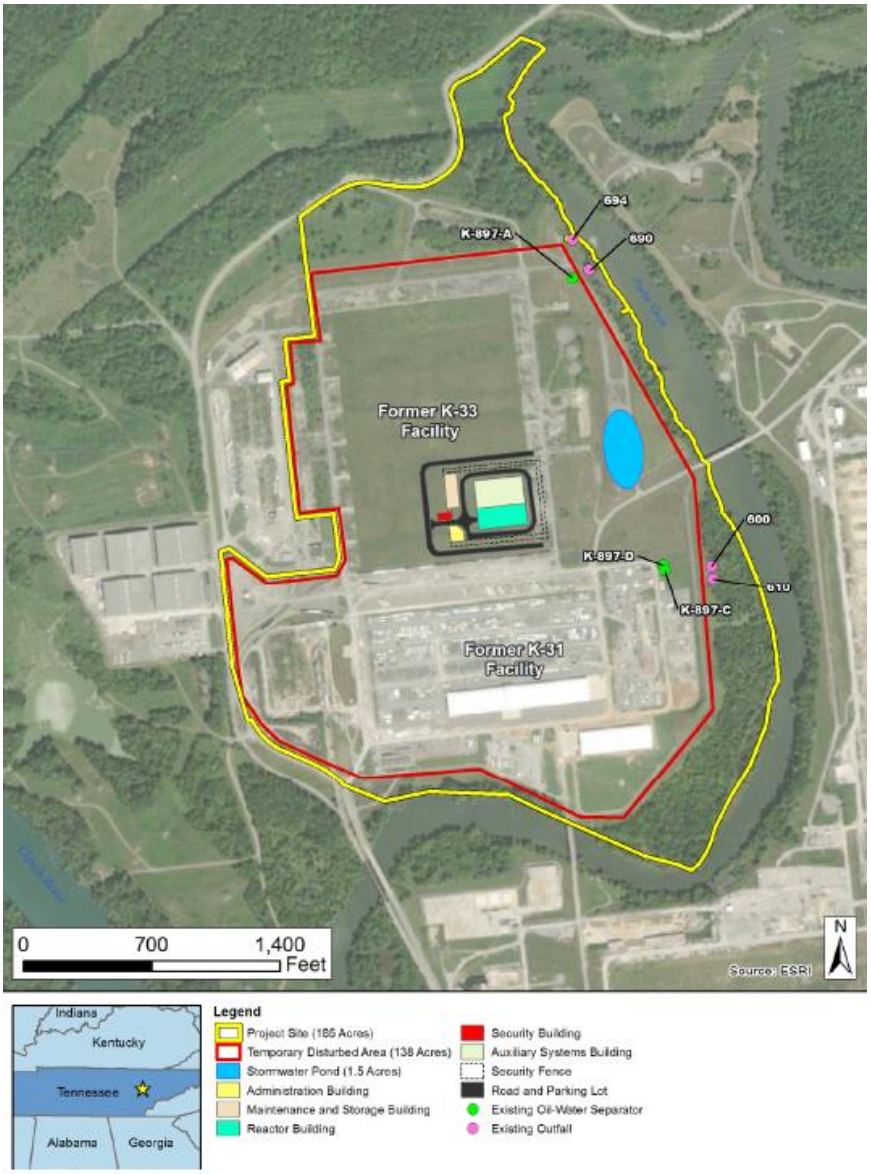

Figure 1-1 Hermes Reactor Site. Source: Kairos 2021-TN7880.

This final EIS constitutes the NRC staff's review of potential environmental impacts from the proposed action of issuing a CP, as required under 10 CFR 51.70 *et seq*. and 10 CFR 51.90 *et seq.* (TN250). Section 2.0 provides more information about the proposed Hermes project. The issuance of a CP is a separate licensing action from the issuance of an OL. If the NRC issues a CP and Kairos were to seek NRC approval to operate the reactor, then Kairos would have to submit a separate application for an OL pursuant to the NRC's requirements and Kairos would have to obtain NRC approval before it can operate the Hermes testing facility. To conduct a complete environmental review, this final EIS covers the potential impacts from the construction, operation, and decommissioning life-cycle phases of the Hermes project. The NRC staff recognizes that new and significant information regarding operation and decommissioning may become available subsequent to issuance of the CP. The NRC staff would therefore review any application for an OL for the Hermes project for new and significant information that might alter

the staff's conclusions made for this CP application. If Kairos were to apply for an OL, the NRC staff would prepare a supplement to this final EIS in accordance with 10 CFR 51.95(b) (TN250).

1.2 Purpose and Need

Kairos proposes to build and operate the Hermes facility to demonstrate key elements of the Kairos Power Fluoride Salt-Cooled, High Temperature Reactor (KP-FHR) technology for possible future commercial deployment (Kairos 2023-TN8172 │ Sec 1.3). Operation of the Hermes reactor would not generate any power for sale or distribution. The technology is an advanced nuclear reactor technology that leverages TRI-structural ISOtropic (TRISO) particle fuel in pebble form combined with a low-pressure fluoride salt coolant. The Hermes reactor would support Kairos's reactor development program, which relies on learning and risk reduction by narrowing the design space through progressive test cycles (Kairos 2023-TN8172 │ Sec 1.3). Kairos states that construction and operation of Hermes would also provide validation and qualification data to support potential future commercial reactors using the KP-FHR technology (Kairos 2023-TN8172 │ Sec 1.3).

Kairos participates in DOE's Advanced Reactor Demonstration Program (ARDP), which assists private industries in the United States in demonstrating advanced nuclear reactors, with the goal of designing and developing safe and affordable reactor technologies that can be licensed and deployed over the next 10 to 14 years. Kairos states that the need for the project is tied to DOE's objectives under the ARDP (Kairos 2023-TN8172 │ Sec 1.3).

1.3 The NRC Application Review

The NRC process to review applications for CPs consists of two separate, parallel reviews. The safety review evaluates the applicant's ability to meet the NRC regulatory safety requirements. The NRC staff documents the findings of the safety review in a Safety Evaluation (SE). The SE was published on June 13, 2023 (NRC 2023-TN8414). The environmental review, governed by NEPA and the requirements in 10 CFR Part 51 (TN250), evaluates the environmental impacts of, and alternatives to, the proposed action. This final EIS presents the results of this evaluation. The NRC considers the findings in both the EIS and the SE in its decision to grant or deny the issuance of a CP.

To guide its assessment of environmental impacts, the NRC staff uses three levels of significance for potential impacts: SMALL, MODERATE, and LARGE, as defined below:

- **SMALL** – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
- **MODERATE** – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
- **LARGE** – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

To conduct its environmental review, the NRC staff used guidance contained in the Final Interim Staff Guidance Augmenting NUREG–1537, Part 1, *Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Format and Content, for Licensing Radioisotope Production Facilities and Aqueous Homogeneous Reactors;* (NRC 2012-TN5527) and Part 2, *Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Standard Review Plan and Acceptance Criteria," for Licensing Radioisotope*

Production Facilities and Aqueous Homogeneous Reactors (NRC 2012-TN5528). Because the Hermes project is a non-power reactor, the NRC staff considered the guidance developed to accompany NUREG-1537 to be the best available NRC guidance most applicable to licensing a test reactor project such as Hermes. As both volumes of the Final Interim Staff Guidance note, use of the guidance is not mandatory and does not substitute for compliance with NRC regulations. The NRC staff therefore ensured that its environmental review, as documented in this final EIS, met the applicable regulations in 10 CFR Part 51 (TN250) and used the guidance associated with NUREG-1537 only as supplementary direction.

In October 2021, Kairos submitted its ER (Kairos 2021-TN7880) as Part 2 of its two-part CP application submittal, as discussed above. On November 29, 2021, the NRC notified Kairos of its decision that the application (including the ER) was sufficient to conduct its detailed review (NRC 2021-TN7893). The NRC staff published a Notice of Acceptance for Docketing in the *Federal Register* on December 1, 2021 (86 FR 68290-TN7884) and a separate *Federal Register* Notice of Intent to prepare an EIS and conduct a scoping process on February 18, 2022 (87 FR 9394-TN7885). Issuance of the scoping notice initiated the 60-day scoping period.

On March 23, 2022, the NRC held a virtual joint public outreach and scoping meeting to discuss the safety and environmental reviews for the CP application from Kairos and obtain public input on the scope of the environmental review (NRC 2022-TN8173). The NRC staff also contacted Federal, State, Tribal, regional, and local agencies to solicit comments. Correspondence between the NRC and Federal, State, Tribal, regional, and local agencies is included in Appendix C of this EIS. The NRC's report entitled, *Environmental Impact Statement Scoping Process Summary Report for the Kairos Hermes Construction Permit Application*, presents the comments received during the scoping process (NRC 2022-TN7953).

In March 2022, the NRC staff conducted a virtual audit to verify information in the Kairos ER. During the audit, the NRC staff reviewed specific documentation and discussed specific information needs with Kairos staff and their contractors. The information needs and the pertinent points from that audit are documented in the staff's audit summary report (NRC 2022-TN7954).

A 60-day comment period began on October 7, 2022, when the U.S. Environmental Protection Agency published its Notice of Filing of the draft EIS (87 FR 61014-TN8174) to allow members of the public and other interested parties to comment on the results of the review. During the public comment period, a public meeting was held on November 16, 2022, in Oak Ridge, Tennessee with the option for virtual attendance (NRC 2023-TN8171). The NRC staff described the results of the environmental review, provided attendees with information to assist them in formulating comments on the draft EIS, responded to questions, and accepted comments. Approximately 100 people attended the public comment meeting (including virtual attendees) and numerous attendees provided oral comments. In addition to comments received at the public meetings, twenty-three letters and email messages were received. Appendix G presents the comments received on the draft EIS, provides responses to the comments, and indicates whether and where the draft EIS was revised as a result of a comment.

This final EIS presents the NRC staff's analysis that considers and weighs the environmental impacts of the Hermes project at the proposed site, including the environmental impacts associated with the construction, operation, and decommissioning of the proposed facilities; the impacts of constructing, operating, and decommissioning the same facilities at an alternative site; the no-action alternative; and mitigation measures available for reducing or avoiding

adverse environmental effects. It also provides the NRC staff's recommendation to the Commission regarding the issuance of the CP for the proposed Kairos Hermes facility at the site in Oak Ridge, Tennessee.

1.4 Regulatory Provisions, Permits, and Required Consultations

The applicant has identified each environmental regulatory requirement, permit, and consultation necessary for construction of the proposed Hermes project in Tables 1.4-1 and 1.4-2 of the ER (Kairos 2023-TN8172 | Sec 1-4). The applicant bears the responsibility for applying for each of the permits listed in Table 1.4-1 of the ER. The NRC staff bear the responsibility for performing each of the consultations listed in Table 1.4-2 of the ER required under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*. TN1010) and National Historic Preservation Act of 1966, as amended (54 U.S.C. 300101 *et seq*. TN4157).

1.5 Preconstruction Activities

In a final rule dated October 9, 2007 (72 FR 57416-TN260), the Commission established the definition of "construction" in 10 CFR 51.4 (TN250) as those activities that fall within its regulatory authority. Many of the activities required to build a test reactor are not part of the NRC action to license the Hermes facility because they do not have a reasonable nexus with radiological health and safety and/or common defense and security; therefore, they are not within the NRC's authority to regulate. Activities associated with building the proposed facility that are not within the purview of the NRC action are grouped under the term "preconstruction." Under 10 CFR 51.45 (TN250), applicants are required to include in an ER a description of the impacts of the applicant's preconstruction activities.

Preconstruction activities include clearing and grading, excavating, building of service facilities (e.g., paved roads, parking lots), erection of support buildings, and other associated activities. These preconstruction activities may take place before the application for a CP is submitted, during the staff's review of a CP application, or after a CP is granted. Consequently, the NRC evaluates preconstruction impacts as cumulative impacts and not as direct impacts resulting from the NRC's Federal action. Although preconstruction activities are outside the NRC's regulatory authority, many are within the regulatory authority of local, State, or other Federal agencies.

The applicant could choose to perform preconstruction work before receipt of the requested CP, or even if the NRC never issues the CP. However, because the preconstruction is a precursor to NRC-authorized construction of the proposed Kairos Hermes test reactor, and because discussion of pre-construction and construction impacts together enhances the readability of the document, Section 3.0 of this EIS presents a single combined discussion of preconstruction and construction impacts for each resource. Because the conclusions determined by the staff in this EIS for all combined preconstruction and NRC-authorized construction activity impact category levels are SMALL for all resource areas (e.g., land use, water resources), no further breakdown of impacts between preconstruction and NRC-authorized construction is provided.

1.6 Report Contents

The sections of this EIS are organized as follows: Section 1.0 is this introduction. Section 2.0 provides a description of the proposed Hermes project summarizing key elements of the design needed by the staff to evaluate potential environmental impacts. Most of the information in Section 2.0 is drawn from the applicant's description of their project in the ER, PSAR, and other

parts of the application. Section 3.0 describes the affected environment for each of the 12 environmental resources identified by the NRC staff through its scoping process, followed by the staff's evaluation of potential environmental impacts on each resource. The staff independently verified and summarized the affected environment descriptions from the ER and other public documents, relying on incorporation by reference to the extent possible to simplify the EIS. The staff developed their evaluations of environmental impacts independently from the applicant, but the staff relied in part on impact data presented by the applicant after independent verification. Section 4.0 of this EIS presents the staff's evaluation of a range of reasonable alternatives to the proposed action. Section 5.0 summarizes the staff's conclusions and recommendation to the NRC Commission based on the environmental review.

The appendices to this EIS contain the following additional information:

Appendix A – Contributors to the Environmental Impact Statement

Appendix B – Agencies, Organizations, and Individuals Contacted

Appendix C – Chronology of Key Environmental Review Correspondence

Appendix D – Regulatory Compliance and List of Federal, State, and Local Permits and Approvals

Appendix E – Greenhouse Gas Emissions

Appendix F – Viewshed Photographs at Nearby Historic and Cultural Resources

Appendix G – Draft Environmental Impact Statement Comments and Responses

2.0 PROPOSED PROJECT

The proposed Federal action is for the U.S. Nuclear Regulatory Commission (NRC) to issue a construction permit (CP) to Kairos Power, LLC (Kairos) under Title 10 of the *Code of Federal Regulations* Part 50 (TN249) to construct the proposed Kairos Hermes non-power demonstration reactor in Oak Ridge, Tennessee. After receipt of a CP from the NRC, the applicant is required to apply for a separate operating license (OL) under 10 CFR Part 50 (TN249) before reactor operation. The NRC would perform a separate environmental review for the OL application. The information presented below summarizes key characteristics of the Hermes project that the NRC staff considered when assessing the environmental impacts of the proposed action. The summaries focus on construction of the proposed facilities but also include general information about operation and decommissioning of the facilities to the extent currently known. Any new and significant information not addressed in the environmental review for the CP would be addressed as necessary in any subsequent environmental review for an OL application.

2.1 Project Overview

The Hermes project would test and demonstrate key technologies, design features, and safety functions of the Kairos Power Fluoride Salt-Cooled, High Temperature Reactor (KP-FHR) technology; and it would provide data that may be used for validation of safety analysis tools and computational methodologies used for designing and licensing future reactors using the technology (Kairos 2023-TN8172 │ Sec 2.1). Kairos plans to begin construction as early as 2023 (Kairos 2023-TN8172 │ Sec 2.1) with an operational life of 4 years. The NRC staff recognizes that the applicant's estimated dates for construction, operation, and decommissioning are approximate and that the actual dates might differ. Information related to land disturbance, onsite workers, and material usage is provided in Chapter 2 of the environmental report (ER) and summarized in the sections below.

The proposed Kairos Hermes non-power demonstration reactor would demonstrate an advanced nuclear reactor technology that leverages TRI-structural ISOtropic (TRISO) particle fuel in pebble form with a low-pressure fluoride salt coolant (Kairos 2023-TN8172 │ Sec 1.3). The proposed facilities would house one Hermes reactor, as described in Section 2.3 of the ER (Kairos 2023-TN8172). A process flow diagram for the Hermes reactor is presented in Figure 2.3-1 of the ER (Kairos 2023-TN8172). The core configuration would consist of a pebble bed core, graphite moderator/reflector, and a lithium tetrafluoroberyllate (Li_2BeF_4, Flibe) molten salt coolant (Kairos 2023-TN8172 │ Sec 2.3). Flibe has several important properties for use in a nuclear reactor, such as neutronic factors and stability at high temperatures. Additional information about Flibe is provided in Chapter 2 of the Kairos Topical Report Reactor Coolant for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor", KP-TR-005-NP (Kairos 2020-TN7988 | Sec 2.1). The facilities would contain one unit with a maximum thermal power of 35 megawatts (MW) (Kairos 2023-TN8172 │ Sec 2.3). Because Hermes would be a research and demonstration reactor, the heat generated would not be used to generate electric power. Instead, the heat would be transported out of the core by a primary heat transport system and dissipated to the atmosphere by a heat rejection radiator (Kairos 2022-TN7882). The reactor core would be fueled using graphite pebbles with a diameter of 4 centimeter (cm) with embedded coated TRISO particle fuel (Kairos 2023-TN8172 │ Sec 2.3). The particles would comprise a uranium fuel kernel and three layers of carbon and ceramic-based materials that prevent the release of radioactive fission products (Kairos 2023-TN8172 │ Sec 2.3). The maximum enrichment of the uranium would be up to 19.55 wt% (Kairos 2023-TN8172 │ Sec 2.3).

2.2 Site Location and Layout

The applicant describes the site location and layout in Section 2.2 of the ER (Kairos 2023-TN8172). Kairos is proposing the new facilities to be built at a 185-acre (ac) site in the East Tennessee Technology Park. As depicted in Figure 2.2-1 of the ER (Kairos 2023-TN8172), construction would involve approximately 135 ac of land on the site that had previously been occupied by Buildings K-31 and K-33, which were formerly part of the U.S. Department of Energy (DOE) Oak Ridge Gaseous Diffusion Plant complex on the Oak Ridge Reservation (ORR). The new facilities would occupy approximately 30 ac within the former footprint of the K-33 facility. Figure 2.2-3 of the ER (Kairos 2023-TN8172) depicts the proposed layout of the new facilities, which would include a reactor building, auxiliary systems building, maintenance and storage building, administration building, security building, security fence, and roads and parking lots. Use of the site would take advantage of existing roads and other utilities within the Heritage Center Industrial Park of the East Tennessee Technology Park, and no land outside of the indicated 135 ac would be disturbed to build, operate, or decommission the new facilities. The only new roads and parking lots that would need to be constructed would be built within the 30 ac tract to directly service the new buildings. The Hermes project 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, heavy haul roads, batch plants, or other offsite facilities.

2.3 Site Workers and Vehicular Deliveries

The applicant estimates the numbers of site workers and vehicular deliveries in Section 2.1 of the ER (Kairos 2023-TN8172). The applicant estimates that construction would require an estimated average of 212 onsite workers, with 425 at peak times, and would involve a monthly average of 213 truck deliveries and four-offsite shipments of construction debris. Operation is estimated to involve an average of 38 workers per weekday (68 full-time positions), with an estimated monthly average of 15 truck deliveries and four-offsite waste shipments. The applicant estimates that decommissioning would require an average of 170 workers (340 workers at peak times) and a monthly average of four-truck deliveries and 170 offsite waste shipments (Kairos 2023-TN8172 │ Sec 2.1).

2.4 Equipment and Material Usage

The applicant provides estimates of anticipated equipment and material use by the project in Section 2.1 of the ER (Kairos 2023-TN8172). Table 2.1-1 in the ER (Kairos 2023-TN8172) provides the applicant's estimates of material such as concrete and steel that would be consumed during construction. Table 2.1-2 in the ER (Kairos 2023-TN8172) presents a list of equipment that the applicant proposes to use during the construction and decommissioning phases. The applicant also provides estimates of anticipated shipments of coolants and other process chemicals, diesel fuel for the standby diesel generator, and other materials. Hazardous materials stored onsite during operation include Flibe, lubricating oil, and cleaning materials and consumables used for cleaning and maintenance. As much as 21,555 gallons (gal) of diesel fuel for the standby diesel generator would be stored in an onsite storage tank. The applicant would connect an electrical distribution line to nearby electric transformers serving the existing Heritage Center Industrial Park to provide electricity to the new Hermes facilities. The staff expects that building and operating this distribution line, which would be located within an existing industrial park, would have no potential for noticeable environmental impacts.

2.5 Water Consumption and Treatment

A detailed description of how the applicant would obtain, use, and discharge water is provided in Section 2.4 of the ER (Kairos 2023-TN8172). The applicant's proposed water balance diagram for the new facilities is depicted in Figure 2.4-1 of the ER (Kairos 2023-TN8172). Water demands during construction, operation, and decommissioning of the proposed facilities would be met using municipal sources or truck deliveries; and wastewater generated by the operation of the proposed facilities would be discharged into municipal sewers that service the East Tennessee Technology Park. The project would not involve the use of any raw surface water or groundwater and, therefore, would not involve building or operation of intake or discharge pipelines. The project would not involve any reservoirs, evaporation ponds, leach fields, or similar facilities. Temporary dewatering of the reactor excavation pit during construction may be necessary but would be managed in accordance with DOE, U.S. Environmental Protection Agency, and Tennessee Department of Environment and Conservation requirements and in conformance with deed restrictions (Kairos 2023-TN8172 | Sec 4.4.1.1.1). As shown in the water balance diagram in Figure 2.4-1 of the ER, the operational demand for offsite water sources would include 50 gallons per minute (gpm) of municipal water plus 12 truck shipments of 4,000 gal each of demineralized water per month to provide water in support of operating the new Hermes facilities), and the offsite discharges would include 16 gpm from the bathrooms. This municipal supply water would be used for potable water and sanitation, the fire protection system, decay heat removal, systems cooling components and spent fuel, and other operational demands.

2.6 Cooling and Heat Removal Systems

The proposed cooling and heating systems are described in Section 2.5 of the ER (Kairos 2023-TN8172). As noted in Section 2.5.1 of the ER, there would be no raw cooling water system. For this reason, there would be no need for cooling towers or for intake or discharge structures or piping to support cooling towers. The heat load from the reactor would be transferred through a heat rejection system directly to the surrounding atmosphere, which would be the ultimate heat sink. The design also contains a decay heat removal system (DHRS), as described in Section 2.5.2 of the ER with diagrammatic representation in ER Figure 2.5-1 (Kairos 2023-TN8172). If the heat rejection system were unavailable when residual heat removal is required, the DHRS would be used instead (Kairos 2022-TN7882). The applicant expects to build the heat rejection radiator stack in the auxiliary systems building just north of the reactor building (see Figure 2.2-3 of the ER for the estimated positions of these buildings on the site) (Kairos 2022-TN7882).

2.7 Waste Systems

Wastes generated during construction, operation, and decommissioning would include radioactive, nonradioactive, and hazardous wastes (Kairos 2023-TN8172 | Sec 2.6). The applicant indicates that all waste disposal would occur in permitted nonradioactive, nonhazardous, and hazardous waste facilities and licensed radioactive disposal facilities (Kairos 2023-TN8172 | Sec 2.6). The proposed radioactive liquid, solid, and gaseous waste systems are described in Section 2.6.1 of the ER (Kairos 2023-TN8172). Included in the ER are descriptions of the tritium management system and fuel pebble handling and storage system. Figure 2.6-1 of the ER depicts the approximate distribution of tritium throughout the reactor system (Kairos 2023-TN8172).

The estimated types, quantities, and number of shipments of radioactive wastes are listed in Table 2.6-1 of the ER (Kairos 2023-TN8172), and include inert gas system capture materials, reactor cell capture materials, Flibe, dry active waste, liquid waste, and spent fuel. The table also identifies possible destinations for each category of waste. The proposed nonradioactive and hazardous waste systems are described in Section 2.6.1 of the ER (Kairos 2023-TN8172). Direct radiation sources are described in Section 2.6.3.1 of the ER and would all be within the reactor building (Kairos 2023-TN8172). The applicant notes that ongoing operation of ORR facilities and of the existing Tennessee Valley Authority Watts Bar Nuclear Facility would also contribute to the radiation dose received by the public near the new facilities (Kairos 2023-TN8172 │ ER Sec 2.6.3). The applicant's proposed pollution prevention and waste minimization program is described in Section 2.6.4 of the ER (Kairos 2023-TN8172).

2.8 Storage, Treatment, and Transportation of Radioactive and Nonradioactive Materials

The applicant describes the proposed storage, treatment, and transportation of radioactive and nonradioactive materials in Section 2.7 of the ER (Kairos 2023-TN8172). The applicant states that TRISO fuel for the Hermes reactor would be manufactured at Los Alamos National Laboratory (LANL) using high-assay, low-enriched uranium (HALEU) supplied by external sources, and that new fuel would be shipped to the reactor in NRC certified shipping containers in accordance with U.S. Department of Transportation (DOT) regulations and stored onsite in the shipping containers until loading into the reactor. Used, or spent, TRISO fuel pebbles would be stored in canisters, each holding up to 2,100 pebbles, in the reactor building; first in an onsite water-cooled storage pool for an initial cooling period and then transferred to a larger onsite air-cooled storage bay with a storage capacity of 192 canisters, sufficient for the anticipated period of operation (Kairos 2023-TN8172 │ Sec 2.7.1). If necessary, Kairos could store the spent TRISO fuel canisters in dry storage casks at an exterior location on the site after the cessation of operation (Kairos 2023-TN8172 │ Sec 2.7.1). Spent fuel would eventually be transported by truck or rail to a final spent fuel repository or a regional spent fuel storage facility (Kairos 2023-TN8172 │ Sec 2.7.1). Handling of low-level radioactive waste and nonradioactive materials is described in Sections 2.7.2 and 2.7.3, respectively, of the ER (Kairos 2023-TN8172).

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

This section presents the affected environment and potential environmental impacts from the proposed action to issue a construction permit (CP) for the Kairos Power, LLC (Kairos) Hermes facilities. The section is organized into separate sections addressing specific environmental resources identified by the U.S. Nuclear Regulatory Commission (NRC) staff's scoping process as being relevant to the proposed action. Each section is organized into subsections addressing the affected environment for the resource; potential direct and indirect impacts on the resource from each of three life-cycle phases for the Hermes facilities (construction, operation, and decommissioning); and cumulative impacts from the facilities. Each section culminates in a final subsection presenting the NRC staff's conclusions regarding the significance of the environmental impacts. 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 range of possible conclusions used by the NRC staff in assessing the significance of impacts on environmental resources is presented in Section 1.0 of this environmental impact statement (EIS).

To present a complete environmental review, this EIS covers the potential impacts from the construction, operation, and decommissioning life-cycle phases of the Hermes project. The NRC staff recognizes that new and significant information regarding the operation and decommissioning may become available after issuance of the CP. The NRC staff would therefore review any application for an operating license (OL) for the Hermes project for new and significant information that might alter the staff's conclusions made for this CP application. If Kairos were to apply for an OL, the NRC staff would prepare a supplement to this EIS in accordance with Title 10 of the *Code of Federal Regulations* 10 CFR 51.95(b) (TN250).

The order of presentation of environmental resources follows that used in Section 19.4 of the Final Interim Staff Guidance Augmenting NUREG-1537 (NRC 2012-TN5527), with the following exceptions. First, the NRC staff considered it more efficient to combine the sections about geological environment and water resources into a single Hydrogeology and Water Resources section (Section 3.3). Although the staff presents separate analyses and conclusions regarding impacts on the geological environment and on water resources, the combined subsection emphasizes their interrelationship. Second, the staff presented the environmental justice (EJ) analysis as part of the socioeconomic analysis in Section 3.6. The staff considered it simpler to present the EJ analysis with the supporting socioeconomic information rather than requiring readers to toggle between separate sections to gain an understanding. Third, the staff developed two separate sections addressing nonradiological and radiological waste management, but not nonradiological waste. The staff termed the latter "Uranium Fuel Cycle and Radiological Waste Management" to also capture uranium fuel cycle impacts.

Finally, the staff considered it more efficient to address cumulative impacts within the sections addressing other impacts to each resource rather than in a separate section as called for in the Final Interim Staff Guidance (NRC 2012-TN5527). Cumulative impacts are defined as impacts on an environmental resource resulting from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of which Federal or non-Federal agency or private party undertakes the other actions (40 CFR 1508.1(g)(3) [TN428]). Cumulative impacts can result from individually minor but collectively significant actions taking place over time (40 CFR 1508.1(g)(3) [TN428]).

The applicant presents a list of past, present, and reasonably foreseeable projects and other actions used in their consideration of cumulative impacts in the Environmental Report (ER) Table 4.13-1 (Kairos 2023-TN8172 │ Table 4.13-1). The continued U.S. Department of Energy (DOE) operations connected with the Oak Ridge National Laboratory (ORNL) and the Y-12 site; industrial development in the East Tennessee Technology Park, including the Heritage Center Industrial Park (Heritage Center) (within which the Hermes site is situated) and the Horizon Center Industrial Park (Horizon Center) to the east; continued operation of the Ultra Safe Nuclear Corporation Pilot Fuel Manufacturing Facility, which opened in August 2022 on a site approximately 0.8 mi to the southeast; and development of a general aviation airport to the south are included in the table. Additional actions included are the continued operation of the Sequoyah Nuclear Plant (Sequoyah) and Watts Bar Nuclear Plant (Watts Bar) and future construction and operation of small modular reactors at the Clinch River Nuclear (CRN) site approximately 2 miles (mi) south of the Hermes site. The NRC staff reviewed that table and concluded that it is an appropriate range of other actions for consideration in its cumulative impact assessment and incorporates it by reference. Table 4.13-1 in the ER notes that the applicant plans to build and operate a fuel fabrication facility, termed the Kairos Atlas Fuel Fabrication Facility (Atlas facility), at the Hermes site. Additionally, another energy development company, TRISO-X LLC, has recently announced that they plan to build and operate a TRISO-X fuel fabrication facility on an unused 110 ac lot in the Horizon Center east of the Heritage Center where the Hermes site is located (TRISO-X, LLC. 2022-TN7987). The staff also expects that continued general urbanization in and around the City of Oak Ridge would contribute to the cumulative impacts.

The NRC staff recognizes that only a subset of this master list of other actions is relevant to cumulative impact analysis for each environmental resource addressed. The subsections under each resource addressing cumulative impacts highlight those specific actions from ER Table 4.13-1 that are most relevant to an analysis of cumulative impacts for that resource. As explained in Section 1.0, some activities necessary to build a nuclear project such as Hermes do not fall within the purview of NRC's regulatory jurisdiction over construction as defined in 10 CFR 50.10 (TN249) and 10 CFR 51.4 (TN250) and are grouped under the term "preconstruction." The NRC staff does not consider the effects of preconstruction to be direct or indirect impacts on a licensing action, but it does recognize the need for evaluating the contribution of preconstruction to cumulative impacts. Identifying the impacts of preconstruction is also necessary to understand the setting for impacts from NRC-authorized construction activities, as well as impacts from subsequent life-cycle phases. For example, clearing portions of a site before beginning a project is preconstruction, but knowing the extent of the clearing is necessary to know what nearby ecological habitats might be affected by noise generated by subsequent regulated activities. The sections below therefore describe impacts from preconstruction and construction jointly for each resource. The joint description, when combined with information on impacts from operation and decommissioning and from other projects in the area, provides a complete basis for drawing conclusions regarding direct, indirect, and cumulative impacts.

3.1 Land Use and Visual Resources

3.1.1 Affected Environment

As described in Section 3.1.1 of the ER (Kairos 2023-TN8172), the site consists of approximately 185 acres (ac) situated in the Heritage Center in the East Tennessee Technology Park within the corporate limits of the City of Oak Ridge, Tennessee. The site is in Roane County, approximately 13 mi west of the densely developed downtown area of Oak Ridge. The

site was previously part of the DOE Oak Ridge Reservation (ORR). The site formerly accommodated Buildings K-31 and K-33, two large rectangular industrial buildings that were operated until 1985 by DOE as part of the Oak Ridge Gaseous Diffusion Plant (ORGDP) (Kairos 2023-TN8172 │ Sec 1.2). Table 3.1-1 (Kairos 2023-TN8172) of the ER quantifies the current land uses on the site and in the region, and Figure 3.1-1 of the ER (Kairos 2023-TN8172) depicts the current land uses graphically. Land cover on the site at present consists of approximately 72 ac of herbaceous grassland, mostly where Building K-33 formerly stood; approximately 87 ac of developed (medium and high intensity) land, mostly where Building K-31 formerly stood, that is currently being used for temporary outdoor industrial purposes; and approximately 24 ac of deciduous and mixed forest cover and woody (dominated by trees and shrubs) wetlands along the site's southern and eastern perimeters.

Figure 3.1-3 of the ER (Kairos 2023-TN8172) shows that the site is in the northwestern part of the previously developed ORGDP land. The site is zoned by the City of Oak Ridge as IND-2 (Industrial Districts IND-2) (City of Oak Ridge 2021-TN7900), a general industrial district established to provide areas in which the principal use of land is for processing, manufacturing, assembling, fabrication, and warehousing (City of Oak Ridge 2020-TN7901). DOE completed the core cleanup of the former ORGDP lands in 2020 and privatized ownership of 1,300 ac, including the site; and DOE expects to complete the ORGDP cleanup by 2024 and privatize an additional 600 ac (DOE 2022-TN7897). DOE decontaminated Buildings K-31 and K-33 between 1998 and 2005 and razed the structures and removed their slabs between 2011 and 2015 (Kairos 2023-TN8172 │ ER Sec 3.5.3). DOE restricts use of groundwater within the Heritage Center and continues to pursue remediation of groundwater contamination. DOE presented the results of groundwater sampling for the K-31/K-33 area (generally correlating to the 185-ac Hermes site) in 2020 and proposed moving forward with monitored natural attenuation (DOE 2021-TN7913). EPA and TDEC requested that DOE continue to provide sampling data for continued trend analysis before determining whether monitored natural attenuation is appropriate, and DOE responded by developing a plan for continued sampling (DOE 2021-TN7913).

The "region" of the site is defined as the area within a 5 mi radius of the site center point. The region comprises a mixture of urban and rural uses characterized in Section 3.1.1.2 of the ER (Kairos 2023-TN8172 │ ER Sec 3.1.1.2) and depicted in Figure 3.1-2 of the ER (Kairos 2023-TN8172). Section 3.1.1.2 of the ER (Kairos 2023-TN8172) provides information about navigable waterways, highways and roads, rail lines, natural gas pipelines, and airports in the region. Although the region includes agricultural land, there is no economically significant crop production. There are no chemical plants, refineries, mining or quarrying, or military facilities within 5 mi of the site.

The visual setting of the site is described in Section 3.1.2 of the ER (Kairos 2023-TN8172). It is influenced by a predominantly industrial setting to the south and east, where the currently and formerly developed areas of the Heritage Center and other East Tennessee Technology Park lands are situated; and a predominantly forested setting to the north, consisting of the forested lands on the 3,073 ac Black Oak Ridge Conservation Easement. The applicant characterizes the scenic quality of the site with the lowest available rating (that of C), using a subjective rating process developed by the Bureau of Land Management (BLM 1984-TN5536). Scenic quality is the relative worth of a landscape from a visual perception point of view. The C rating reflects the existing modifications of the site and surrounding industrial areas (Kairos 2023-TN8172 │ Sec 3.1.2). The applicant subjectively characterizes the site's sensitivity level, a measure of public concern for the maintenance of scenic quality, as "low to moderate" (Kairos 2023-TN8172 │ Sec 3.1.2). The sensitivity level considers the types of users, amount of use, public interest,

adjacent land users, and special area management objectives. The NRC staff finds the applicant's subjective determinations to be reasonable in that they reflect the large areas of previously disturbed and graded soils on and close to the site, ongoing industrial redevelopment of the surrounding landscape, and broad areas of forest cover separating the industrial area from the closest residential land uses.

3.1.2 Environmental Impacts of Construction

Figure 2.2-1 of the ER indicates that construction would temporarily disturb approximately 138 ac of previously developed industrial lands on the site, but that the disturbance would not encroach into areas of natural vegetation (Kairos 2023-TN8172). Based on projected start dates reported in Section 2.1 of the ER (Kairos 2023-TN8172), temporary land uses would likely persist for two to three-years. Once built, the new facilities would permanently occupy approximately 30 ac of land within the footprint of the former K-33 facility (and within the area already subject to temporary disturbance). The City of Oak Ridge informed the applicant that because the proposed Hermes reactor is not designed to generate power, it fits within the range of activities allowed under the IND-2 zoning (Kairos 2022-TN7902). Had the reactor been designed to generate power, it may have required IND-3 zoning. Unlike the IND-2 zoning, IND-3 zoning specifically allows for power generation facilities (City of Oak Ridge 2020-TN7901). The DOE completed an environmental assessment (EA) in 2011 for the transfer of up to approximately 1,800 ac of East Tennessee Technology Park land including what is now the proposed Hermes site (DOE 2011-TN4888). DOE concluded that the anticipated industrial and commercial development would not significantly change the existing industrial land use character and appearance of the already highly disturbed main portion of the East Tennessee Technology Park, which includes what is now the proposed Hermes site (DOE 2011-TN4888 │Sec 3.1.2.1). DOE notes that the anticipated future land use scenarios in the transferred lands include (among other uses) research and testing facilities, including renewable and advanced energy, industrial, and scientific research laboratories that include incidental pilot plant processing operation (DOE 2011-TN4888 │Sec 2.1.1).

Building the Hermes facilities would disturb only lands whose soils were previously graded to build the former K-31 and K-33 facilities; therefore, the project has no potential to disturb natural soils potentially capable of meeting the definitions of prime or unique farmland or other special status farmland. Because there is no agricultural activity on or adjacent to the site, and only small-scale agricultural production in the region (Kairos 2023-TN8172 │Sec 3.1.1), there is little potential for noticeable impacts on agricultural land uses. Land disturbance would not encroach into any wetlands (Kairos 2023-TN8172 │Sec 4.5.1.2). Disturbances would be limited to areas mapped by the Federal Emergency Management Agency as "Zone X" (Kairos 2023-TN8172 │ Figure 3.4-2) and would not encroach into 100-year or 500-year floodplain lands (Kairos 2023-TN8172 │ Sec 3.4.1.1.7). The proposed project would not extend to the Oak Ridge Wildlife Management Area, Black Oak Ridge Conservation Easement, or other special land uses in the region (Kairos 2023-TN8172 │ Sec 4.1.1.2), although it might be distantly visible from parts of those areas. As discussed in Section 3.5 on historic and cultural resources, the proposed project would be visible from, but would not substantially interfere with, the public's use and enjoyment of nearby Manhattan Project National Historical Park (NHP).

The project would introduce new industrial facilities only into an established industrial setting and would not qualitatively alter the visual character of the setting or surrounding region. The tallest structures built on the site would be ventilation stacks with a height of 100 feet (ft) (Kairos 2023-TN8172 │ Sec 4.1.2). The applicant presents a visual simulation of the proposed facilities in Figure 4.1-1 of the ER (Kairos 2023-TN8172) as well as photographic visual analyses from

six key observation points at visually sensitive locations surrounding the site (Kairos 2023-TN8172 | Figure 4.1-2). The selected observation points include locations in a new residential development approximately 2 miles to the west of the site, other nearby residential areas, a parking area and trailhead for the Black Oak Ridge Conservation Easement north of the Heritage Center and rest of the East Tennessee Technology Park, a historic cemetery approximately 1 mi to the south, and the K-25 Overlook and Visitor Center approximately 1 mi to the southeast. The photographs (Kairos 2023-TN8172 | Figures 4.1-3 through 4.1-8) demonstrate that the view of the new facilities from the observation points would be blocked by existing vegetation (Kairos 2023-TN8172 | Sec 4.1.2). The applicant acknowledges that the facilities might be visible in the far distance when the deciduous trees are leafless but suggests that the surrounding hills and mountains would soften the industrial appearance of the facilities (Kairos 2023-TN8172 | Sec 4.1.2). Considering the existing industrial character of the East Tennessee Technology Park, the visual changes from construction would not be noticeable.

3.1.3 Environmental Impacts of Operation

The completed facilities would occupy approximately 30 ac within the footprint of the former Building K-33, as indicated above, for a four-year operational period. The applicant has identified the entire 185 ac site as the exclusion area for the Hermes reactor (Kairos 2023-TN8398 | Figure 2.1-3). Under 10 CFR 100.3 (TN282), "Definitions," the exclusion area is an area surrounding a reactor, that must meet specific radiological criteria outlined in 10 CFR 100.11 (TN282), "Determination of exclusion area, low population zone (LPZ), and population center distance," in which the reactor licensee has the authority to determine all activities including exclusion or removal of personnel and property. The remaining 108 ac within the area of temporary disturbance would be available for other land uses under Kairos's control once they are no longer needed for construction. No additional land would be disturbed for the Hermes project during operation. Operational activity would be consistent with the site's zoning and industrial setting. The overall appearance of the Hermes facilities would not noticeably change during the operational period. The NRC staff therefore expects that the land use and visual impacts from operation would be minimal.

3.1.4 Environmental Impacts of Decommissioning

Land-disturbing activities during decommissioning would generally resemble those during construction and involve the use of heavy equipment to remove buildings, roadways, and other structures (Kairos 2023-TN8172 | Sec 4.1.1.5). Although most work would take place within the approximately 30 ac of land occupied by the formerly operational facilities, the staff expects that some adjoining land within the lands temporarily disturbed for construction might be temporarily required for laydown of equipment and materials. Decommissioning could ultimately free up all or part of the site for other uses consistent with the objectives of the Heritage Center. The overall visual appearance of the site would remain industrial throughout decommissioning, but the site could then revert to a vacant appearance until the site is ultimately redeveloped. The decommissioning impacts on land use and visual resources would be bounded by the analyses in the decommissioning generic EIS (NRC 2002-TN7254). Although the conclusions of the generic EIS extend only to the site and not surrounding lands, the land use impacts for decommissioning Hermes would not involve use of surrounding land. The NRC staff therefore expects that the land use and visual impacts from decommissioning would be minimal.

3.1.5 Cumulative Impacts

Tables 4.13-1 and 4.13-2 of the ER identify past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts of the proposed action (Kairos 2023-TN8172). Key past and present actions affecting land resources and visual quality in the affected area include the Federal nuclear and energy development facilities on the ORR such as the Y-12 plant, ORNL, and other energy research facilities; the residential and commercial areas in the original townsite of the City of Oak Ridge; multiple energy and industrial park projects; a large housing development currently undergoing construction approximately 2 mi west of the site termed the Preserve at Clinch River; and other land use features of a suburban or semi-rural landscape. Key reasonably foreseeable proposed projects in the region include the Horizon Center on former ORR forest land approximately 2.3 mi northeast of the site (for which DOE has excessed land to the City of Oak Ridge and roadways have been built), anticipated industrial development of other previously developed land in the Heritage Center, and a proposed general aviation airport approximately 1.1 mi south and east of the site. Additionally, as noted above in Section 3.0, the applicant anticipates possibly using a portion of the site outside of the Hermes facilities to build and operate the Atlas fuel fabrication facility. Another company (TRISO-X, LLC. 2022-TN7987) has recently announced that they plan to build and operate a TRISO-X fuel fabrication facility on an unused 110 ac lot in the Horizon Center to the east.

The NRC staff expects that the ongoing and reasonably foreseeable projects noted above and other anticipated continued development around Oak Ridge would increase the extent of industrial and other urban land in the region but would not noticeably change its land use patterns or overall visual quality. The City and DOE have planned over several decades to attract industrial development to the East Tennessee Technology Park to offset losses of employment from closure of the ORGDP and winding down environmental cleanup. Substantial infrastructure such as roads and utilities are already in place for the East Tennessee Technology Park, including the Heritage Center and Horizon Center, although the character of specific projects that ultimately use East Tennessee Technology Park land could necessitate additional infrastructure development. The infrastructure would, however, be built in areas that already display an industrial character and visual appearance.

The reasonably foreseeable new projects that have the greatest potential to affect land uses and visual qualities in the area around the site are the proposed Atlas facility and the proposed general aviation airport. The proposed Atlas facility would be built somewhere on the same 185 ac site proposed for the Hermes project. The applicant has indicated that the Atlas facility would occupy no more than 30 ac on the site (Kairos 2022-TN7902)), located within the proposed reactor's exclusion area, which encompasses the remainder of the site. According to the NRC definition of the exclusion area in 10 CFR 100.3 (TN282), activities unrelated to operation of the reactor may be allowed in an exclusion area under appropriate limitations, provided that no significant hazards to public health and safety would result. Because the Atlas facility would be built by the same applicant as the Hermes facilities, the NRC staff expects that the applicant would design the Atlas facility to be compatible with respect to land use with the Hermes project. Building the Atlas facility would not substantially alter the already industrial character and appearance of the Hermes site and the Heritage Center overall. The NRC staff would ensure the compatibility of the Atlas facility with the land uses and visual quality of the Hermes site and the Heritage Center in general when reviewing a future licensing application for the Atlas facility project.

Building the airport would require dedication of hundreds of acres of land within the East Tennessee Technology Park but would enhance rather than conflict with the City's efforts to attract employers to the Heritage Center and other former DOE lands targeted for redevelopment. It would not substantially alter the industrial appearance and visual quality of the Heritage Center. Operating an airport requires limiting nearby land uses as necessary to keep the approach and departure zones at the ends of the runways free of obstructions to aircraft. The new airport would however be situated more than 1 mi south of the Hermes site and would be oriented such that the approach and departure zones would extend east and west of the runway, not north (DOE 2016-TN7903). The applicant indicated that the tallest structure height of the proposed Hermes facilities would be less than 200 ft and therefore would not meet the definition of a flight obstruction, as established by the Federal Aviation Administration in 14 CFR 77.17 (a) (TN7902). The applicant indicated that it would still notify the Federal Aviation Administration in accordance with 14 CFR 77.9 (TN7902) before building any of the Hermes structures. Upon receipt of the notification, the Federal Aviation Administration would officially verify that none of the proposed Hermes structures constitutes a flight obstruction.

3.1.6 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative land use and visual resource impacts of the proposed action would be SMALL. This conclusion is based primarily on the fact that the proposed test reactor and support facilities are consistent with the objectives of the Heritage Center as well as the site's zoning and are functionally and visually compatible with the existing and anticipated future land uses surrounding the site. Reuse of former industrial land provides the economic benefits of the test reactor without requiring the conversion of sensitive lands such as forests, wetlands, or agricultural land for industrial use. Use of the site would also take advantage of existing roadways and utilities at the Heritage Center.

3.2 Air Quality and Noise

Section 3.2.1 addresses air quality, and Section 3.2.2 addresses noise.

3.2.1 Meteorology and Air Quality

3.2.1.1 Affected Environment

3.2.1.1.1 Climatology and Local Meteorology

The proposed site is located in an area of Tennessee commonly referred to as "The Great Valley" (Kairos 2023-TN8172 │ Sec 3.2.1). This area is dominated much of the year by the Azores-Bermuda anti-cyclonic circulation, which is most pronounced in late summer and early fall and is accompanied by extended periods of fair weather and widespread atmospheric stagnation. Frequent incursions of warm, moist air from the Gulf of Mexico and occasionally from the Atlantic Ocean are experienced in the summer. In winter and early spring, eastward-moving migratory high- or low-pressure systems bring alternately cold and warm air masses into the area (Kairos 2023-TN8172 │ Sec 3.2.1).

To characterize the region's climate, the applicant used climatological data collected from multiple sources including data from the National Climatic Data Center. Data were gathered from multiple meteorological towers at nearby airports and from meteorological towers located on the ORR (Kairos 2023-TN8172 │ Sec 3.2.1-3.2.5). Local meteorology data were gathered

using multiple sources including three meteorological towers located on the ORR (ORR Tower J, Tower L, and Tower D). Data from all three towers were used to evaluate the impact of topography on site meteorology, and Kairos relied upon existing measurements taken within ORR to address pre-operational site-specific meteorological monitoring. On May 6, 2021, Tower L was decommissioned because the land it occupies was ceded by the DOE to another party. The tower will not be relocated; instead, it has been replaced with a wind light detection and ranging measurement program (using a Vaisala WindCube remote-sensing lidar instrument) (Kairos 2023-TN8172 │ Sec 3.2.4.3).

Average wind speeds in the region are low, with a mean annual wind speed of 2.1 miles per hour (mph) at Oak Ridge (Kairos 2023-TN8172 │ Sec 3.2.1). During winter when the jet stream moves southward, the Cumberland Mountains serve to moderate cold outbreaks by blocking dense, cold polar continental air masses; and during the summer they reduce the intensity of thunderstorms produced by synoptic-scale systems crossing the region due to the downward momentum of the air mass as it comes off the higher terrain and moves into the Great Valley. Therefore, thunderstorms are more frequently caused by atmospheric heating from the land during the day; and the orographic lift produced by the local topography may enhance these thunderstorms (Kairos 2023-TN8172 │ Sec 3.2.1).

Area temperatures at Oak Ridge indicate warm summers and mild winters (Kairos 2023-TN8172 │ Sec 3.2.1). In January, the normal daily maximum temperature is about 47 degrees Fahrenheit (°F) with a normal daily minimum temperature of about 29 °F, based on 30 years of data. In July, the normal daily maximum temperature is about 88 °F, while the normal daily minimum temperature is about 69 °F based on 30 years of data (1981–2010) from the National Climatic Data Center. Relative humidity in the region, measured at Knoxville, Tennessee, averaged 73 percent based on 30 years of data from National Climatic Data Center (1981–2010) (Kairos 2023-TN8172).

Precipitation averages about 51 inches (in.) annually. Late winter (January–March) is usually the wettest season, with more than 14 in.; while late summer–early autumn (August–October) is the driest season, with less than 10 in. (Kairos 2023-TN8172 │ Sec 3.2.1). Droughts are uncommon. Snowfall, though normally light, usually occurs between November and March (Kairos 2023-TN8172 │ Sec 3.2.1).

Severe weather events include extreme wind; tornadoes and waterspouts; water precipitation extremes; hail, snowstorms, and ice storms; thunderstorms and lightning; snowpack and probable maximum winter precipitation; extreme temperatures; and restrictive dispersion conditions. The applicant discusses severe weather events for the proposed site in Section 3.2.3 of the ER (Kairos 2023-TN8172 │ Sec 3.2.3).

Atmospheric stability is a critical parameter for estimating atmospheric dispersion characteristics. Pasquill atmospheric stability is a method of categorizing the atmospheric stability of a region in terms of the horizontal surface wind, the amount of solar radiation, and the fractional cloud cover where Class A is extremely unstable conditions, Class B is moderately unstable conditions, Class C is slightly unstable conditions, Class D is neutral conditions, Class E is slightly stable conditions, Class F is moderately stable conditions, and Class G is extremely stable conditions (NOAA 2022-TN7904 and AMS 2012-TN7905). One typical method for computing atmospheric stability is based on the temperature difference between two tower measurement levels, e.g., between the upper and lower measurement levels. The frequency of occurrence of Pasquill (Classes A–G) atmospheric stability classes at the site were based upon temperature differences for local ORR meteorological Tower L over a two-year period (2018–2019) (Kairos 2023-TN8172

│ ER Sec 3.2.4.5). While the atmosphere at the site for the 2 years analyzed appears to be almost equally stable, neutral, and unstable, the stable lapse conditions (Classes E, F, and G; i.e., inversions) occur much of the time (42 percent). However, the majority of the stable lapse conditions are only slightly stable (Class E), occurring 27 percent of the time. The most stable class (Class G) occurs approximately 5.5 percent of the time. Neutral lapse conditions (Class D) occur approximately 27 percent of the time. Unstable class conditions (Classes A, B, and C) occur approximately 31 percent of the time (Kairos 2023-TN8172 │ Sec 3.2.5).

3.2.1.1.2 Air Quality

The region of influence for this air quality analysis is Roane County. In accordance with the Federal Clean Air Act of 1970, as amended (CAA) (Clean Air Act-TN1141), the U.S. Environmental Protection Agency (EPA) established National Primary and Secondary Ambient Air Quality Standards (40 CFR Part 50-TN1089) for six pollutants (often referred to as criteria pollutants) to protect the environment and public health. These pollutants include ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), lead (Pb), and particulate matter (PM). PM includes particles less than 10 micrometers (μm) in diameter and particles less than 2.5 μm in diameter—particles that have equivalent aerodynamic diameters less than or equal to 10 and 2.5 μm, respectively. Other air pollutants of concern include greenhouse gases (GHGs), such as carbon dioxide (CO_2) and methane (CH_4), and hazardous air pollutants (HAPs).

National Ambient Air Quality Standards (NAAQS) limit the concentrations of the six criteria pollutants in order to protect human health and welfare. Areas in which pollutant concentrations exceed these standards are designated as “nonattainment areas” because air quality levels do not meet the required standards. “Attainment areas” are areas in which recent monitoring data demonstrate that concentrations of criteria pollutants are lower than the NAAQS. If monitoring has been insufficient to determine whether an area meets the standards, the area is designated as an “unclassifiable area.”

The CAA (TN1141) requires development of regulatory plans for nonattainment areas to reduce pollution levels until the area meets the NAAQS within a specified timeframe. State agencies typically complete these plans, called state implementation plans, which are then approved by the EPA. After air quality has improved in an area to the point that monitoring data demonstrate the air quality requirements outlined in the NAAQS, the area is designated as a “maintenance area.”

Air quality designations are generally made at the county-level, but designations may also be made for smaller localized areas. The City of Oak Ridge spans parts of Roane and Anderson Counties, which are part of the Knoxville-Sevierville-LaFollette, Tennessee air quality area (Kairos 2023-TN8172 │ Sec 3.2.2). The immediate areas of Roane and Anderson Counties are currently in attainment for all criteria pollutants. Parts of Roane County were in nonattainment for several years for $PM_{2.5}$ and were redesignated to maintenance status in 2017. Similarly, Anderson County was in nonattainment for several years for eight hour ozone and $PM_{2.5}$ but was redesignated to maintenance status in 2015 for eight hour ozone and in 2017 for $PM_{2.5}$ (EPA 2022-TN7906). While the immediate area surrounding the proposed facilities is in attainment for all criteria pollutants, it is approximately 5 mi away from an area designated as a maintenance area for $PM_{2.5}$. Because areas within Roane County are designated as maintenance areas, the NRC staff uses the thresholds for maintenance areas when determining the impacts from NAAQS emissions to understand whether the project could potentially further degrade the air quality in those maintenance areas. Table 3-1 presents the national thresholds contained in 40 CFR 93.153 (TN2495) for maintenance areas.

Table 3-1 National Ambient Air Quality Standards for Maintenance Areas

Criteria Pollutant	Threshold (TPY)
Ozone (O_3), nitrogen oxides (NO_X), SO_2 or NO_2	
All maintenance areas	100
Ozone (O_3), (volatile organic compounds [VOC])	
Maintenance areas inside an ozone transport region	50
Maintenance areas outside an ozone transport region	100
CO	
All maintenance areas	100
PM_{10}	
All maintenance areas	100
$PM_{2.5}$	
Direct emissions, SO_2, NO_X, VOC, and ammonia	100
All maintenance areas	100
Pb	
All maintenance areas	25

Key: TPY = ton(s) per year; O_3 = ozone; NO_X = nitrogen oxides, SO_2 = sulfur dioxide; NO_2 = nitrogen dioxide; volatile organic compounds = VOC; CO = carbon monoxide; PM = particulate matter; Pb = lead.

Source: 40 CFR Part 93-TN2495.

HAPs are pollutants known or suspected to cause cancer or other serious health effects, such as reproductive effects, birth defects, or adverse environmental effects. Under the CAA (TN1141), the EPA regulates a list of 188 HAPs (EPA 2022-TN7907).

EPA promulgated the Regional Haze Rule to improve and protect visibility in national parks and wilderness areas from haze that many diverse sources across a broad region may cause (40 CFR 51.308–51.309) (TN1090). Specifically, 40 CFR Part 81 (TN7226), Subpart D, lists 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 (40 CFR 51.300 through 51.309) (TN1090). The closest two Federal Class I areas are approximately 62 mi from the site: Joyce Kilmer-Slickrock Wilderness Area and Great Smoky Mountains National Park. (Kairos 2023-TN8172 │ Sec 3.2.2). If the proposed project is a major source of emissions and within approximately 31 mi (50 kilometers [km]) of a Class I area, then a Class I visibility impact analysis would be completed (NPS 2010-TN7925).

3.2.1.1.3 Federal and State New Source Permitting Requirements

New facilities that emit air pollutants, such as the proposed Hermes facilities, could be subject to Federal requirements, depending on the location and the type and amount of emitted air pollution. The following sections summarize these requirements.

Prevention of Significant Deterioration and Nonattainment New Source Reviews

The New Source Review regulations are broken down into two separate programs: Prevention of Significant Deterioration (PSD) and Nonattainment New Source Review. PSD is a Federal permitting program that applies to sources classified as major sources (as defined in 40 CFR 52.21) (TN4498) under the PSD program and located in attainment areas. The purpose of the program is to prevent degradation of air quality in areas where air quality is good. New or modified sources of criteria pollutants that exceed de minimis emission rates are subject to the

program. For purposes of this air quality analysis, the 250 tons per year (TPY) of any criteria pollutant threshold (40 CFR 52.21) (TN4498) will be considered when determining the significance of air quality impacts for operation. A nonattainment new source review applies to new major sources or major modifications at existing sources for pollutants at a source location that is within a NAAQS nonattainment area (Part D of Title I of the CAA) (TN1141). Nonattainment new source review requirements are customized for the nonattainment area. All nonattainment new source review programs require (1) the installation of the lowest achievable emission rate, (2) emission offsets, and (3) opportunity for public involvement (EPA 2022-TN7908). Minor new source reviews are for pollutants from stationary sources that do not require PSD or nonattainment new source review permits. The purpose of minor new source review permits is to prevent the construction of sources that would interfere with attainment or maintenance of a NAAQS or violate the control strategy in nonattainment areas (EPA 2021-TN7909). Emissions from new sources are evaluated by the State of Tennessee through the PSD program (EPA 2022-TN7910).

Title V of the Clean Air Act

Title V of the CAA (TN1141) requires a Federally enforceable operating permit program that applies to large, new, and existing sources of air pollution. Any facility with the potential to emit 100 TPY or more of any criteria pollutant, 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 (EPA 2022Q). For purposes of this air quality analysis, the 100 TPY of any criteria pollutant threshold for a Title V operation permit will be considered in determining the significance of air quality impacts for operation. A project would be required to obtain a permit from the Tennessee Department of Environment and Conservation (TDEC), if they are above the 100 TPY threshold. (EPA 2022-TN7910). If a project is below the threshold, then the project would need to comply with non-Title V permitting requirements. The Kairos project, as discussed below in Section 3.2.1.1.5, is expected to be below the 100 TPY threshold.

Greenhouse Gas Rules

In September 2009, the EPA issued a final rule for mandatory GHG reporting by large GHG emission sources in the United States (74 FR 56260-TN1024). The purpose of the rule is to collect and use comprehensive and accurate data about CO_2 and other GHG emissions to inform future policy decisions. In general, the threshold for reporting is 25,000 metric tons (MT) or more of carbon dioxide equivalent (CO_2eq)[1] emissions per year, excluding mobile-source emissions.

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 (75 FR 31514-TN1404). According to the rule, operating permits issued to major sources of GHG under the PSD or Title V Federal permit programs must contain provisions requiring the use of best available control technology to limit the emissions of GHGs, if those sources would be subject to PSD or Title V permitting requirements because of their non-GHG pollutant emission potentials and if their estimated GHG emissions are at least 75,000 TPY of CO_2eq. In June 2014, the U.S. Supreme Court issued its decision in *Utility Air Regulatory Group v. EPA*, 573

[1] The CO_2eq is a metric used to compare the emissions of GHGs based on their global warming potential (GWP). GWP is a measure used to compare how much heat a GHG traps in the atmosphere. GWP is the total energy that a gas absorbs over a period of time compared to CO_2. The CO_2eq is obtained by multiplying the amount of the GHG by the associated GWP.

U.S. 302 (2014), in which it held that EPA may not treat GHGs as an air pollutant for determining whether a source is a major source required to obtain a PSD or Title V permit. The Court also stated that EPA could continue to require PSD and Title V permits otherwise required based on emissions of conventional pollutants (Utility Air Regulatory Group v. Environmental Protection Agency et al. 2014-TN7924). A recent Supreme Court decision limits the EPA's authority to regulate GHGs through industry-wide measures under the Clean Air Act (West Virginia v. Environmental Protection Agency 2022-TN8185).The two GHG rules discussed above, however, remain in effect.

State Air Quality Permitting

Unless specifically exempted, any person wishing to construct an air emission source or to modify an existing air emission source is required to obtain a CP from the Tennessee Division of Air Pollution Control (TDAPC; TDEC 2022-TN7911).

Under Tennessee law, air contaminant sources typically are classified as major or minor sources depending on their potential to emit pollutants. Major sources generally are:

- sources that are in specific source categories listed in Part 1200-03-09-.01(4)(b)1 of the Tennessee Air Pollution Control Regulations and have potential total facility emissions greater than 100 TPY; and
- other sources with potential total facility emissions greater than 250 TPY or more of the following criteria pollutants: carbon monoxide (CO), particulate matter (PM), nitrogen dioxide, sulfur dioxide (SO_2), lead (Pb) and ozone (O_3) (indirectly determined from emissions of volatile organic compounds (VOCs) and nitrogen oxides (NOx).

Examples of major sources are large power plants, chemical manufacturers, some secondary metal production facilities, and large printing operations (TDEC 2022-TN7911).

Minor sources are sources of air contaminants that are not major sources and are not specifically exempt from the CP requirements of Tennessee. Examples include concrete batch plants and small surface coating and printing operations (TDEC 2022-TN7911).

3.2.1.2 Environmental Impacts of Construction

During construction, air quality may be affected near the proposed facilities. Air pollutants would include fugitive dust from earth-moving equipment and other vehicles, exhaust gases from diesel engines, and exhaust gases from worker vehicles and delivery vehicles as they commute to and from the proposed facilities. These activities generate combustion product emissions such as carbon monoxide (CO), nitrogen oxides (NO_x) and, to a lesser extent, sulfur dioxide (SO_2). Painting, coating, and similar activities during construction generate emissions from the use of volatile organic compounds. Over the two-year construction schedule, the applicant estimates a monthly average of 213 truck deliveries, 4 offsite shipments of construction debris, and an average of 212 onsite workers with a peak construction workforce estimated to be 425 (Kairos 2023-TN8172 │ Sec 2.1). Table 3-2 lists the air emission estimates for the project for criteria pollutants during the two-year construction phase. The estimates of air emissions for all criteria pollutants are below the thresholds presented in Table 3-1. The applicant would still be required to apply for any needed state air quality permits for minor sources for construction. Because the proposed project is not a major source, and the project is more than 31 mi (50 km) away from the nearest Class 1 area, a Class I visibility impact analysis

is not needed. Lastly, the HAPs are estimated to be below 10 TPY for any single pollutant and below 25 TPY for all HAPs combined (Kairos 2023-TN8172 │ Sec 4.2.1.1).

Table 3-2 National Ambient Air Quality Standards Air Emissions During Construction

Emission Effluent	Emissions During Construction (T)[(a)]
NO_X	5.79
CO	2.49
Sulfur oxides (SO_x)	0.10
VOC	0.51
PM_{10}	0.40
$PM_{2.5}$	0.38

Key: T = ton(s); NO_X = nitrogen oxides, CO = carbon monoxide; SO_x = sulfur oxides; volatile organic compounds = VOC; PM = particulate matter.
[(a)] The emissions totals presented are for the two-year construction period.

Source: (Kairos 2022-TN7912).

Impacts from fugitive dust and other air emissions could be further reduced by mitigation measures and would reduce impacts on local ambient air quality and impacts on the site and nearby offsite areas. According to the applicant (Kairos 2023-TN8172 │ Sec 4.2.1.1), specific mitigation measures available to control air emissions including fugitive dust could include any or all of the following:

- stabilizing construction roads and spoil piles;
- limiting speeds on unpaved construction roads;
- periodically watering unpaved construction roads;
- performing housekeeping (e.g., remove dirt spilled onto paved roads);
- covering haul trucks when loaded or unloaded;
- minimizing material handling (e.g., drop heights, double-handling);
- phased grading to minimizes the area of disturbed soils;
- re-vegetating road medians and slopes;
- implementing controls to minimize daily emissions such as reducing engine idle time, using cleaner fuels (e.g., ultra-low sulfur diesel fuel or biodiesel), using pollution control equipment on construction equipment (e.g., diesel oxidation catalysts and particulate matter filters), and curtailing or controlling the time-of-day construction activities are performed; and
- proper maintenance of construction vehicles to maximize efficiency and minimize emissions.

3.2.1.3 Environmental Impacts of Operation

Air emissions of nonradiological gaseous criteria pollutants and HAPs would be emitted during the operation phase from (1) intermittent use of diesel-powered or natural gas powered standby power generation sources such as generators or combustion gas turbines, (2) diesel-powered trucks that deliver material and haul off wastes, and (3) worker commuter vehicles (Kairos 2023-TN8172). Shipment-related emissions could be emitted beyond the region of interest (ROI) and would traverse various counties, air quality control regions, and states; therefore, the air quality analysis presented below focuses on emissions from generators, combustion gas turbines, delivery trucks and waste removal, and worker commuting. Because the proposed Hermes facilities would not have cooling towers, the analysis does not address issues related to cooling

tower operation such as salt drift, ground-level fogging and icing, plume shadowing, and ground-level temperature and humidity increases.

Table 3-3 lists the air emission estimates during operation for criteria pollutants for the proposed Hermes facilities. The applicant stated in its ER that emissions from the proposed Hermes facilities would be smaller than those estimated by Tennessee Valley Authority (TVA) from its small modular nuclear reactor at the CRN site (Kairos 2022-TN7912). The Clinch River early site permit (ESP) EIS analyzed air emissions and included emissions from auxiliary boilers and cooling towers (Kairos 2022-TN7912). The NRC staff incorporated by reference Table 5-3 from the CRN ESP EIS, and because the proposed Hermes facilities are not expected to use auxiliary boilers or cooling towers, the staff removed the emission estimates from those sources to create Table 3-3. Intermittent emissions from standby power generation sources such as generators or combustion gas turbines would operate less than 500 hr/yr and would produce insignificant emissions (less than 5 TPY for criteria pollutants and less than 1,000 pounds (lb) per year for an individual HAP), as defined in Chapter 1200-03-09 of the Tennessee Air Pollution Control Regulations. If used exclusively for replacement or standby service and at or less than 500 hr/yr, these generator units would not require a construction or operating permit, as outlined in Chapter 1200-3-9-04 (construction and operating permits) of the Tennessee Air Pollution Control Regulations (Kairos 2023-TN8172 │ Sec 4.2.1.2.2).

Table 3-3 National Ambient Air Quality Standards Annual Air Emissions During Operation

Emission Effluent	Emissions During Operation (TPY)[(a)]
NO_X	20.65
CO	1.85
SO_x	0.0125
VOC[(b)]	0.3575
PM (PM_{10})[(c)]	0.15

Key: TPY = ton(s) per year; NO_X = nitrogen oxides, CO = carbon monoxide; SO_x = sulfur oxides; volatile organic compounds = VOC; PM = particulate matter.

(a) Emissions from diesel generators and gas turbines are based on four-hour of operation per month.

(b) As total hydrocarbon.

(c) The emission estimates for PM_{10} (≤10 µm) encompass the $PM_{2.5}$ (≤2.5 µm) emissions.

Source: Adapted from (NRC 2019-TN6136), (Kairos 2022-TN7912).

The estimates of air emissions for all criteria pollutants are below the thresholds presented in Table 3-1. The estimated emissions are well below the thresholds for the Title V and PSD permits discussed above. In addition, because the project is located in an attainment area for all criteria pollutants, the proposed project is not subject to a Nonattainment New Source Review. Because the proposed project is not a major source, and the project is more than 31 mi (50 km) away from the nearest Class 1 area, a Class I visibility impact analysis is not required. Lastly, the HAPs are estimated to be below 10 TPY for any single pollutant and below 25 TPY for all HAPs combined during operation (Kairos 2023-TN8172 │ Sec 4.2.1.2).

3.2.1.3.1 GHG Emissions

Gases found in the Earth's atmosphere that trap heat and play a role in the Earth's climate are collectively termed GHGs. GHGs include CO_2; CH_4; nitrous oxide (N_2O); water vapor (H_2O); and fluorinated gases, such as hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride (SF_6). Climate change is a subject of national and international interest because of how it

changes the affected environment. *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.[2] Estimates of GHG emissions from a reference 1,000 megawatt electric (MWe) reactor were developed using the approach in Interim Staff Guidance COL/ESP-ISG-026 (NRC 2014-TN3767), "Interim Staff Guidance on Environmental Issues Associated with New Reactors" (NRC 2014-TN3768), and the Council on Environmental Quality's (CEQ's) 2016 final guidance on considering GHGs emissions and effects of climate changes in NEPA reviews (CEQ 2016-TN4732), and are presented in in Appendix E of this EIS. The NRC is currently reviewing the January 2023 CEQ Guidance: National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change (88 FR 1196) and will update its guidance as necessary.

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). Appendix E estimates GHG emissions for life-cycle phases for a reference 1,000 MWe reactor with an 80 percent capacity factor. The AP1000 Reference Reactor assumed in Appendix E has a rating of 3,415 MW(th) (Westinghouse 2023-TN8176).

The calculation of GHG emissions for the proposed Hermes facilities assumes that one 35 megawatt thermal (MWt) advanced reactor would be installed. Assuming that GHG emission estimates for operation and extended SAFSTOR for the proposed Hermes plant, could generally be scaled based on the plant's output, the estimates for these stages would be scaled down to 1.0 percent of the totals for the reference reactor calculated in Appendix E. Since only one unit would be installed, no additional scaling was needed to account for the number of the reactors at the proposed site. As a conservative assumption, emissions from preconstruction/construction and decommissioning activities are assumed to be half of those estimated for the reference reactor. In addition, the durations for preconstruction/construction activities would be shorter than the durations assumed for the reference reactor in Table E-4 in Appendix E.

GHG emission estimates for the reference reactor for the uranium fuel cycle and transportation of fuel and waste are based on an annual capacity factor of 80%. Although this annual capacity factor assumed for the reference commercial power production would not necessarily apply to a research reactor, a capacity factor of 80% is assumed to be bounding for the Kairos Hermes test reactor. Under this assumption, the staff estimated GHG emissions for uranium fuel cycle activities and fuel and waste transport associated for the proposed Kairos Hermes facilities as 1.0 percent of the totals presented for the reference 1,000 MWe reactor in Appendix E. The assumed activity durations and total GHG emissions for these activities for the reference reactor and for the Kairos Hermes reactor are shown in Table 3-4.

The staff calculated that the GHG emissions for the proposed Hermes facilities to be approximately50,000 MT CO_2eq using the assumptions discussed above to scale the emissions from the reference 1,000 MWe reactor in Appendix E. These emissions can be compared with 2019 total gross annual U.S. energy sector emissions of 5,410.8 million metric ton (MMT) CO_2eq (EPA 2021-TN6965). Comparing the entire life cycle estimated GHG emissions from construction, operation, uranium fuel cycle, transportation of fuel and waste, and

[2] The Commission stated that "the Staff's analysis for reactor applications should encompass emissions from the uranium fuel cycle as well as from construction and operation of the facility to be licensed" (CLI-09-21 [NRC 2009-TN6406], at 6).

decommissioning activities to the 2019, the total gross annual U.S. energy sector emissions the project's GHG emissions would be about 0.0009 percent of the 2019 GHG emissions from the U.S. energy sector.

Table 3-4 Life-Cycle Assumptions and Greenhouse Gas Emissions for the Hermes Kairos Project

	Reference Reactor Activity Duration (in years)	Hermes Activity Duration (in years)	Total Emissions (MT CO_2e)
Preconstruction/Construction Equipment	7	6	16,714
Preconstruction/Construction Workforce	7	6	18,429
Plant Operations	40	4	186
Operations Workforce	40	4	139
Uranium Fuel Cycle	40	4	553
Fuel and Waste Transportation	40	4	14
Decommissioning Equipment	10	10	9,500
Decommissioning Workforce	10	10	4,000
SAFSTOR Workforce	40	40	102
Total			49,638

3.2.1.4 Environmental Impacts of Decommissioning

Decommissioning includes decontamination and dismantling facilities to the ultimate end state of demolition (Kairos 2023-TN8172 │ Sec 4.2.1.3). Demolition includes the recycling of demolition materials to the extent practical and the disposal of non-recyclable materials. During the decommissioning phase, activities, equipment usage, and their associated emissions are expected to be similar, but less than those during the construction phase because decommissioning activities are less extensive than construction activities (Kairos 2023-TN8172 │ Sec 4.2.1.3).

3.2.1.5 Cumulative Impacts

Table 4.13-1 of the ER identifies past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts of the proposed action (Kairos 2023-TN8172). Key past, present, and reasonably foreseeable actions affecting air quality in the region include the Federal nuclear and energy development facilities on the ORR such as the Y-12 Plant, ORNL, and the proposed CRN site. Continued development including transportation projects, new industrial facilities, and new large-scale residential development will affect local air quality. Continued operation of industrial parks and energy facilities such as TVA fleet (i.e., Kingston Fossil Plant) will also affect air quality (Kairos 2023-TN8172 │ Table 4.13-1). New projects would all be governed by new construction air permits processed through TDEC. The permit process would ensure that counties potentially impacted would continue to be in attainment or maintenance. Additionally, any facilities that are currently operating would continue to operate within their permit limits. Permitting reviews performed by the TDEC are conducted to ensure that new permits do not result in regional air quality degradation. The incremental impact on air quality from construction, operation, and decommissioning activities from the proposed facilities would not be significant.

3.2.1.6 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative meteorology and air quality impacts of the proposed action would be SMALL. Air emissions from the proposed Hermes facilities are well below all thresholds considered in the analysis and would not be a major source of air emissions. GHG emissions would be 0.00068 percent of the overall energy sector, and the potential changes to the affected environment as a result of climate change would not change the conclusions discussed in this EIS.

3.2.2 Noise

3.2.2.1 Affected Environment

Noise is unwanted or unwelcome sound usually caused by human activity that is added to the natural acoustic setting (Kairos 2023-TN8172 │ Sec 3.2.6). Although sound pressure levels are measured in decibels (dB), noise levels in environmental analyses are commonly expressed using A-weighted sound levels (dBA) that are adjusted to better reflect how the human ear perceives the sound. The applicant correlates ranges of dBA levels to common noise experiences in Section 3.2.6 of the ER (Kairos 2023-TN8172 │ Sec 3.2.6). A change of at least 3 dBA is necessary for most people to perceive an increase in noise, while a change of 5 dBA would be readily noticeable (Kairos 2023-TN8172 │ Sec 3.2.6). The applicant notes that the nearest noise receptors within a 5 mi radius of the Hermes site include several churches and two parks (the adjacent Black Oak Ridge Conservation Easement and the Oak Ridge Country Club 4.9 mi to the northeast)(Kairos 2023-TN8172 │ Sec 3.2.6). The nearest resident is situated approximately 0.7 mi north of the Hermes site boundary but is separated from the site by forests. There are also other noise contributors in the area, such as a railroad station and yard to the west, a marina approximately 2 mi southwest, and ORNL facilities; other new noise sources, including a new airport approximately 1.1 mi south of the site, are anticipated (Kairos 2023-TN8172 │ Sec 3.2.6).

The applicant conducted baseline noise monitoring in June 2021 for two locations (Kairos 2023-TN8172│Sec 3.2.6), one inside the proposed Hermes site and one on the boundary of the site (Kairos 2023-TN8172 │ Figure 3.2-22). The applicant chose the location inside the currently undeveloped site to be representative of nearby areas away from publicly accessible roads and chose the location on the site boundary to be representative of nearby areas close to publicly accessible roads (Kairos 2023-TN8172 │ Sec 3.2.6). The results of the baseline noise measurements are presented in Tables 3.2-9 and 3.2-10 of the ER (Kairos 2023-TN8172). The tables show a baseline Day-Night Sound Level (L_{dn}) of 53 dBA at the location on the site boundary and of 46 dBA at the quieter location inside the site. A L_{dn} refers to a 24-hour average noise level with a 10 dB penalty applied to noise levels between 10 p.m. and 7 a.m. due to increased sensitivity to noise during those hours (Kairos 2023-TN8172 │ Sec 3.2.6).

3.2.2.2 Environmental Impacts of Construction

Construction noise would cause temporary increases and fluctuations in noise levels around the site during an anticipated two-year construction period between 2023 and 2025. The applicant reported that the existing ambient noise level at two sensitive locations close to the proposed Hermes site, one a greenway approximately 1 mi away (the nearest park) and the other in a residential area approximately 1.1 mi northwest of the reactor building (the nearest resident), was measured at an average noise level (L_{eq}) of 38 dBA (Kairos 2022-TN7912). The applicant then calculated projected noise levels at each of the two sensitive locations of each type of

construction equipment likely to be used to build the proposed facilities (Kairos 2022-TN7912). Projected noise levels L_{eq} from use of most construction equipment at the nearest residence and park would not increase by more than 3 dBA over the ambient level of 38 dBA and therefore would not likely be perceptible to persons at the two sensitive locations (Kairos 2022-TN7912). The applicant notes that operation of a pile driver vibratory hammer, or simultaneous operation of multiple pieces of heavy equipment, could increase noise levels by more than 3 dBA (Kairos 2022-TN7912) and therefore could be perceptible to persons at the two sensitive locations. The applicant also notes that simultaneous operation of multiple types of construction equipment may result in perceptible noise increases for temporary periods (Kairos 2022-TN7912). The NRC staff reviewed the information provided in the ER and finds the applicant's conclusions to be reasonable. The NRC staff further notes that any perceived noise increases would likely be typical of construction sites in industrial parks such as the Heritage Center, and that forest cover separating the industrial areas from the nearest residential areas would help blunt the noise even if the noise might be perceptible. This would also be true regarding any temporary increases in noise from construction vehicles and equipment using local roadways to access the Hermes site. The NRC staff expects that the noise resulting from building the proposed Hermes facilities would not be objectionable to the Oak Ridge community.

3.2.2.3 Environmental Impacts of Operation

Operation of equipment at the proposed Hermes facilities would generate noise typical of industrial activities, but most equipment generating noise would be enclosed within buildings such as the reactor building, auxiliary building, and maintenance and storage building, which would minimize outdoor noise generation (Kairos 2022-TN7912). Operation of some outdoor equipment such as heat exchange fans, exhaust and ventilation stacks, and vehicles could generate operational noise perceptible in the immediate vicinity of the site (Kairos 2022-TN7912). However, because the site is situated within an existing industrial park, the operational noises can be expected to blend into and be consistent with other operational noises typical of an industrial park. Additionally, the nearest residential areas are more than a mile distant and separated by forest land. Based on the setting of the operation within an existing industrial park and the distance to nearby sensitive noise receptors, and the presence of forest cover between the site and the receptors, the NRC staff expects that area residents and users of public facilities in the area would not notice the operational noises of the facilities.

3.2.2.4 Environmental Impacts of Decommissioning

Noise generation during decommissioning is expected to be similar to, or less than that during construction (Kairos 2023-TN8172 │ Sec 4.2.2.3). The decommissioning impacts from noise would be bounded by the analyses in the decommissioning generic EIS (NRC 2002-TN7254). Based on the analysis summarized above for construction, and the expected similarity of decommissioning noise to construction noise, the NRC staff expects that the noise resulting from decommissioning the proposed Hermes facilities would be brief and temporary, and not objectionable to the Oak Ridge community.

3.2.2.5 Cumulative Impacts

Table 4.13-1 of the ER identifies past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts of the proposed action (Kairos 2023-TN8172). Key past and present actions affecting noise in the affected area include the Federal nuclear and energy development facilities on the ORR such as the Y-12 Plant and ORNL. Continued development of the Heritage Center can be expected to increase noise levels to

those of a typical industrial park, as can continued development of the Horizon Center to the east, where the TRISO-X fuel fabrication facility is proposed. The most likely noticeable increase in noise in the surrounding lands would be from operation of the proposed general aviation airport south of the site. DOE's EA for transfer of land to build the proposed airport states that cumulative noise levels with the airport would remain below levels considered compatible with residential areas (65 dBA L_{dn}) (DOE 2016-TN7903 | Sec 3.3.2.1). Maps overlaying projected airport operational noise levels show that levels exceeding 55 dBA (L_{dn}) would be confined to areas within approximately 3,000 feet (ft) of the new runway, encompassing portions of the southern part of the East Tennessee Technology Park and some lands immediately straddling Highway 58 (TN7903 | Figure 3.2). Airport operational noise levels shown on the map for what is now the proposed Hermes site and the sensitive receptors considered by the Hermes ER are at or below 40 dBA L_{dn}, too low to substantially interact with noise generated by the Hermes facilities.

3.2.2.6 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative noise impacts of the proposed action would be SMALL. Noise generated by use of pile driving equipment and multiple pieces of heavy construction equipment could be perceptible at some sensitive locations close to the site for brief periods, but the brief and temporary nature of the pile driver noise would likely prevent the noise from noticeably interfering with use and enjoyment of the affected properties. Otherwise, the noise generated by construction, operation, and decommissioning of the Hermes facilities would likely blend in with the expected noise levels expected from an active industrial park.

3.3 Hydrogeology and Water Resources

3.3.1 Hydrogeology

3.3.1.1 Affected Environment

The Hermes site is within the southwestern portion of the Valley and Ridge physiographic province. The province is characterized by a series of long, parallel ridges consisting primarily of limestone with interbedded shale and dolostone, and limestone bedrock following a northeast to southwest trend. The K-31/K-33 Area, which contains the proposed Hermes site, is underlain by bedrock of the upper Knox Group in the northern portion of the area, and the lower Chickamauga Group formations occupy the southern portion of the area (DOE 2021-TN7913). Weathering of these limestones and dolomites has produced approximately 20 ft of silt, sand, and clay intermingled with alluvial material that is overlain by approximately 4 ft of undifferentiated fill. The bedrock of the Knox and Stones River Group ranges between 20 to 40 ft below the ground surface at the Hermes site (Figure 3-1).

Surface soils were previously reworked to accommodate the K-31 and K-33 building construction and their subsequent demolition and removal. After decontamination, decommissioning, and demolition, the slabs of the former buildings were removed or grouted into place to accommodate reindustrialization of the Hermes site (Kairos 2023-TN8172 | Sec 3.3.3). Portions of the former building foundations have been encountered less than 12 ft below the ground surface (Kairos 2023-TN8172 | Sec 3.3.3.3). Recent investigations in the Hermes site area have included mapping of the K-25 site, a final remedial investigation of the East Tennessee Technology Park, an EA for the transfer of land and facilities within the East Tennessee Technology Park and surrounding area, and a K-31/K-33 groundwater remedial site

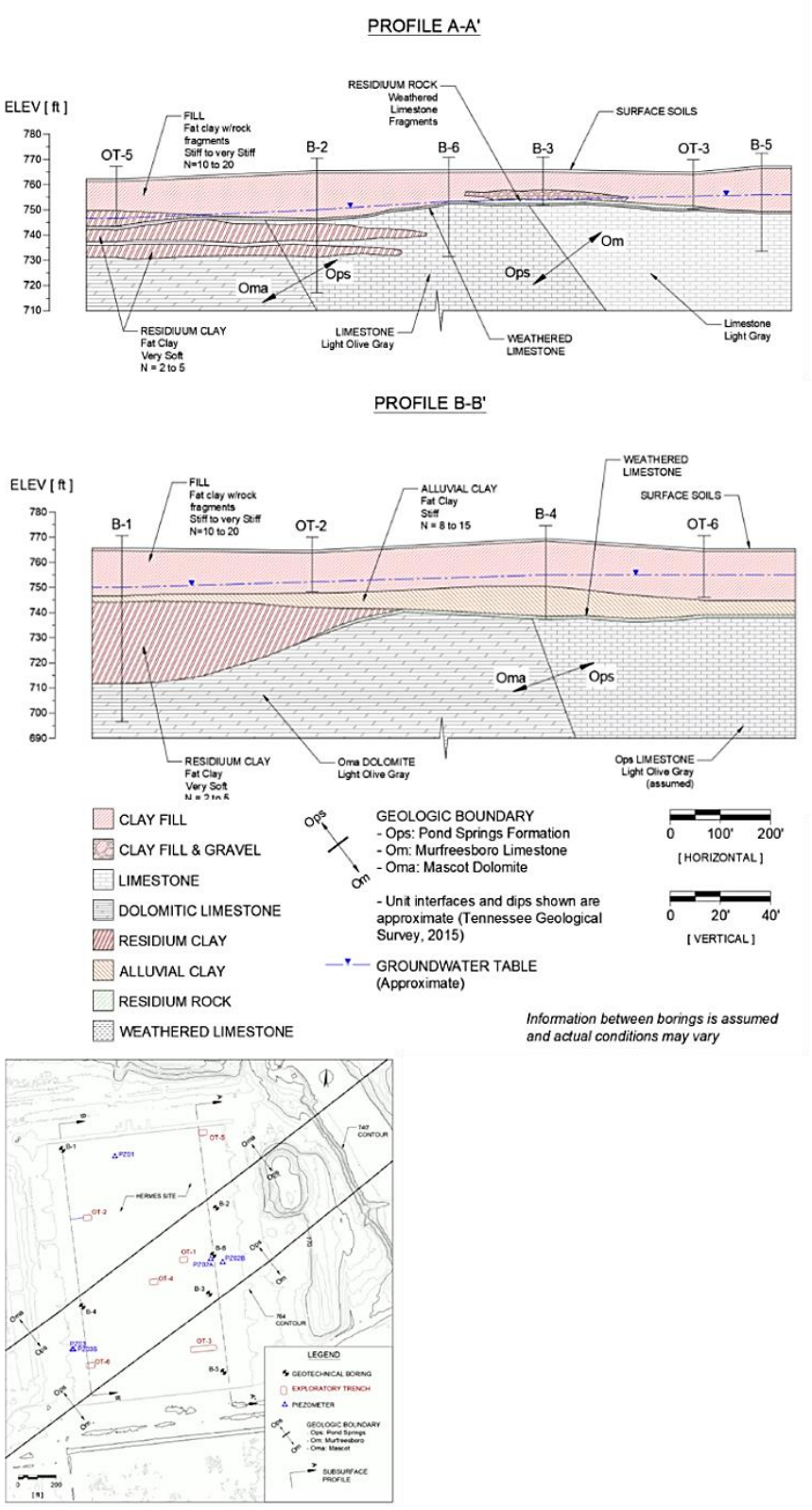

Figure 3-1 Cross-Sections A-A' and B-B' Across the Hermes Site. Source: Kairos 2023-TN8398

evaluation report for the East Tennessee Technology Park (Kairos 2023-TN8172 | Sec 3.3.1). Geotechnical soil properties of the site soils are provided in the preliminary safety analysis report (PSAR) (Kairos 2023-TN8398 | Sec 2.5.2.2). Hermes site-specific investigations have included installation and evaluation of geotechnical borings, observation trenches, groundwater monitoring wells, and a laboratory testing program (Kairos 2023-TN8172 | Sec 3.3.3.3).

Primary potential geologic hazards within the Hermes site region include faults and sinkholes. Consistent with the northeast to southwest trending axis of the surface ridges and valleys, the faults follow a similar trend within the area of the Hermes site. Details of the local and regional seismicity are discussed in Section 2.5 of the PSAR (TN7879 | Sec 2.5). Preparation for construction of the K-31 and K-33 facilities in the early 1950s included minor leveling of the Hermes site and filling of karstic sinkholes (Kairos 2023-TN8172 | Sec 3.3.6). The Hermes site is not vulnerable to soil liquefaction, landslides, tsunamis, or volcanism due to the soil composition, geology, and surrounding geography of the site location.

3.3.1.2 Environmental Consequences of Construction

Building the proposed facilities would temporarily disturb approximately 138 ac of the site previously affected by industrial development and long-term operation. Primary effects on the geologic environment of deformation and disturbance would occur on a local scale due to excavation, exposure of potentially contaminated soils, and, if required for construction, bedrock blasting. The applicant stated that excavated material during Hermes site grading and construction would be stockpiled onsite and used as backfill, while unsuitable material would be placed as non-structural fill (Kairos 2023-TN8172 | Sec 4.3.2). The applicant anticipates that offsite borrow areas will not be needed (Kairos 2023-TN8172 | Sec 4.3.2). Construction effects would be temporary and localized. Before construction, topsoil would be removed, stockpiled, or regraded, and potentially reused after decommissioning. Therefore, the common effects of construction on geology and soil resources from continued operation would be low.

The geology of the Hermes site and surrounding region is similar to the surrounding area with no rare or unique geologic resources, economically viable rock material, minerals, or energy resources, that could be affected. The potential for landslides and subsidence in Roane County is not considered high (Kairos 2023-TN8172 | Sec 4.3.1), and landslides on the relatively level Hermes site are very unlikely. The site has been previously disturbed during construction for the K-31/K-33 facilities. Anticipated construction on the Hermes site would not adversely affect the surface or subsurface geologic environment, given the applicant's implementation of grading permits and best management practices (BMPs) during grading, including a sediment and erosion control plan. Although the Hermes site area would be disturbed by excavation and grading, the disturbance would not be substantially greater than the disturbance from the previous construction and subsequent demolition of the former industrial buildings on the Hermes site.

For the Reactor Building and the Auxiliary Systems Building, the applicant anticipates an excavation depth of approximately 30 ft below a final grade of 765 ft. Utilities are anticipated to have a nominal depth of 5 ft below ground surface. The applicant estimated that other Hermes site buildings would have an excavation depth of approximately 10 ft below grade. An estimated total of approximately 113,000 cubic yards (cy or yd^3) of material would be excavated and reused onsite. The applicant stated that the final Hermes site grading is to be determined based on material excavated onsite; however, grading activities would be managed to have minimal impact on the existing site drainage and topography (Kairos 2022-TN7902). Any potentially contaminated soils encountered would be managed in coordination with the DOE

requirements for the property (TN7902). Construction mitigation strategies including construction BMPs, development of a Storm Water Pollution Prevention Plan (SWPP) in accordance with the rules of the TDEC, and implementation of the necessary erosion control measures would effectively minimize the impacts of soil erosion and soil compaction. The NRC staff finds that the effects of construction on the geologic environment would likely be low given that the implementation of mitigation strategies will need to be in compliance with local building code requirements.

3.3.1.3 Environmental Consequences of Operation

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

3.3.1.4 Environmental Consequences of Decommissioning

Based on the information provided in this CP application, decommissioning would have little effect on the geologic environment because the Hermes site is a brownfield undergoing reindustrialization in a previously disturbed industrial park. 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 geological environment impacts.

3.3.1.5 Cumulative Impacts

Table 4.13-1 of the ER identifies past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts of the proposed action (Kairos 2023-TN8172). Soil erosion and sediment runoff is a typical effect of surface disturbances due to construction,, operation, and decommissioning. Past, current, and reasonably foreseeable projects in the area would add to the total extent of disturbed soil permanently altering the building sites and soils. Within the Hermes site area, most of the proposed actions would take place in the reindustrialization area where similar construction of roads, parking lots, buildings, and utility lines has occurred or has been planned. The staff also recognizes that Kairos may build a planned fuel fabrication facility (referred to as Kairos Atlas Fuel Fabrication Facility or Atlas facility) on the same site as the Hermes reactor. The staff anticipates that the applicant would use the same construction BMPs described above in compliance with Federal, State, and local environmental laws, rules, regulations, and statutes in coordination with the DOE.

As with the adjacent Atlas facility, measures similar to those implemented at the proposed facility—such as securing appropriate construction and building permits and BMPs—would be applied at these nearby projects, including erosion and sediment control measures, further limiting the compounded impact. Neither the existing projects nor the proposed action would further contribute to impacts on the geologic environment because there are no identified sensitive or economic geologic resources in the area and the proposed facility would be located in a previously disturbed reindustrialized area.

3.3.1.6 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative geological 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 industrial lands of low economic value as geologic resources. Reuse of former industrial land provides the economic benefits of the test 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 185-ac Hermes site is bounded by Poplar Creek to the east and south, the Clinch River arm of the Watts Bar Reservoir and secondary drainage features including the K-901 Holding Pond to the west, and a rapid increase in topography from approximately 765 ft at the Hermes site to over 1,000 ft just north of the site. Poplar Creek is a part of the Clinch River arm of the Watts Bar Reservoir (Kairos 2023-TN8172 | Sec 3.4.1.1), whose water levels and flow patterns are controlled by the power generation and release schedules of the Watts Bar, Fort Loudon, and Melton Hill Dams. During past decontamination, decommissioning and demolition of the former industrial facilities on the Hermes site, the upper 10 ft of surface soils were remediated. Within the area of the Hermes site, the shallow aquifer materials predominately consist of clay with sandy clay lenses of the alluvial fill (Figure 3-1). Beneath the shallow aquifer, a deeper groundwater zone consists of weathered bedrock grading to fractures and joints of the underlying competent bedrock. Groundwater flow directions on the Hermes site are influenced by runoff infiltration from the highlands to the north and subsequent discharge to nearby surface water bodies. As indicated by DOE studies (TN7913 | Figures 3.1 and 3.2), the highland infiltration creates a radial groundwater flow pattern toward Poplar Creek to the east, Clinch River to the south, and secondary surface water drainage features to the west and southwest. Subsequent regrading has resulted in a relatively flat site with no distinguishable surface water drainage features.

Considering the past industrial history of the Hermes site and surrounding area, the groundwater and adjacent surface water bodies in the area are expected to be of a poor quality. Poplar Creek and the Clinch River arm of the Watts Bar Reservoir are considered impaired waters, as listed by the EPA (EPA 2021-TN7914). Both surface water features are impaired by mercury and polychlorinated biphenyls (PCBs), while pesticides are also listed for the Clinch River arm of the Watts Bar Reservoir (Kairos 2023-TN8172 | Sec 3.4.3.1). The primary pollutant in soils and sediment is mercury. Historical industrial activities produced and used a variety of chemicals including VOCs, PCBs, and radionuclides (primarily uranium, tritium, and strontium-90), which remain present at low concentrations in groundwater on the Hermes site and in the surrounding area. The DOE continues to monitor surface water and groundwater at various locations (DOE 2021-TN7913 | Figure 2.2, DOE 2021-TN7915 | Figure 3.24) within the Hermes site area. The applicant does not intend to use onsite groundwater for construction, operation, or decommissioning (Kairos 2023-TN8172 | Sec 3.4.2.2). As noted in Section 3.1.1 of this EIS, DOE restricts use of groundwater within the Heritage Center and continues to pursue remediation of groundwater contamination. DOE presented the results of groundwater sampling for the K-31/K-33 area (generally correlating to the 185-ac Hermes site) in 2020 and proposed moving forward with monitored natural attenuation (DOE 2021-TN7913). EPA and TDEC requested that DOE continue to provide sampling data for continued trend analysis

before determining whether monitored natural attenuation is appropriate, and DOE responded by developing a plan for continued sampling (DOE 2022-TN7897).

For groundwater monitoring, the applicant will implement a quarterly radiological environmental monitoring plan consistent with NUREG-1301 (TN5758, TN7879 | Sec 11.1.7), complementing existing DOE sampling locations (TN7913, Figure 2.2 and TN7915, Figure 3.24) and monitoring obligations within the Hermes site area (Kairos 2023-TN8172 | Sec 4.8.3.2, TN7902). Neither the surficial nor bedrock aquifers at or near the Hermes site are classified as EPA sole source aquifers (EAP 2022-TN7916). The applicant stated that there would be no liquid effluent release pathways and consequently no detectable radionuclides released to surface waters (Kairos 2023-TN8172 | Sec 4.8.3.2). Therefore, surface water monitoring is not included in the applicant's radiological environmental monitoring plan.

Within Roane County, over 70 percent of the water supply is derived from surface water sources and the remainder from groundwater. Within the area of the Hermes site, potable water is supplied through the City of Oak Ridge Public Works Department by way of Melton Hill Lake. The applicant estimated the total daily demand for water to be approximately 49 gallons per minute (gpm) or 0.07 million gallons per day (mgd), with an infrequent fire suppression system requirement of 3,170 gpm (4.56 mgd) and an associated makeup requirement of 793 gpm (1.14 mgd) within eight hours (Kairos 2023-TN8172 | Sec 3.4.2.3) for a static total storage requirement of approximately 380,400 gallons (gal). (Kairos 2022-TN7902). The applicant would not directly use any raw surface water or groundwater (Kairos 2023-TN8172 | Sec 4.4.2). Formerly owned and operated by the DOE, the City of Oak Ridge has owned and operated the current water supply treatment plant since 2000 (Kairos 2023-TN8172 | Sec 4.4.2.1). The City of Oak Ridge plans to design and construct a new ultrafiltration membrane drinking water treatment plant to replace the several decades old conventional treatment plant, which is currently at capacity and beyond its useful life (EAP 2022-TN7916). The new plant will have the capacity to treat up to 16 mgd with completion and operation targeted to occur in 2025 (Kairos 2023-TN8172 | Sec 3.4.2.1).

The Clinch River Industrial Park, the East Tennessee Technology Park, Horizon Center, and Rarity Ridge are served by the Rarity Ridge Wastewater Treatment Plant (WWTP), which has a wastewater treatment capacity of 0.6 mgd. Correspondingly, the applicant's proposed facilities within the East Tennessee Technology Park would be served by the Rarity Ridge WWTP. Currently the Rarity Ridge WWTP operates at peak (0.6 mgd) capacity during wet weather; however, the applicant stated that the City of Oak Ridge is currently working toward reducing inflow and infiltration coming into the WWTP (Kairos 2023-TN8172 | Sec 5.2). To date, the Oak Ridge Public Works Department has continued to make progress in reducing unnecessary inflow and treatment of rainfall runoff, thereby preserving the capacities of the existing WWTPs (NRC 2022-TN7955). Under a capacity, management, operation, and maintenance program for upkeep of sewer collection systems, the City of Oak Ridge plans to evaluate the timing of a Rarity Ridge WWTP expansion during fiscal year 2022 (City of Oak Ridge 2021-TN7917).

Given the planned expansion of the City of Oak Ridge's municipal water supply and wastewater treatment improvement program, municipal capacities would be sufficient for the anticipated water supply and water treatment requirements for the planned facilities. The NRC staff confirmed that the Oak Ridge Public Works Department has sufficient capacity to meet the water supply and wastewater treatment requirements of the proposed facility (NRC 2022-TN7955).

3.3.2.2 Environmental Consequences of Construction

Building the proposed facilities would involve temporary disturbance of approximately 138 ac on the Hermes site (Kairos 2023-TN8172 | Sec 4.5.1.3). The applicant would use approximately 30 ac of the previously developed land for the proposed plant and associated facilities. The applicant anticipates an excavation depth of approximately 30 ft below a finished grade of 765 ft for the Reactor Building and the Auxiliary Systems Building. Other ancillary buildings would be excavated to an estimated depth of approximately 10 ft below grade (Kairos 2023-TN8172 | Sec 4.3.2). The water table is approximately 6 to 8 ft below the anticipated approximate finished grade of 765 ft.

Groundwater would not be used during construction activities but may be extracted as a consequence of dewatering for the Reactor Building and the Auxiliary Systems Building excavation because these excavations are anticipated to be up to 30 ft deep (Kairos 2023-TN8172 | Sec 4.3.2). Using site-specific parameters derived from field studies, the applicant has estimated a total dewatering upper bound of approximately 2.2 million gal over an approximately 30-day foundation construction period (Kairos 2022-TN7902). Because the Hermes site is hydraulically bounded by Poplar Creek and the Clinch River arm of the Watts Bar Reservoir, the NRC staff determined that the influence of dewatering would be limited to the shallow groundwater system on the site and that the effects would be negligible at offsite locations. Because of past industrial activities at the Hermes site, the quit claim deed includes a site prohibition for use of groundwater in any way unless such use is approved by the DOE, EPA, and TDEC (Kairos 2023-TN8172 | Sec 4.4.1.1). The applicant plans to manage the extracted groundwater in accordance with the requirements of the three agencies indicated above and obtain any necessary approvals (Kairos 2023-TN8172), Sec 4.4.1.1). The approvals would include any necessary approvals from DOE or other agencies needed for the excavation. The storm-water discharge permit would prescribe the amount of any surface water discharge and establish the parameters to minimize impacts on the surrounding waters (Kairos 2023-TN8172 | Sec 4.4.1.1) in compliance with EPA, TDEC, and DOE requirements (TN7902). The dewatering action would therefore have minimal effects on the surrounding surface water quality because of BMPs, the TDEC stormwater discharge permit restrictions, and the regulatory oversight of extracted water as managed by the DOE, EPA, and the TDEC.

In ER Table 1.3-1, the applicant summarized the Federal, State and local regulations and permits applicable to surface water hydrology and quality applicable to construction, operation and decommissioning for the project (Kairos 2023-TN8172 | Sec 4.4.1.1). Although the Hermes site will be temporarily disturbed by construction activities, there are no distinguishable surface water features on the site that could be affected. There are no discernible surface water features draining the Hermes site and the majority of rainfall runoff flows directly to Poplar Creek and to the K-901-A Holding Pond (Kairos 2023-TN8172 | Sec 3.5.2). No direct use of raw surface water or groundwater would be used during the Hermes site construction. Adherence to DOE, EPA, and TDEC quit claim deed requirements, BMPs, and implementation of a SWPP and associated permits during construction would result in minimal effects on the groundwater and surface water quality surrounding the Hermes site. Based on its review of the ER, the NRC staff expects that building the proposed facilities would have at most minimal impacts on water resources on or near the Hermes site.

3.3.2.3 Environmental Consequences of Operation

Impacts on water resources from the proposed four-year period of operation would be similar to those described above for the period of construction. As described by the applicant,

groundwater withdrawal and dewatering discharge during operation would not be required (Kairos 2023-TN8172 | Sec 4.4.1.1). No raw surface water or groundwater would be used for Hermes site operation and the City of Oak Ridge would supply the site with potable water.

Based on an estimated daily water use of approximately 49 gpm (0.07 mgd) for the plant and the City of Oak Ridge's pending construction and completion of a new water treatment plant with a capacity of 16 mgd, the proposed facility would have sufficient potable water supply. Periodic supply to the fire suppression system would include an initial fill and occasional makeup water refill (Kairos 2023-TN8172 | Sec 3.4.2.3). The City of Oak Ridge municipal supply system would provide for the initial and any required subsequent refills of the fire suppression storage system. With the facility's water supply provided by the City of Oak Ridge, and demineralized water trucked into the facility, the applicant would have no need for a raw surface water supply or surface water cooling intake (Kairos 2023-TN8172 | Sec 6.3.3). Consistent with other facilities within the East Tennessee Technology Park, wastewater service for the proposed facility would be provided by the City of Oak Ridge (NRC 2022-TN7955 | personal communication) and the applicant anticipates no direct discharge to surface water bodies (Kairos 2023-TN8172 | Sec 6.3.3). Stormwater BMPs combined with the required permitting for stormwater management, including initial discharge to an onsite stormwater pond and later release to Poplar Creek, would minimize the effects of Hermes site runoff. Therefore, the applicant does not propose any mitigation (Kairos 2023-TN8172 │ Sec 4.4.1), and the NRC staff finds that none is necessary to minimize adverse water resource impacts based on the NRC staff's evaluation of this CP application. At the OL stage, NRC staff will review the application for any new and significant information that might alter the staff's conclusions made about this CP application.

3.3.2.4 Environmental Consequences of Decommissioning

The applicant noted that no decommissioning activities would occur in the surface water bodies of Poplar Creek or the Clinch River (Kairos 2023-TN8172 | Sec 4.4.1). As stated by the applicant, an SWPP similar to that required by construction, including a sediment and erosional control plan, would be required for decommissioning and the existing stormwater retention pond used during operation could be used for decommissioning (Kairos 2023-TN8172 | Sec 4.4.1). Although no groundwater would be used onsite, dewatering may be needed to complete removal of building foundations. As previously discussed, the extraction, consumption, and exposure to or the use of groundwater on the Hermes site requires approval from the DOE, EPA, and the TDEC (Kairos 2023-TN8172 | Sec 4.4.1). Depending on the duration and volume of groundwater extracted, minor impacts could be associated with discharges of the extracted groundwater to Poplar Creek; however, the extraction of groundwater would be managed in compliance with the DOE, EPA, and TDEC permitting requirements (TN7902). The NRC staff expects that decommissioning impacts on water resources would be bounded by the analyses in the decommissioning generic EIS (NRC 2002-TN7254 │ Supplement 1) and the stormwater discharge permit requirements for discharge and quality of stormwater. The applicant does not propose any mitigation (Kairos 2023-TN8172 │ Sec 4.4.1), and the NRC staff finds at this time that none is necessary to minimize adverse water resource impacts based on the evaluation of this CP application.

3.3.2.5 Cumulative Impacts

Table 4.13-1 of the ER identifies past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts of the proposed action (Kairos 2023-TN8172). Key past and present actions affecting water resources in the Hermes site area

include the Federal nuclear and energy development facilities on the Oak Ridge Reservation such as the Y-12 Plant and ORNL; the residential and commercial areas in the City of Oak Ridge; multiple energy and industrial park projects; a planned General Aviation Airport 1.1 mi east of the Hermes site; a large housing development, (the Preserve at Clinch River), currently undergoing construction approximately 2 mi west of the site; and other land use features of a suburban or semi-rural landscape. Construction, operation, and decommissioning actions for the proposed Hermes facilities or the planned Atlas facility adjacent to the Hermes site would not directly use groundwater or surface water. The Atlas facility is anticipated to use the same BMPs in compliance with Federal, State, and local environmental laws, rules, regulations, and statutes in coordination with the DOE. Therefore, the staff finds that the proposed action would implement appropriate stormwater management, spill prevention and response plans, an environmental monitoring program, and comply with stormwater permit requirements including the SWPP. Further, because the proposed action would be built and operated within an existing industrial park, the NRC staff finds it would not contribute to the adverse cumulative impacts on groundwater or surface water resources in Poplar Creek or in the Clinch River arm of the Watts Bar Reservoir.

3.3.2.6 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 Hermes facilities would be met through municipal or commercial suppliers, there would be no direct groundwater or surface or water use, and that disturbances to groundwater from potential dewatering would be temporary and localized to the hydrologically isolated onsite shallow aquifer in accordance with BMPs and the required permits. The NRC staff recognizes that there could be minor impacts on the municipal water supply due to the relatively small increased daily demand of the facility (0.07 mgd); however, the planned increases in the City of Oak Ridge's municipal water supply and existing wastewater treatment capacity would be adequate to service the facility and the future water treatment plant would create additional reserve capacity. Given the municipal water supply source and the low water demands of the Hermes project, the proposed facilities would result in minimal effects on aquifers and surface water bodies.

3.4 Ecological Resources

3.4.1 Affected Environment

The site is situated in the Southern Limestone/Dolomite Valley and Low Rolling Hills ecoregion, which is characterized by limestone and cherty dolomite with rolling ridges and valleys with soils of varying productivity (Kairos 2023-TN8172 │ Sec 3.5.1). Section 3.5.7.1 of the ER describes terrestrial habitats on the site (Kairos 2023-TN8172). The 185 ac site consists of 88 ac of developed land, 72 ac of herbaceous grassland, 19 ac of deciduous forest, and 6 ac of mixed evergreen/deciduous forest. As seen in Figure 3.1-1 of the ER (Kairos 2023-TN8172), the developed land and herbaceous grassland correspond mostly to lands previously occupied by former DOE Buildings K-31 and K-33, while the forested land occurs only in perimeter areas on riparian lands separating the previously developed lands from Poplar Creek. The ER notes that the only wetland on the site occurs in the forested perimeter lands adjoining Poplar Creek, and that none occurs in the previously disturbed lands that formerly accommodated DOE Buildings K-31 and K-33 (Kairos 2023-TN8172 │ Sec 3.5.6 and Figure 3.5-2). The NRC staff accessed the online National Wetlands Inventory mapper maintained by the U.S. Fish and Wildlife Service (FWS) on March 9, 2022; and the mapper showed only one wetland on or adjacent to the site,

the channel of Poplar Creek, but it did not show the wetlands mentioned in the ER (FWS 2022-TN5327). There are no aquatic habitats on the site, although the site adjoins Poplar Creek, a tributary to the Clinch River arm of Watts Bar Reservoir (Kairos 2023-TN8172 │ Sec 3.5.5). A 17 ac holding pond (K-901-A Holding Pond) is approximately 700 ft west-southwest of the site (Kairos 2023-TN8172 │ Sec 3.5.5.3).

Given its industrial history, the site can be expected to provide poor quality ecological habitat (Kairos 2023-TN8172 │ Sec 3.5.2). The developed and grassland areas on the site consist of grasses and forbs typical of previously disturbed soils, as characterized in Section 3.5.7.1 of the ER (Kairos 2023-TN8172). Terrestrial wildlife expected to occur on the site—including mammals, birds, reptiles, and amphibians—is described in Section 3.5.7.2 of the ER (Kairos 2023-TN8172). Species of wildlife expected in the previously developed lands formerly occupied by DOE Buildings K-31 and K-33 are the regionally abundant species typical of open field habitats. The applicant characterizes the aquatic biota of the Clinch River arm of the Watts Bar Reservoir; including fish, benthic macroinvertebrates, and plankton; in Section 3.5.5.1 of the ER. Because the reach of Poplar Creek adjoining the site is influenced by water levels in the reservoir, the applicant posits in Section 3.5.5.2 of the ER that the aquatic habitat in that part of the creek can be expected to be similar. Due to the history of disturbance on the site and surrounding areas, and in the adjoining reach of Poplar Creek, the terrestrial and aquatic biota in the area has been substantially influenced by invasive species (Kairos 2023-TN8172 │ Sec 3.5.8). The applicant also describes aquatic biota in the K-901 Holding Pond in Section 3.5.5.3 of the ER, but the Hermes project is unlikely to affect this pond, which is located approximately 700 ft away from the site. The applicant summarizes the history of ecological monitoring by DOE under the ORR Biological Monitoring and Abatement Program in Section 3.5.10 of the ER.

Section 3.5.11 of the ER identifies and characterizes species protected under Federal and State regulations based on a review of databases maintained by the FWS and TDEC (Kairos 2023-TN8172). Species addressed include those listed as threatened or endangered under the Federal Endangered Species Act (ESA) (TN1010) (or designated with another special Federal status), species designated with a State protected status, migratory birds protected under the Migratory Bird Treaty Act, and eagles protected under the Bald and Golden Eagle Protection Act. Each species with a Federal or State protected status is listed in Table 3.5-2 of the ER (Kairos 2023-TN8172). The applicant accessed the FWS Information for Planning and Consultation (IPaC) database on May 24, 2021, to identify Federally listed species and habitats for purposes of preparing the ER. The NRC staff accessed the database independently on February 24, 2022, and received similar results. Both the applicant and NRC staff used the 185 ac site as the action area for the IPaC search because the site is a large lot within an established industrial park (the Heritage Center within the East Tennessee Technology Park). The action area therefore encompasses the lands previously distributed by former DOE operations, but for conservatism also includes the slivers of riparian forested land on the site bordering Poplar Creek that might be affected by project-related noise. Neither the applicant nor the NRC staff extended the action area beyond the site boundary because it would then encompass areas distinctly different from those actually affected by the Hermes project.

The IPaC searches indicate that four Federally listed endangered species, four Federally listed threatened species, and one Federal candidate species could potentially occur at the site. The endangered species include two mammal species, the gray bat (*Myotis grisescens*) and Indiana bat (*M. soldalis*); and two freshwater clam species, the finerayed pigtoe (*Fusconaia cuneolus*) and shiny pigtoe (*F. cor*). The threatened species include one bat species, the northern long-eared bat (*M. septentrionalis*); one fish species, the spotfin chub (*Erimonax monachus*); and two

plant species, the Virginia spiraea (*Spiraea virginiana*) and white fringeless orchid (*Platanthera integrilabia*). The Federal candidate species is the monarch butterfly (*Danaus plexippus*).

A biological assessment (BA) recently completed for the nearby CRN site (NRC 2019-TN6136 | Appendix M), approximately 2 mi south of the Hermes site, addresses the gray bat, Indiana bat, and northern long-eared bat. For each of the three bat species, the BA characterizes the range, status and threats, life history, and baseline data from past field surveys in the region. According to the BA, gray bats hibernate in deep caves during the winter but disperse within the protection of forest canopy to a broader variety of caves during the rest of the year to form maternity colonies. Indiana and northern long-eared bats also hibernate in caves (the latter also in mines or human-made structures) and disperse to forested areas to form maternity roosts in trees. The BA reports the results of past field studies, including mist netting studies and acoustic studies, for the three bat species in the Oak Ridge area. Based on information in the BA, the NRC staff expects that each of the three bat species may potentially forage, and thus could be transiently present anywhere in the Oak Ridge area. However, the absence of trees or vegetation other than ruderal vegetation in the area where the Hermes facilities would be sited suggests that even transient presence in the affected area is unlikely. The 135 ac of land potentially subject to temporary or permanent disturbance for building, operating, and decommissioning the Hermes facilities contains only immature trees and thus lacks any potential roost or maternity trees.

The NRC staff recognizes that the subject bat and plant species would be unlikely to occur anywhere in the action area other than in the forest and other riparian vegetation separating the project lands from Poplar Creek, and that the only part of the action area where the clam and fish species could occur is the channel of Poplar Creek. The searches did not indicate the presence of critical habitat identified under the ESA.

The NRC staff initiated its own informal consultation under ESA Section 7 through written correspondence with the FWS dated March 10, 2022 (NRC 2022-TN7918). The staff received an E-mail from FWS dated April 15, 2022 (FWS 2022-TN7956) requesting that NRC include in the draft EIS a biological evaluation addressing the potential impacts from the Hermes project to potentially affected resources covered by the Endangered Species Act. Table 3-5, together with information included in the subsections below, constitute the NRC staff's biological evaluation.

3.4.2 Environmental Consequences of Construction

Building the proposed facilities would involve temporary disturbance of approximately 138 ac on the site, of which 58 ac consist of herbaceous grassland and the remainder consists of existing developed land (Kairos 2023-TN8172 | Table 4.5-1). As depicted in Figure 2.2-1 of the ER (Kairos 2023-TN8172), no naturally vegetated land would be disturbed, including the deciduous and mixed evergreen/deciduous forest on the site. Approximately 30 ac of the temporarily disturbed herbaceous grassland would be permanently converted to industrial land cover. Because all of the disturbed vegetation occupies previously disturbed soils, the disturbances would not further promote establishment of invasive species. The applicant plans to restore herbaceous grassland to the remaining temporarily disturbed land (Kairos 2023-TN8172 | Sec 4.5.1.3). No wetlands or aquatic habitats would be disturbed (Kairos 2023-TN8172 | Sec 4.5.1.2). The applicant proposes to manage stormwater on the site using BMPs as required by the TDEC (Kairos 2023-TN8172 | Sec 4.5.1.2). Common BMPs for managing stormwater runoff into aquatic habitats near construction sites include the use of silt fences, vegetative stabilization of exposed soils, and stormwater ponds. Because of the historical disturbance of the affected land and the lack of disturbance to forest and other natural vegetation, wetlands, or aquatic habitat, the NRC staff expects that effects on terrestrial wildlife habitats would be minimal.

Table 3-5 Biological Evaluation of Federally Listed Species from Proposed Kairos Hermes Project

Species	Federal Status	NRC Staff Evaluation	Conclusion
Gray bat (*Myotis grisescens*)	Endangered	Baseline information: Flying mammal. Hibernates and breeds in caves, such as those that occur in undeveloped lands in the karst landscape located in the Oak Ridge area (NRC 2019-TN6136 | Sec M.6.1.1). Moves and forages under forest cover (NRC 2019-TN6136 | Sec M.6.1.1). Factors contributing to population declines include human disturbance of the hibernacula, flooding, and use of pesticides (NRC 2019-TN6136 | Sec M.6.1.1). May be susceptible to white nose disease, a fatal fungal disease that infects hibernating bats (NRC 2019-TN6136 | Sec M.6.1.1) and observed through frequent mist net and acoustic study-based observations conducted in Oak Ridge area from 2000–2015 (NRC 2019-TN6136 | Sec M.6.1.1). Impacts: May forage transiently in riparian forest along Poplar Creek. Unlikely to enter lands where the Hermes facilities would be built, operated, and decommissioned, because those lands are not currently forested (or contain trees) and would not be forested or contain trees for the duration of the Hermes life cycle. Bats are expected to avoid areas of human activity, so the potential for injuries is minimal.	May affect, but not likely to adversely affect (MA-NLAA)
Indiana bat (*M. soldalis*)	Endangered	Baseline information: Flying mammal. Hibernates in caves and mines and forms maternity roosts in mature trees over 5-in diameter at breast height, especially trees with exfoliating barks (NRC 2019-TN6136 | Sec M.6.1.2). Roosts and forages in forested or semi-forested areas (NRC 2019-TN6136 | Sec M.6.1.2). Threats include disturbance to the hibernacula, loss and fragmentation of forested swarming and staging habitat, chemical contaminants, collision with wind turbines, and white nose disease (NRC 2019-TN6136 | Sec M.6.1.2). Closest known maternity roost in Blount County, TN, is roughly 30 mi away (NRC 2019-TN6136 | Sec M.6.1.2). One or more individuals were detected acoustically in forested areas at CRN site in 2013, but maternal roosting is not suspected (NRC 2019-TN6136 | Sec M.6.1.2). Impacts: May forage transiently in the riparian forest along Poplar Creek. Expected to avoid lands where the Hermes project would be built, which presently contain only ruderal vegetation of no foraging value.	MA-NLAA

Table 3-5 Biological Evaluation of Federally Listed Species from Proposed Kairos Hermes Project (Continued)

Species	Federal Status	NRC Staff Evaluation	Conclusion
Fine-rayed pigtoe (*Fusconaia cuneolus*)	Endangered	Baseline information: Freshwater mollusk. Prefer substrate in streams with running water. Unlikely to thrive in stream channels influenced by impoundments such as Poplar Creek, adjacent to the Hermes site. Impacts: Hermes project would not involve physical disturbances of aquatic or riparian habitats. Water demands would be met by municipal or commercial suppliers. BMPs to control sedimentation and runoff. Stormwater on the Hermes site would be managed by BMPs throughout the project life cycle.	MA-NLAA
Shiny pigtoe (*F. cor*)	Endangered	Baseline information: Freshwater mollusk. Prefer substrate in streams with running water. Unlikely to thrive in stream channels influenced by impoundments such as that of Poplar Creek, adjacent to the Hermes site. Impacts: Hermes project would not involve physical disturbances of aquatic or riparian habitats. Water demands would be met by municipal or commercial suppliers. BMPs to control sedimentation and runoff. Stormwater on the Hermes site would be managed by BMPs throughout the project life cycle.	MA-NLAA
Northern long-eared bat (*M. septentrionalis*)	Threatened	Baseline information: Winged mammal. Hibernates in caves, mines, and human-made structures and forms maternity roosts in trees with exfoliating barks or holes, or that are dead (NRC 2019-TN6136 | Sec M.6.1.3). Roosts and forages in forested or semi-forested areas (NRC 2019-TN6136 | Sec M.6.1.3). Prefers to roost in interior of late successional forests (NRC 2019-TN6136 | Sec M.6.1.3). Listed as threatened in 2015 due to the effects of white nose disease (NRC 2019-TN6136 | Sec M.6.1.3). Detected acoustically in forested areas at the CRN site in 2013, but maternal roosting is not suspected (NRC 2019-TN6136 | Sec M.6.1.3). Impacts: May forage transiently in the riparian forest along the Poplar Creek. Expected to avoid lands where the Hermes project would be built, which currently contain only ruderal vegetation of no foraging value.	MA-NLAA

Table 3-5 Biological Evaluation of Federally Listed Species from Proposed Kairos Hermes Project (Continued)

Species	Federal Status	NRC Staff Evaluation	Conclusion
Spotfin chub (*Erimonax monachus*)	Threatened	Baseline information: Fish. Prefer streams with boulders and swift currents (NRC 2019-TN6136 | Sec M.6.1.7). Unlikely to thrive in impounded stream channels such as that of Poplar Creek adjacent to the Hermes site. Impacts: Hermes project would not involve physical disturbances of aquatic or riparian habitats. Water demands would be met by municipal or commercial suppliers. Stormwater managed by BMPs. BMPs to control sedimentation and runoff. Stormwater on the Hermes site would be managed by BMPs throughout the project life cycle.	MA-NLAA
Virginia spiraea (*Spiraea virginiana*)	Threatened	Baseline information: Shrub. Prefers stream bars and ledges (Kairos 2023-TN8172 | Table 3.5-2). May occur in riparian forested lands along the Poplar Creek. Impacts: Physical disturbance for the Hermes project would be limited to soils previously disturbed for past industrial development. Plants not affected by noise. BMPs to control sedimentation and runoff. Stormwater on the Hermes site would be managed by BMPs throughout the project life cycle.	MA-NLAA
White fringeless orchid (*Platanthera integrilabia*)	Threatened	Baseline information: Herbaceous wildflower of acidic seeps and stream heads (Kairos 2023-TN8172 | Table 3.5-2). May occur in riparian forested lands along the Poplar Creek. Impacts: Physical disturbance for Hermes project would be limited to soils previously disturbed for past industrial development. Plants not affected by noise. BMPs to control sedimentation and runoff. Stormwater on the Hermes site would be managed by BMPs throughout the project life cycle.	MA-NLAA

Key: NRC = U.S. Nuclear Regulatory Commission; MA-NLAA = may affect, but is not likely to adversely affect.

- Species identified through IPaC searches conducted by the applicant in May 2021 and the NRC staff in February 2022, for an action area encompassing the entire 185 ac Hermes site.
- Conclusions follow terminology used by the FWS when providing consultations under Section 7 of the ESA.
- Conclusions are inclusive for the Hermes project for construction, operation, decommissioning, and cumulative effects, based on the information available at the time of the NRC staff's environmental review of the CP.

Mobile terrestrial wildlife can be expected to avoid areas where construction equipment is in use (Kairos 2023-TN8172 | Sec 4.5.1.3). Less mobile wildlife could be injured or killed by equipment, but because of the low-quality of the affected habitat, any losses are unlikely to be ecologically substantial. Birds might be injured or killed by collision with tall structures or equipment such as construction cranes (Kairos 2023-TN8172 | Sec 4.5.1.3), but a recent literature review by the NRC staff indicates that bird collisions with structures at nuclear power

sites are generally not substantive (NRC 2013-TN2654 | Sec 4.6.1.1). That review focused on structures such as natural draft cooling towers, communications towers, or electric transmission lines that are taller or pose a greater risk to birds than the structures proposed for the Hermes project. The proposed Hermes project would not include any cooling towers or transmission lines. The NRC staff also recognizes that vehicles using roads to access and traverse the site could injure or kill wildlife; but considering the low number of projected site workers and the already disturbed character of the habitats on the site and nearby portions of the East Tennessee Technology Park, vehicular collisions with wildlife would likely be too infrequent to noticeably affect regional populations. Overall, the NRC staff recognizes that the ecological quality of habitat affected by the Hermes project is low and that the potential effects on wildlife are likewise low.

The applicant indicated that excavation to build the Hermes reactor would necessitate temporary dewatering of the excavation pit (Kairos 2023-TN8172 | Sec 4.4.1.1.1). The applicant confirmed that the dewatering would involve no more than 2.2 million gal over a period of approximately 30 days (Kairos 2022-TN7902). The applicant confirmed that the dewatered groundwater would be transported offsite for disposal or would be treated onsite and returned to the groundwater in accordance with applicable EPA, DOE, and State of Tennessee requirements (TN7902). The dewatering could temporarily reduce water levels in wetlands in nearby forested riparian lands bordering Poplar Creek, but any effects would be temporary. These brief and temporary effects on water levels in the wetlands would be less severe than expected from short droughts that commonly occur as part of the natural hydroperiod of the wetlands. Because of the brevity of the effects, the functional characteristics and habitat quality of the affected wetlands are unlikely to be changed.

The applicant acknowledges that building the Hermes facilities would result in a localized, minor, and temporary increase in noise that may be noticeable to wildlife on or close to the site (Kairos 2023-TN8172 | Sec 4.5.2.3). The applicant describes most noise as being within 3 dbA of ambient noise 1 mi from the site (Kairos 2023-TN8172 | Table 4.2-3), but recognizes that temporary periods of greater noise would occur even at that distance when some construction equipment such as pile drivers are in use, or when multiple pieces of construction equipment are in use simultaneously (Kairos 2023-TN8172 | Sec 4.2.2). The NRC staff recognizes that wildlife using the fragments of forested habitat remaining within the East Tennessee Technology Park might experience occasional periods of elevated noise that could cause startle responses or cause wildlife to avoid some areas for brief periods of time. But the staff also recognizes that the habitat quality within the East Tennessee Technology Park, including within the remaining fragments of forested habitat within the East Tennessee Technology Park, is not of high-quality and that large areas of superior habitat are available outside of the East Tennessee Technology Park for displaced wildlife. Furthermore, the affected wildlife is likely already acclimated to noise from other ongoing industrial and urban activity within the East Tennessee Technology Park.

A commenter on the draft EIS noted that the red imported fire ant (*Solenopsis invicta*) is an invasive species prevalent in the Oak Ridge area that uses freshly disturbed soils for colony establishment. The NRC staff recognizes that soil disturbance to build the proposed Hermes facilities would create a temporary opportunity for colonization of the exposed soils. However, the staff expects that Kairos would promptly revegetate disturbed soils using routine best management practices (BMPs) for erosion control, thereby limiting the opportunity for colonization. The opportunity for colonization would be no more than that provided each year by routine plowing of agricultural soils as is common in the rural landscape surrounding Oak Ridge. The staff therefore finds that soil disturbance for Hermes would not noticeably increase the rate of colonization by this species in the local landscape.

Although Federally and State-listed protected species are present in forested and other naturally vegetated lands and in water bodies near the site (Kairos 2023-TN8172 │ Sec 4.5.2.1), no habitat potentially suitable for those species would be disturbed. All of the protected species noted as occurring in Roane County in Table 3.5-2 of the ER (Kairos 2023-TN8172) require aquatic, wetland, or other naturally vegetated habitats that would not be disturbed by building the proposed new facilities. The applicant states that no Federally protected plant species has been observed on the site and that only one Federally listed species has a greater than low potential to occur on the site, the endangered Indiana bat; but the applicant explains that there are no trees of species favorable to the Indiana bat in the adjoining riparian lands along Poplar Creek (Kairos 2023-TN8172 │ Sec 4.5.1.5).

Based on its review of the project, the NRC staff expects that building the proposed facilities may affect, but is not likely to adversely affect, certain species listed as threatened or endangered under the ESA (Table 3-5). Preparing the site and building the Hermes facilities would not disturb any trees, forest cover, or natural vegetation and therefore would have little potential to adversely affect the three Federally-listed bats or two listed plants identified in the IPaC searches. The three bat species all hibernate in caves and when dispersing from the caves move, roost, breed, and forage in forested and semi-forested areas, not in large, developed areas without trees (NRC 2019-TN6136 │ Appendix M) such as the area where the Hermes facilities would be built and operated (see Table 3-5 for more information). Noise from building the Hermes facilities could be audible to bats transiently present while foraging in forested areas along Poplar Creek, but those thin fragments of habitat are unlikely to attract bats for extended time periods. The project would also have little potential to adversely affect the monarch butterfly, an insect species identified in the IPaC searches as a Federally listed candidate species that could potentially be transiently present in the area. The mowed grasses and concrete foundations present on those areas of the site subject to disturbance to build and operate the Hermes facilities do not provide quality habitat for the monarch butterfly. Because the project would not withdraw or discharge cooling water or industrial process water (see Section 3.3 of this EIS) or disturb surface water or shoreline habitats, it would have no potential to adversely affect the two listed clam species or the listed fish species. As indicated above, the NRC staff initiated informal consultation under Section 7 of the ESA through written correspondence with the FWS dated March 10, 2022 (NRC 2022-TN7918).

On January 27, 2023 (NRC 2022-TN8156), the U.S. Fish and Wildlife Service (FWS) concurred with the NRC staff's conclusions drawn in Table 3-5 of this EIS regarding resources protected under the Endangered Species Act (Endangered Species Act of 1973-TN1010). This concurrence completes activity by the NRC staff necessary to comply with consultation requirements under Section 7 of the Endangered Species Act.

3.4.3 Environmental Consequences of Operation

Impacts on ecological resources from the proposed 4 years of operation of the completed facilities would be less than those described above for the construction period. Only about 30 ac of former terrestrial habitat, all presently supporting herbaceous grassland within the former footprint of DOE Building K-33, would remain occupied by the Hermes facilities during the operational period. No additional land, and hence no additional habitat, would be physically disturbed by operation. Noise generation would affect wildlife in the same way as described above for construction but would not include brief periods of higher noise generation using exceptionally noisy equipment such as pile drivers. The potential for bird collisions with structures would be as described above for construction. The applicant would use occasional applications of herbicides in developed areas on the site for lawn maintenance and to control

weeds (Kairos 2023-TN8172 | Sec 4.5.2.3). Use of properly labeled herbicides in developed areas in accordance with instructions on the label is unlikely to adversely affect nearby habitats. The applicant does not propose any mitigation measures (Kairos 2023-TN8172 | Sec 4.5.2.5), and the NRC staff expects the effects from operation to be minimal, so no mitigation would be necessary to minimize adverse ecological impacts. Because operations would not disturb natural terrestrial or aquatic habitats and would have little potential to affect wildlife through noise or collisions, they would have little potential to adversely affect threatened or endangered species.

3.4.4 Environmental Consequences of Decommissioning

The applicant reports that ecological impacts from decommissioning would be similar to those from construction (Kairos 2023-TN8172 | Sec 4.5.3). The NRC staff expects that land disturbance during decommissioning would take place mostly within already developed areas within the 30 ac area permanently occupied by the proposed new facilities but may require exterior storage of debris or equipment in adjoining exterior areas of previously disturbed soils on the 185 ac site. The NRC staff also expects that noise generated during decommissioning may involve intermittent generation of higher noise levels than during operation as buildings and structures are demolished, with effects on wildlife as described above for construction. Additionally, the NRC staff expects that decommissioning impacts on ecological resources on the site would be bounded by the analyses in the decommissioning generic EIS (NRC 2002-TN7254 | Supplement 1). Although the generic conclusion does not extend to offsite ecological impacts from decommissioning, the offsite impacts would be minimal for the reasons indicated above. The applicant does not propose any mitigation measures (Kairos 2023-TN8172 | Sec 4.5.3), and the NRC staff feels that the effects from operations would be so minimal that no mitigation is necessary to minimize adverse ecological impacts. Decommissioning would have no more potential than construction to affect threatened or endangered species.

3.4.5 Cumulative Impacts

Table 4.13-1 of the ER identifies past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts of the proposed action (Kairos 2023-TN8172). Key past and present actions affecting ecological resources in the affected area include the Federal nuclear and energy development facilities on the ORR such as the Y-12 Plant, ORNL, and other energy research facilities; the residential and commercial areas in the original townsite of the City of Oak Ridge; multiple energy and industrial park projects; a large housing development presently undergoing construction approximately 2 mi west of the site (called “the Preserve at Clinch River”); and other land use features of a suburban or semi-rural landscape. Key reasonably foreseeable proposed projects in the region include the Horizon Center on former ORR forest land approximately 2.3 mi northeast of the site (for which DOE has excessed land to the City of Oak Ridge and roadways have been built, and where the proposed TRISO-X fuel fabrication facility is proposed), anticipated industrial development of other previously developed land in the Heritage Center, and a proposed general aviation airport approximately 1.1 mi south and east of the site. If the applicant were to build the Atlas facility on the site, it would only affect the herbaceous grassland and developed land formerly disturbed by DOE Buildings K-31 and K-33 and therefore would not further contribute to loss or degradation of ecological habitats. Because of the close proximity of the Hermes and Atlas facilities, the addition of the Atlas facility would not likely alter the patterns of noise and physical obstructions experienced by wildlife.

Past and present urban and industrial development in the surrounding area has already resulted in a landscape of fragmented areas of forest and other terrestrial habitats. The proposed action would not further contribute to this fragmentation because it would be sited entirely within an existing developed area. The new facilities, especially the proposed airport (DOE 2016-TN7903), would contribute noise, artificial light, and wildlife hazards to some natural habitats to the south of the site but would not result in substantial decreases in the overall quality of nearby habitats. Building the airport would also result in the loss of approximately 132 ac of forested, riparian, shrub, and grassy areas, but DOE notes that the losses would constitute only a small percentage of similar habitats in the surrounding area and would affect mostly areas already influenced by development in the East Tennessee Technology Park. Because the proposed action would not involve physical disturbance of aquatic, wetland, or riparian habitats and not involve withdrawals or discharges of water to aquatic habitats, it would not cumulatively contribute to degradation of aquatic habitats in Poplar Creek, the Clinch River arm of the Watts Bar Reservoir, or other water bodies in the area.

3.4.6 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative ecological impacts of the proposed action would be SMALL. This conclusion is based primarily on the proposed action not physically disturbing aquatic, shoreline, or wetland habitats or natural terrestrial vegetation; the location of the site within an existing industrial park; and disturbances being limited to herbaceous grassland in previously disturbed industrial lands of low value as wildlife habitat. Reuse of former industrial land within an existing industrial park setting provides the economic benefits of the test reactor without requiring the disturbance of sensitive terrestrial or aquatic habitats that have not been previously disturbed. The staff recognizes that there could be minor effects from noise and lighting on terrestrial wildlife in habitats elsewhere surrounding the site, but the affected habitats are of low quality because of their proximity to other industrial activity and the affected wildlife can be expected to acclimate to the noise and lighting conditions. In particular, the staff recognizes the anticipated effects on surrounding habitats from future construction and operation of a new regional airport but does not expect the proposed action to substantially contribute to those effects. The staff recognizes that because no naturally vegetated areas would be disturbed, no special maintenance or conservation practices or mitigation measures (beyond BMPs typically employed for soil erosion and sediment control and for stormwater management) would be necessary to protect ecological resources.

Table 3-5 presents the NRC staff's biological evaluation, that received concurrence from the FWS under Section 7 of the ESA, of the possible effects of the Hermes project on Federally listed species potentially occurring in an action area consisting of the 185 ac Hermes site. For conservatism, the action area for the biological evaluation encompasses the entire site, including strips of riparian forest on the site that would not be physically disturbed by the project. All project work would be confined to lands previously disturbed by former DOE Buildings K-31 and K-33 and currently being used for exterior industrial storage or herbaceous grasslands planted to stabilize previously disturbed soils. The NRC staff used the same conclusion terminology used by the FWS when responding to consultation requests under Section 7 of the ESA. The NRC staff concluded, and the FWS concurred, that the Hermes project may affect, but is not likely to adversely affect, or would have no effect, on each of the species considered.

3.5 Historic and Cultural Resources

3.5.1 Affected Environment

Historic and cultural resources refer to archaeological sites, historic buildings, traditional cultural properties important to a living community,[3] shipwrecks, and other resources considered under the National Historic Preservation Act (54 U.S.C. § 300101 *et seq*. TN4157) of 1966, as amended. Historic and cultural resources determined to be significant include those that are eligible for inclusion in or formally listed on the National Register of Historic Places (NRHP). Section 106 of the NHPA requires Federal agencies to consider the effects of their undertakings on historic properties listed or eligible for listing on the NRHP. The procedures in 36 CFR Part 800 (TN513) define how Federal agencies meet the statutory responsibilities of NHPA Section 106. 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[4] (TN1682) in consultation with the State Historic Preservation Officer, Indian Tribes that attach cultural and religious significance to historic properties, and other interested parties, pursuant to 36 CFR 800.2(c) (TN513).

In accordance with 36 CFR 800.8(c) (TN513), the NRC has initiated the NHPA Section 106 consultation process and notified consulting parties, including the Advisory Council on Historic Preservation (ACHP), the Tennessee Historical Commission (THC, i.e., the State Historic Preservation Officer), Tribes, and the National Park Service (NPS), of its intent to use the NEPA (42 U.S.C. § 4321 *et seq*. TN661) process to comply with Section 106 of the NHPA (see section on consultation below).

The current NRC undertaking is the issuance of a CP to Kairos that allows for the construction of the proposed Kairos Hermes project (see Section 1.1 of this EIS). If Kairos chooses to proceed with its proposed project, they will need to apply for, and receive, a separate OL from the NRC. This authorization would constitute a separate NRC undertaking and would require the NRC to prepare a supplement to the CP final EIS and complete a separate NHPA Section 106 review and consultation.

The proposed project site is located within the East Tennessee Technology Park in the northwest quadrant of the ORR and is adjacent to the Clinch River arm of Watts Bar Reservoir in Roane County, Tennessee. The site comprises approximately 185 ac and is located on a parcel that previously housed Buildings K-31 and K-33, which were part of the K-25 complex

[3] Traditional cultural properties are places that are important to a living community of people for maintaining its culture, including Indian Tribes that attach cultural and religious significance to historic properties (Parker and King 1998-TN5840). It is important to note that Indian Tribes also attach cultural and religious significance to other cultural resource types including pre-contact and historic-era archaeological sites.

[4] The NRHP was established by the NHPA and is maintained by the National Park Service. The eligibility of cultural resources for listing on the NRHP are assessed based on four criteria:

- Criterion A: Associated with events that have made a significant contribution to broad patterns of our history; or Criterion B: Associated with the lives of persons significant in our past; or Criterion C: Embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- Criterion D: Have yielded, or are likely to yield, information important to prehistory and history.

and operated as the ORGDP. The NRC has determined that the area of potential effect (APE)[5] for the CP review includes the area at the Hermes reactor site and its immediate environs where the character and use of historic properties may be directly (i.e., physically) or indirectly (i.e., visually or auditory) impacted by land-disturbing and building activities associated with the construction and operation of the proposed facility. Specifically, the NRC defined the direct-effects APE as the approximately 185 ac site (i.e., Kairos ownership site boundary) and the indirect-effects APE as the 0.5 mi area around the site (Figure 3-2).

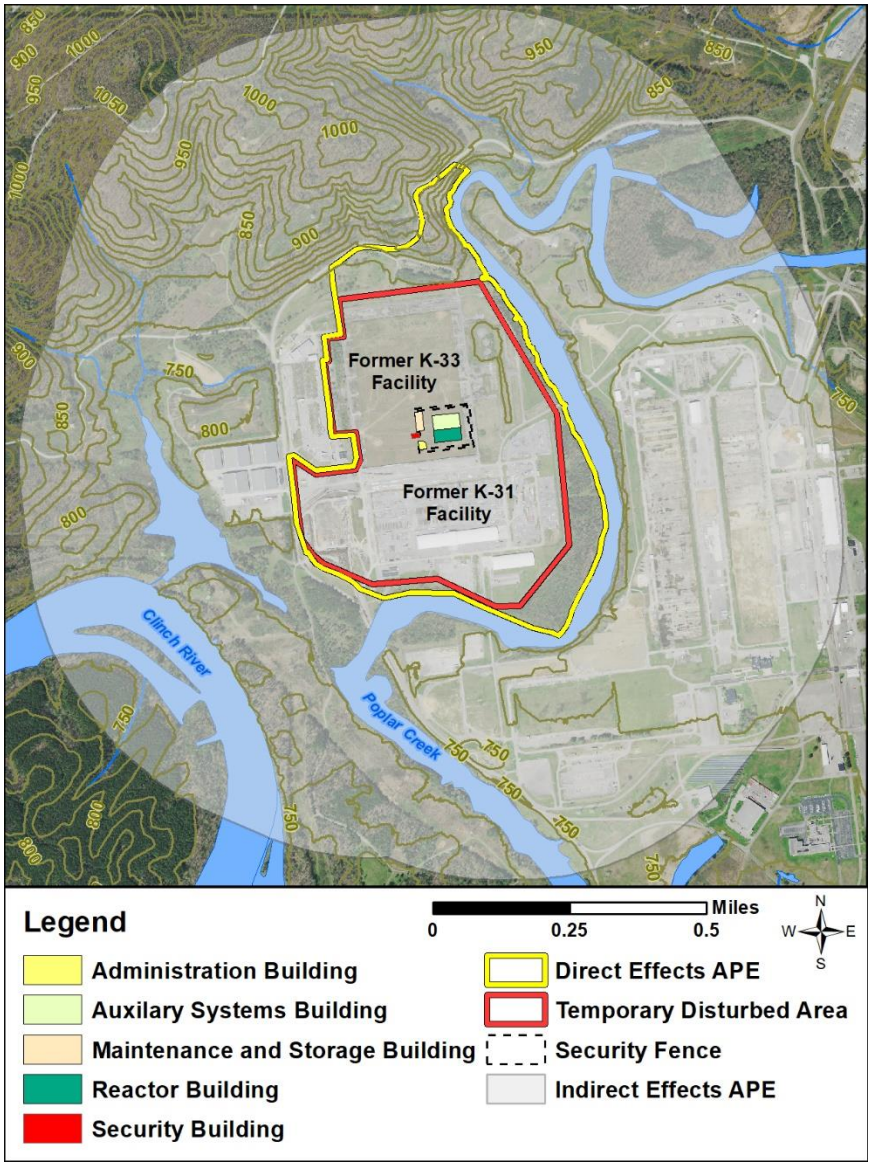

Figure 3-2 Direct- and Indirect-Effects Area of Potential Effects at the Kairos Hermes Project

[5] 36 CFR 800.16 (d) (TN513) defines the APE as "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties if they exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking."

3.5.1.1 Cultural Background

In April 2019, the NRC published NUREG-2226 (NRC 2019-TN6136), *Environmental Impact Statement for an Early Site Permit (ESP) at the Clinch River Nuclear Site* (hereafter referred to as the CRN EIS). Because of the timeliness of this EIS, and the close proximity (3.5 mi) of the CRN site to the proposed Kairos test reactor site, the NRC staff considers the cultural background description in the CRN final EIS (described in Section 2.7.1) to be relevant and accurate for the assessment of the proposed Hermes project and incorporated it into this EIS by reference.

As indicated in the referenced cultural background description, human occupation in east Tennessee spans thousands of years. The cultural background is derived from the pre-contact and historic overviews provided by Hunter et al. (Hunter et al. 2015-TN4971) and Barrett et al. (Barrett et al. 2011-TN4974, Barrett et al. 2011-TN4975).

Archaeologists divide the pre-contact period in east Tennessee into four distinct phases: Paleo-Indian, Archaic, Woodland, and Mississippian. Based on these divisions, archaeologists estimate that human occupation in this region began in at least 10,000 BC, if not earlier. The Paleo-Indian period is estimated to span from 10,000 BC to 8,000 BC (TN4971). The Paleo-Indian period was largely subsistence-based and archaeological finds identified in the region are limited to the recovery of a few Paleo-Indian Clovis-style projectile points, suggesting an infrequent pattern of resource utilization (TN4971).

The Archaic period is divided into three eras: Early (8,000 to 6,000 years BC), Middle (6,000 to 3,000 BC), and Late (3,000 to 1,000 years BC). Settlement patterns associated with the Early Archaic Period are characterized by short-term resource use areas and base camps. The Middle Archaic Period reveals an increased diversity in artifact type as well as increased complexity in tool making. Settlement patterns are similar to the Early Archaic Period and are characterized by an increase in population and longer-term use of camp occupations. The Late Archaic Period is characterized by an increase in sedentary settlement patterns consisting of seasonal base camps and more short-term camps.

Two eras are associated with the Woodland Period in east Tennessee: Early (1,000 BC to 200 BC) and Middle (200 BC to A.D. 900). Archaeological evidence suggests that rather than a transition to Late Woodland after the Middle Woodland Period, there is a transition to the Mississippian Period beginning in A.D. 900. The Early Woodland Period is characterized by mound building and widespread use of pottery, along with an increase in horticultural practices, including the cultivation of seeds, berries, and grains. Burial practices include internment in mounds and the development of more complex mortuary and ritual practices. Settlement patterns associated with the Early Woodland Period continue to include seasonally based camps. The Middle Woodland Period is characterized by an increase in sedentism and the development of a more complex social system. At the end of the Middle Woodland Period, there is an abrupt shift from base camp settlement to permanent villages, which correlates with an increased dependence on the cultivation of maize. The Mississippian Period (A.D. 900 to 1540) is characterized by the increased reliance upon agriculture and the establishment of fortified villages, chiefdoms, and complex burial practices.

European explorers arrived in the vicinity of the proposed project area in 1540 as part of the DeSoto expedition and likely encountered the Coosa American Indian population (TN4971). By the 1700s, the Overhill Cherokee inhabited the area. With the arrival of fur traders in the 1700s, skirmishes between the French, British, and Indian groups increased in the area through

the early 1800s. In 1796, the State of Tennessee was formed. Between 1794 and 1838, as a result of three treaties with the Cherokee Indians and through forced removal at the time of the Trail of Tears, the Cherokee Indians were evicted from their ancestral homelands and required to relocate to Oklahoma (TN4971).

After the Depression, development in the Tennessee Valley, including the establishment of the TVA, led to a more-varied economic base in the region (TN4971). The first dam built by TVA commenced operation in 1936 with the opening of the Norris Dam (TN4975). The existence and location of the Norris Dam were contributing factors in the decision to locate "Site X" of the top-secret Manhattan Project in the Clinch River Valley area (Kairos 2023-TN8172 │ Sec 3.6.1). Other factors included the area's remoteness, rural nature, the ridge and valley topography, accessibility of the area via highway and rail, the low cost for acquiring property, and the prevalence of non-farm workers in the area (Kairos 2023-TN8172) │ Sec 3.6.1, which referenced Cultural Resources Management Plan for DOE Oak Ridge. "Site X" eventually became the ORR and was part of the Manhattan Project (Kairos 2023-TN8172 │ Sec 3.6.1). Land acquisition for the ORR began in 1942. Several agricultural communities in the area at that time were relocated to accommodate Manhattan Project related construction activities (Kairos 2023-TN8172 │ Sec 3.6.1).

The proposed project is located at the site of the former NRHP-eligible K-31 and K-33 buildings, which were part of the K-25 complex and operated as the ORGD, which was constructed between 1943 and 1945 (Valk et al. 2011-TN4972, Kairos 2023-TN8172 │ Sec 3.6.1). Uranium enrichment operation ceased in 1986, and restoration, decontamination, and decommissioning activities began soon thereafter (Kairos 2023-TN8172 │ Sec 3.6.1). Reindustrialization of the site, later renamed the East Tennessee Technology Park, by DOE in cooperation with the Community Reuse Organization of East Tennessee in preparation for conversion of the site to a private sector industrial park began in 1996 (Kairos 2023-TN8172 │ Sec 3.6.1). In 1998, the DOE and THC signed a Memorandum of Agreement (MOA) to resolve the adverse effects of decontamination, decommissioning as well as removal, recycling, and/or disposal of equipment associated with Buildings K-29, K-31, and K-33 as well as other ancillary activities (Kairos 2023-TN8172 │ Sec 3.6.4). This MOA was amended in 2001 to discuss which diffusion equipment and displays would be retained, and upon completion of MOA stipulations, Buildings K-29, K-31, and K-33 and the ancillary facilities were demolished (Kairos 2023-TN8172 │ Sec 3.6.4). Currently, the site is a brownfield.

3.5.1.2 Historic and Cultural Resources at the Kairos Hermes Reactor Site

In 2011, DOE completed an EA prior to transferring the land and facilities within the East Tennessee Technology Park to the Community Reuse Organization of East Tennessee. According to DOE's EA, no prehistoric archaeological resources are known to exist within the East Tennessee Technology Park, which also includes the proposed Hermes site. This is due to the massive cut and fill excavation activities associated with the construction, demolition, and decontamination of the former K-25 site and associated facilities (i.e., K-33 and K-31). DOE concluded that there are likely no intact archaeological sites to be found within the East Tennessee Technology Park (DOE 2011-TN4888).

As part of the land transfer, DOE and Heritage Center, LLC executed a Quitclaim Deed on September 29, 2017, that stated the grantee shall protect any historical and/or archaeological cultural resources which may be discovered on the premises subsequent to the date of the conveyance and shall comply with the procedures set forth in an attachment entitled Exhibit C (DOE 2017-TN8206 and DOE 2017-TN8207). Exhibit C of the Quitclaim Deed states that no

land-altering activity of any kind, including but not limited to digging or excavation, shall be allowed or conducted in any areas on which archaeological sites and resources are discovered subsequent to the transfer (DOE 2017-TN8206 and DOE 2017-TN8207). The owner of the record shall consult with the THC to determine what measures are required to mitigate any adverse effects and shall carry out the agreed-upon mitigation plan (DOE 2017-TN8206 and DOE 2017-TN8207).

The NRC reviewed the THC files and confirmed that there are no extant architectural (i.e., aboveground structures) resources within the direct-effects APE.

After issuance of the draft EIS, and in response to a tribal comment regarding cultural resource surveys (NRC 2023-TN8169), the NRC staff contacted DOE-OREM to obtain additional information related to site geology, geomorphology, and the scope and extent of prior disturbance (i.e., total area and depth of disturbance) on the K-31 and K-33 site. DOE provided additional information and met with NRC staff on December 21, 2022, to discuss the NRC's interpretations of previous site disturbance, the buried 1949 surface, and the potential for deeply buried paleosols (i.e., old, buried soil surfaces) on the K-33/K-31 site (NRC 2023-TN8208). Based on this new information, the subsequent discussion with DOE-OREM, and the proposed action, the NRC staff determined that there is a potential for archaeological deposits on the 1949 surface and in possible paleosols.

DOE confirmed that surface material in the proposed Hermes reactor footprint and surrounding areas was removed (i.e., cut) during original construction of K-31 and K-33 and used as fill in other areas, which buried the 1949 surface. DOE also corrected the NRC's previous understanding that the top 10 feet of soil and sediment were not removed as part of remediation efforts. Additionally, DOE confirmed still-buried alluvial sediments and other areas could contain paleosols that may or may not have been cut into during construction of K-31 and K-33. Thus, there is the potential that the buried 1949 surface and deeply buried paleosols could contain archaeological deposits and supports the Quitclaim Deed requirement to develop a mitigation plan in advance of digging or excavation on the property.

NRC staff presented to Kairos its assessment of the DOE information and concluded that there is potential at the Hermes site for buried archaeological resources (NRC 2023-TN8208). Paleosols have potential to contain archaeological deposits, and parts of the buried 1949 surface are still intact. Based on discussions with the NRC staff, Kairos submitted supplemental information on April 20, 2023 (NRC 2023-TN8412). Kairos's submittal included a management summary, draft Archaeological Resources Monitoring and Unanticipated Discovery Plan (monitoring plan), and a cultural resources memorandum (supplemental information).

The Manhattan Project National Historical Park (NHP, established in 2015, is the only NRHP-eligible property located within the indirect-effects APE. The Manhattan Project NHP is jointly operated and administered by the DOE and the NPS (DOI 2022-TN7957). The Manhattan Project NHP consists of the K-25 History Center, which opened in 2020 and focuses on the men and women who built and operated the ORDF during the Manhattan Project and Cold War. The proposed viewing platform and associated exhibits will help visitors understand the scope and magnitude of the site, while they learn about the personal stories of the workforce (DOE 2022-TN7897). Future plans include construction of a viewing platform and wayside exhibits that are the final components of the previously mentioned MOAs related to the K-25 site (TN7897).

To verify the NRC's decision to delineate the indirect-effects APE to 0.5 mi radius around the proposed site, the NRC staff requested that Kairos take viewshed photographs from four known

historic and cultural resources located within the vicinity of the proposed Kairos Hermes site (1 mi) but outside of the 0.5 mi area. These historic and cultural resources include the following: the Wheat Community Historic District (archaeological district); the Wheat Community African Burial Ground, Gallaher, and Ellis cemeteries; and the NRHP-eligible George Jones Memorial Baptist Church. Kairos provided the photographs as supplemental information, which confirms that the proposed project area is not visible from these historic and cultural resources due to screening from topographic features and vegetation (Kairos 2022-TN7926)(see Appendix F).

3.5.1.3 Traditional Cultural Properties

The Kairos ER states that previous cultural resource surveys have identified eight sites within the vicinity of ORR that include mounds and/or are known human burial sites, which could be considered sacred sites (Kairos 2023-TN8172 │ Sec 3.6.2). None of these sites is located within the direct- or indirect-effects APE. To date, the results of NRC's NHPA Section 106 consultation conducted with Tribes that attach cultural or religious significance to historic properties also indicate that no traditional cultural properties are known to be located within the Hermes direct- or indirect-effects APE at the time of publishing this EIS (see Appendix C).

3.5.1.4 Consultation

The NRC initiated consultation via a letter dated March 4, 2022, with the THC (NRC 2022-TN7927), the ACHP (NRC 2022-TN7928), NPS (NRC 2022-TN7929), and 18 Federally recognized Tribes (Absentee Shawnee Tribe, Alabama-Coushatta Tribe of Texas, Alabama-Quassarte Tribal Town, Cherokee Nation, Chickasaw Nation, Eastern Band of Cherokee Indians, Coushatta Tribe of Louisiana, Delaware Nation, Eastern Shawnee Tribe of Oklahoma, Jena Band of Choctaw Indians, Kialegee Tribal Town, Muscogee (Creek) Nation, Poarch Band of Creek Indians, Seminole Nation of Oklahoma, Seminole Tribe of Florida, Shawnee Tribe, Thlopthlocco Tribal Town, and United Keetoowah Band of Cherokee Indians). All letters are presented in Appendix C. There are no Federally recognized Tribes located within the State of Tennessee. The results of the NHPA Section 106 consultation efforts completed to date are described below.

On March 11, 2022, the THC replied by letter stating that the project as currently proposed would not adversely affect the Manhattan Project NHP (THC 2022). Additionally, the THC has no objection to the implementation of this project as currently planned (THC 2022-TN7930).

The NRC conducted a virtual joint public outreach and scoping meeting on March 23, 2022 (NRC 2022-TN7933). No comments regarding historic and cultural resources were provided at the meeting.

On March 30 and 31, 2022, the Chickasaw Nation stated that the proposed project is outside its area of interest and declined the NRC's request for government-to-government consultation (Chickasaw 2022-TN7931, Chickasaw 2022-TN7932).

By letter dated April 12, 2022, the NPS expressed an interest collaborating with Kairos and/or the NRC to develop interpretative material at or in proximity to the proposed Kairos facility site that illustrates the history of nuclear science and technology and demonstrates linkages to the work done at K-25 during World War II (DOI 2022-TN7957). The NPS noted that it is currently working with Roane County to develop interpretation and recreation programs based at and near the waterways near the K-25 site (DOI 2022-TN7957). Additionally, the NPS expressed concerns related to other DOE planned development in the area, particularly the Oak Ridge Airport and the potential impacts to on public access to the Manhattan Project NHP.

The NRC conducted follow-up calls with Tribes in April 2022. The Eastern Shawnee Tribe stated via letter (Eastern Shawnee 2022-TN7934) that they find no known properties of historical and/or cultural significance to the Tribe that will be affected by this project. However, if this project inadvertently discovers an archeological site or object(s), the Eastern Shawnee requested that the Tribe and appropriate State agencies be contacted immediately (within 24 hours) and that all ground-disturbing activity stop until the Tribe and State agencies are consulted (TN7934).

The Delaware Nation responded that Tennessee is outside of their area of interest (Delaware Nation 2022-TN7935), and the Poarch Band of Creek Indians stated that the location of the project appears to be outside their area of interest (Poarch Band 2022-TN7936). On April 6, 2022, the Seminole Nation of Oklahoma accepted the NRC's invitation to participate in the environmental scoping process (Seminole Nation 2022-TN7937). On May 2, 2022, the NRC staff conducted a teleconference with a Tribal Historic Preservation Officer (THPO) from a consulting Tribe to discuss the proposed project, the associated direct- and indirect-effects APE, and potential impacts on historic and cultural resources. At the conclusion of the teleconference, the consulting Tribe requested copies of cultural resource surveys completed in the vicinity of the proposed project. On May 17, 2022, NRC staff followed up its teleconference with an e-mail summarizing the contents of the discussion and indicated that the NRC had requested copies of the cultural resources reports from the Tennessee Division of Archaeology (TDOA) and would send them to the consulting Tribe upon their receipt (NRC 2022-TN7958). On July 6, 2022, NRC staff submitted the cultural resources reports to the consulting Tribe (NRC 2022-TN7958).

Post-Draft EIS Consultation Activities

The NRC transmitted the draft EIS and the results of its NHPA Section 106 determination to the THC [NRC 2022-TN8162], the ACHP [NRC 2022-TN8161], the NPS [NRC 2022-TN8160], and 15 Federally recognized Tribes [NRC 2022-TN8158, NRC 2022-TN8159, NRC 2022-TN8157, NRC 2022-TN8183] (i.e., Absentee Shawnee Tribe, Alabama-Coushatta Tribe of Texas, Alabama-Quassarte Tribal Town, Cherokee Nation, Eastern Band of Cherokee Indians, Coushatta Tribe of Louisiana, Eastern Shawnee Tribe of Oklahoma, Jena Band of Choctaw Indians, Kialegee Tribal Town, Muscogee (Creek) Nation, Seminole Nation of Oklahoma, Seminole Tribe of Florida, Shawnee Tribe, Thlopthlocco Tribal Town, and United Keetoowah Band of Cherokee Indians). All letters are presented in Appendix C. The NRC did not send consultation letters to the Chickasaw Nation, Delaware Nation, and Poarch Band of Creek Indians as those Tribes stated that the proposed project area was located outside their respective areas of interest.

On September 29, 2022, the THC commented that, in accordance with its previous correspondence dated March 11, 2022, that the project will not adversely affect historic properties (THC 2022-TN8209).

On October 13, 2022, a consulting Tribe forwarded questions to the NRC inquiring if the APE has been subject to an archeological survey, requesting to review the monitoring plan, and inquiring whether the THC's comments were available for review. NRC staff responded to these questions by email dated October 18, 2022 (THC 2022-TN8209). Based on the consulting Tribe's concerns, the NRC staff contacted DOE-ORR to obtain additional information related to site geology, geomorphology, and the scope and extent of prior disturbance (i.e., total area and depth of disturbance) on the K-31 and K-33 site.

On October 21, 2022, and November 1, 2022, the NRC re-sent the draft EIS letters via e-mail to Federally recognized Tribes to confirm receipt of letters and answer any questions regarding the proposed project (NRC 2022-TN8211).

NRC staff sent additional information obtained from DOE-OREM for the consulting Tribe's review on December 1, 2022. The NRC received comments from the consulting Tribe on December 6, 2022, which requested that a cultural resources survey be conducted for the proposed project (NRC 2023-TN8169). In its letter, the Tribe also informed the NRC of its interest in acting as a consulting party and requested that the NRC include its office in development of the monitoring plan for the Kairos site (NRC 2023-TN8169). Additionally, the consulting Tribe requested government-to-government consultation with the NRC (NRC 2023-TN8169).

The NPS concurred with the finding in the draft EIS on February 2, 2023 (NPS 2023-TN8170).

On February 13, 2023, NRC informed the THC and TDOA that a consulting Tribe requested that a cultural resources survey be conducted and that the NRC include its office in the development of the monitoring plan (NRC 2023-TN8212).

During a series of closed meetings with Kairos from February to April 2023, NRC staff discussed the need for additional information from Kairos to support the NRC's ongoing NHPA Section 106 consultations. Specifically, the staff indicated the need to understand the presence or absence of deeply buried soils (i.e., paleosols) that have the potential to contain historic and cultural resources (NRC 2023-TN8208) (NRC 2023-TN8408).

On April 28, 2023, NRC staff forwarded Kairos's supplemental information to the consulting Tribe for review and comment (NRC 2023-TN8409).

NRC staff provided an update to the THC and TDOA on May 8, 2023, regarding the status of NRC's Section 106 consultation (NRC 2023-TN8403).

NRC staff met with the consulting Tribe's THPO on June 1, 2023, and June 5, 2023, to discuss Kairos's supplemental information and to receive the Tribe's initial feedback (NRC 2023-TN8407). During the June 1, 2023, call, the consulting Tribe requested additional information regarding the extent and depth of construction fill across the site and requested that a reconnaissance field investigation be performed. Additionally, the THPO also provided preliminary comments on the draft monitoring plan. The consulting Tribe agreed with the NRC that the monitoring plan should be updated to include a mitigation plan, work controls, and monitoring procedures, and that these updates be prepared by a geoarchaeologist, qualified under Secretary of the Interior (SOI) standards. The THPO also stated that their office wants to receive the weekly monitoring reports once construction commences (NRC 2023-TN8407).

NRC staff followed up on June 5, 2023, with the consulting Tribe to discuss clarifying questions related to the request for an additional reconnaissance field investigation. The NRC stated that it would request that Kairos provide the survey methodology and updated monitoring plan to the NRC and consulting Tribe for review and comment NRC 2023-TN8407).

On June 6, 2023, and June 14, 2023, the NRC met with Kairos to discuss the April 2023 supplemental information and provide comments from the NRC and the consulting Tribe. As a result of NRC's meetings with the consulting Tribe, Kairos agreed to work with a geoarchaeologist, qualified under SOI standards, to review pertinent information related to the proposed project, to develop a methodology for the reconnaissance field investigation, and to

update the draft monitoring plan, as appropriate. The NRC stated that the methodology should be made available to the NRC and consulting Tribe for review and comment. Consistent with the Tribe's request for government-to-government consultation, the NRC will facilitate the discussion with the consulting Tribe and will provide information to Kairos (NRC 2023-TN8413).

At the time of publishing this EIS, the consulting parties have agreed upon a path forward to support NHPA Section 106 consultation closure. Kairos agreed to work with a geoarchaeologist, qualified under SOI standards, to develop a methodology for a reconnaissance field investigation and make appropriate updates to the monitoring plan. This documentation would be made available to the NRC and the consulting Tribe for review and comment. Weekly closed meetings will continue to facilitate close coordination on future information submittals (Kairos 2023-TN8437 and NRC 2023-TN8411). NHPA Section 106 consultation closure will be documented in the NRC's Record of Decision.

3.5.2 Environmental Impacts of Construction

The proposed footprint of disturbance for the Hermes project is composed entirely of land that was previously used for industrial purposes (i.e., brownfield). No historic and cultural resources are currently known to exist within the proposed project area due to the massive cut and fill excavation activities associated with the construction of the former K-25 site and associated facilities (i.e., Buildings K-33 and K-31) and their subsequent decontamination, demolition, and decommissioning. Since issuance of the draft EIS, new information regarding the potential for the buried 1949 surface and deeply buried paleosols that could contain archaeological deposits has been raised (NRC 2023-TN8208).

As discussed by DOE (DOE 2011-TN4888), lease and/or deed restrictions require that if an unanticipated discovery of cultural materials (e.g., human remains, pottery, weapon projectiles, and tools) or sites is made during any development activities, all ground-disturbing activities in the vicinity of the discovery would be halted immediately. Per the deed restrictions, Kairos has developed a draft monitoring plan for implementation that would establish stop work and notification procedures to address the unexpected discovery of human remains or archaeological material (Kairos 2023-TN8172 │ Section 4.6.1, Kairos 2022-TN7902, DOE 2017-TN5081). The monitoring plan would be in place prior to commencing ground-disturbing activities (Kairos 2022-TN7902). If human remains or archaeological resources were discovered, work would cease in the area, and notifications would be made in accordance with Tennessee law (T.C.A. § 11-6-107 *et seq*.-TN7938). If human remains were discovered, Kairos would also notify appropriate local law enforcement. If the human remains were determined to be archaeological in nature, Kairos would notify the TDOA and the THC to determine what further actions would be taken (Kairos 2023-TN8172 │ Sec 4.6.1, Kairos 2022-TN7902).

No impacts are expected to occur on traditional cultural properties of significance to Indian Tribes because none have been identified in the direct- or indirect-effects APE at the time of publishing this EIS.

The Manhattan Project NHP is located at the site of the former K-25 plant that was demolished and is the only NRHP-eligible site located within the indirect-effects APE. The major structures to be constructed for the proposed project would not exceed 100 ft in height. The overall visual setting of the proposed project is predominantly industrial and is in keeping with the current setting of the historical park, which consists of a brownfield site, newly built history center, and concrete pads. Therefore, the construction of the proposed Kairos project would not adversely affect the Manhattan Project NHP.

3.5.3 Environmental Impacts of Operation

No impacts on historic and cultural resources from operations and maintenance activities are expected to occur. Operations and maintenance activities may entail ground-disturbing activities within the direct-effects APE; however, because there is a potential for the buried 1949 surface and deeply buried paleosols to contain archaeological deposits, Kairos would follow its monitoring plan and applicable Tennessee law regarding inadvertent discovery of human remains.

3.5.4 Environmental Impacts of Decommissioning

Impacts from decommissioning are expected to be similar to those resulting from construction activities. Because there are no known historic properties under 36 CFR 800.4(d)(1) (TN513) or historic and cultural resources located within the proposed Hermes reactor site, impacts on these resources would not be expected during decommissioning. Decommissioning activities would involve the use of heavy equipment to remove buildings, roadways, and other structures within the APE (Kairos 2023-TN8172 │ Sec 4.6.1). However, because there is potential for the buried 1949 surface and deeply buried paleosols to contain archaeological deposits, Kairos would follow its monitoring plan and applicable Tennessee law regarding inadvertent discovery of human remains.

3.5.5 Cumulative Impacts

The description of the affected environment above serves as the baseline for the assessment of cumulative impacts on historic and cultural resources. No historic and cultural resources are known to exist within the proposed Hermes project area; however, there is potential for the buried 1949 surface and deeply buried paleosols to contain archaeological deposits. The Manhattan Project NHP is the only NRHP-eligible site within the indirect-effects APE.

Table 4.13-1 of the ER identifies past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts of the proposed action (Kairos 2023-TN8172). Projects within the direct- and indirect-effects APE that may have a potential cumulative impact on historic and cultural resources include ongoing infrastructure improvements and future urbanization. Past activities include adverse effects associated with the decontamination, demolition, and decommissioning of K-25 and the ORGDP facilities. Adverse effects on historic properties associated with these past activities were resolved by DOE via execution of MOA(s). Ongoing and future projects listed in ER Table 4.13-1 include cleanup and redevelopment activities at the East Tennessee Technology Park, construction and operation of the Atlas facility, and redevelopment activities at the Heritage Center. Development of such projects could affect historic and cultural resources if ground-disturbing activities occur, and the severity of the impacts would vary depending upon the extent of damage caused to archaeological resources and the extent of mitigation required to address adverse effects on historic properties. If new aboveground structures are constructed as part of the present and reasonably foreseeable projects, there could be significant cumulative impacts on the Manhattan Project NHP. However, in most instances, visual impacts can be minimized using creative design and by establishing vegetative screening. Although the Manhattan Project was historically significant in U.S. national history, most of the historic structures formerly at the East Tennessee Technology Park have already been demolished. Additionally, no known historic properties would be affected by development on the proposed Hermes site; therefore, no additional cumulative impacts on historic and cultural resources would occur (Kairos 2023-TN8172 │ Sec 4.13.7).

Historic and cultural resources are nonrenewable, hence certain activities can result in an irretrievable loss of the resource. Therefore, the impact of destruction on historic and cultural resources is cumulative. Overall, the cumulative impacts of the proposed Hermes project combined with other past, present, and reasonably foreseeable future actions is substantial, but the contribution of the proposed Hermes project to those cumulative impacts would be minimal.

3.5.6 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative impacts on historic and cultural resources would be SMALL. Even though other projects in the area surrounding the proposed Hermes site have resulted in past impacts and may potentially result in future impacts on historic and cultural resources, the Hermes project would not contribute further to those impacts. For the purposes of the NRC's NHPA review, the staff concludes that there would be no adverse effect to historic properties from the proposed project. At the time of publishing this EIS, the consulting parties have agreed upon a path forward to support NHPA Section 106 consultation closure. NHPA Section 106 consultation closure will be documented in the NRC's Record of Decision.

3.6 Socioeconomics and Environmental Justice

3.6.1 Affected Environment

3.6.1.1 Socioeconomics

In April 2019, the NRC published NUREG-2226 (NRC 2019-TN6136), *Environmental Impact Statement for an Early Site Permit (ESP) at the Clinch River Nuclear Site*. The CRN site is relevant for several reasons and can reasonably serve as applicable analyses for the purpose of this EIS. First, the CRN EIS considers the environmental impacts associated with a site that is within 4 mi of the proposed Hermes reactor site, so all of the physical, geological, hydrological, and atmospheric conditions identified in the CRN EIS are very similar for the Hermes site. Second, the publication of the CRN EIS in April 2019 occurred recently, so the information and data in the CRN EIS is still relevant to and useful for this project. Consequently, the NRC staff determined much of the analysis conducted for the CRN site was relevant and accurate for the assessment of socioeconomic and EJ impacts from the proposed Hermes project. For socioeconomic and EJ analyses of the Hermes project, the NRC staff used the CRN EIS's data source, the U.S. Census 2016 American Community Survey (ACS) Five-Year estimates, and identified the economic region (hereafter "the region") as the counties of Anderson, Knox, Loudon, and Roane, which in aggregate contained about 87 percent of the 2019 ORR workforce (TN6136). The Hermes ER used the Census 2019 ACS Five-Year estimates and established its economic region of interest as the four-counties listed above, plus Morgan County, which are all within 10 mi of the proposed site. To leverage the analyses used in the CRN EIS with the additional information provided in the Hermes ER, the NRC staff included Morgan County in its economic region of interest for the socioeconomic and EJ analyses. However, due to an unavailability of the 2019 ACS data set, the staff incorporated Morgan County demographic data from the U.S. Census Bureau, 2020 Census Redistricting Data (Population, Tabulation for State Legislative Apportionment Act-TN7959) at the Census Block Group (CBG) level of disaggregation. This decision was made after the staff determined the differences for representative counties' values in 2019 and 2020 ACS datasets were within 1 percent of each other. This section describes the baseline socioeconomic and EJ characteristics: the populations and the economy of the region, and the region's infrastructure and public services.

The following analysis focuses on resident populations with reference to the transient and migrant worker population analyses performed for the CRN EIS. The NRC staff's definitions for demographic cohorts follow the definitions of the U.S. Census Bureau. Table 3-6, below, provides key baseline demographic data for the economic region of the proposed project.

Table 3-6 2020 Population of Counties in the Economic Region

	Tennessee	Anderson County	Knox County	Loudon County	Morgan County	Roane County
Total	6,910,840	77,123	478,971	54,886	21,035	53,404
Hispanic or Latino	479,187	2,820	28,568	5,356	299	1,011
White	4,900,246	66,044	373,790	46,419	19,029	48,094
Black or African American	1,083,772	2,841	39,853	578	971	1,302
American Indian and Alaska Native	15,539	217	1,079	95	54	161
Asian	134,302	975	11,881	450	41	341
Hawaiian/Other Pacific Islander	3,594	53	300	2	8	19
Some Other Race	23,977	272	1,776	161	64	157
Two or More Races:	270,223	3,901	21,724	1,825	569	2,319
Number of CBG		54	301	47	14	51

Key: CBG = Census block group.

The CRN EIS indicated the population of the economic region increased at an average annual rate of about 1.2 percent between 2010 and 2015, with the fastest annual growth rate (1.96 percent per year) occurring in Loudon. Knox had the second highest annual growth rate projection at 1.31 percent, and Anderson the third highest at 0.57 percent. The slowest annual growth rate was in Roane (0.45 percent per year) (NRC 2019-TN6136 │ Sec 2.5.1.1, Table 2-22). Expanding that analysis to account for the 2020 Census, the relative rankings between counties remained the same, with Loudon again the fastest at 4.04 percent per year, then Knox at 2.54 percent, Anderson at 0.81 percent, and Roane at 0.29 percent. However, Morgan County's 2010 population Census was 21,987, almost more than a thousand individuals than that recorded in the 2020 population Census, indicating an average annual loss of about 0.43 percent. Comparisons between the CRN EIS Census data for key municipalities in the economic region show changes consistent with the county-level analyses.

Table 2-24 of the CRN EIS (TN6136) displays 100 years of past and projected populations for the CRN ESP site economic region. Comparison between the projected 2020 economic region estimates in the CRN EIS and the 2020 Census data for those same areas indicates the CRN EIS overestimated population growth in the economic region, ranging between 2.04 percent (Knox) and 5.15 percent (Roane), for an average of 2.62 percent. The NRC staff determined the population projections provided in the CRN EIS were reasonable and incorporate them here by reference. Based on those population projections, the staff can reasonably assume the economic region will continue to grow in population at around 1 percent per year until about 2080.

In 2020, Loudon County had the lowest poverty rate in the economic region (13.7 percent) and ranked 12th of the 95 Tennessee counties. Roane ranked 24th with a 15.4 percent poverty rate, Knox ranked 25th with 15.8 percent, Anderson ranked 28th with 16.3 percent, and Morgan had the highest poverty rate at 22.9 percent, which makes that county 82nd in state ranking. The economic region is less racially diverse than the population of Tennessee, with more than

80 percent of the population self-identifying as “White Only,” and about 12 percent of the population divided between “Black or African American Only” (6.64 percent) and “Hispanic or Latino” (5.55 percent). Another 4.43 percent of the economic impact area population self-identify as “Two or More Races,” and the remaining 2.64 percent is divided between the remaining single race categories.

The staff used Tennessee Department of Labor and Workforce Development data to report employment and unemployment data for the five-county economic region (Table 3-7). In 2020, the total labor force for the economic region was approximately 397,000 people, with about 19,000 unemployed, representing 5.4 percent, a full percentage point lower than the Tennessee 2020 annual unemployment rate. Almost 70 percent of those unemployed in the economic region lived in Knox County, but because of the county’s much larger population, the number of unemployed did not result in a Knox County unemployment rate that was greater than that for the State. Of all the counties in the economic region, only Morgan County had an unemployment rate greater than the State’s, at 7.0 percent.

Table 3-8 presents 2020 employment for private industries in Tennessee and the five counties of the economic region. The shaded rows provide three-digit level North American Industry Classification System code values for Goods-Producing and Service-Providing sectors of the Tennessee economy. The four-digit disaggregation numbers indicate the economic region has an active workforce of 14,300 construction workers and that roughly 116,000 more construction workers live in Tennessee and could potentially support the proposed project’s construction workforce. For the purposes of this analysis, the NRC staff determined the data were not unreasonable as an approximation of the region's employment structure.

Sections 2.5.2.2.1 through 2.5.2.2.4 of the CRN EIS provide the NRC staff’s 2019 economic characterizations of the four-counties in the CRN site’s economic region and are incorporated here by reference (NRC 2019-TN6136). Morgan County has a total area of 522 square miles (mi^2) (1,352 km^2), all but a third of a mi^2 being land. Based on the 2020 census, the largest settlement in Morgan County is the community of Coalfield, with 2,361 residents. Wartburg, the county seat, is a town of 848 residents. The three largest industries in Morgan County are manufacturing, health care, and public administration. Morgan County has developed a 19.2 ac industrial park in Sunbright, 40 mi from Interstate 75, where tenants lease county-owned buildings. Their largest tenant is Tennier Industries, which manufactures military clothing.

Comparison of 2019 and current tax data indicates the tax structures in Anderson, Knox, Loudon, and Roane Counties have not changed since publication of the CRN EIS, and their data are incorporated here by reference (NRC 2019-TN6136). Morgan County has a complex property tax formula that results in an average rate of 7 mils (0.7 percent of a structure’s appraised value). Tennessee assesses a 7 percent sales tax and allows local governments to add up to 2.75 percent (in quarter percent increments) for local revenue. Morgan County adds 2 percent to the Tennessee sales tax, for a total sales tax of 9 percent.

Vehicles access the ORR by State Route (SR) 58/Interstate-40 running east and west to the south of Clinch River and the proposed site, and SR 61 north of the ORR and running east and increasingly northward. From these main arteries, SR 95, SR 327, and SR 58 bring traffic closer to the ORR, where local roads provide the final leg of the journey. One major and one minor rail line also provide transportation routes to the ORR, and barge transportation via the Clinch River is possible.

Table 3-7 2020 Employment Data for the Economic Area

	Tennessee	Anderson County	Knox County	Loudon County	Morgan County	Roane County	Total Economic Region
Total labor force	3,454,168	36,308	255,750	24,574	8,325	24,633	397,210
Employed	3,234,116	34,176	242,457	23,182	7,745	22,987	330,547
Unemployed	220,052	2,132	13,293	1,392	580	1,646	19,043
Unemployment rate	6.4%	5.9%	5.25%	5.7%	7.0%	6.7%	5.45%

Source: State of Tennessee 2021-TN7960.

Table 3-8 2020 Private Employment by Industry for the Economic Region

Industry	Tennessee	Anderson County	Knox County	Loudon County	Morgan County	Roane County	Total Economic Region
101 Goods-producing	476,156	13,059	25,649	5,033	398	1,279	45,418
1011 Natural resources and mining	11,134	24	339	583	0	0	946
1012 Construction	130,050	1,147	12,364	811	0	0	14,322
1013 Manufacturing	334,972	11,888	12,945	3,639	318	899	29,689
102 Service-providing	2,026,094	21,701	176,262	9,612	1,182	14,616	223,373
1021 Trade, transportation, utilities	627,005	4,771	50,101	4,201	306	2,712	62,091
1022 Information	42,929	235	4,361	153	31	46	4,826
1023 Financial activities	155,926	1,280	12,720	364	49	240	14,653
1024 Professional & business services	414,644	7,163	37,929	1,205	210	8,183	54,690
1025 Education and health services	421,097	4,467	39,250	1,427	398	1,823	47,365
1026 Leisure and hospitality	293,033	3,166	25,355	1,770	148	1,373	31,812
1027 Other services	70,977	617	6,536	493	39	238	7,923
1029 Unclassified	482	1	12	0	0	0	13

Source: BLS 2020-TN7961.

In 2015, AECOM Technical Services, Inc. (AECOM) completed a traffic impact study for the CRN application. In 2021, Kairos commissioned a traffic study that determined the annual average daily traffic volumes for roads serving the ORR have grown at a rate of 2 percent per year over a 6-year period (Kairos 2023-TN8172). The NRC staff compared the data from the two studies and determined the data in the AECOM traffic study for the CRN EIS are still relevant and timely and the study is incorporated here by reference (TN6136 | Sec 2.5.2.4.1). The NRC staff also inspected the anonymized location records process used for the Kairos traffic study for estimating traffic volumes and determined that the process is reasonable. The staff therefore accepts the applicant's 2 percent annual growth assessment for the purposes of this EIS and applies it to the AECOM study conclusions.

The data provided in the CRN EIS is only 3 years old and is incorporated by reference here regarding the recreational characterization of the economic region for the proposed project (TN6136 │ Sec 2.5.2.5). Morgan County is home to Frozen Head State Park and Natural Area, the headwaters of the Obed Wild and Scenic River, Lone Mountain State Forest, Catoosa Wildlife Management Area, Historic Rugby Tennessee, the Historic Brushy Mountain Penitentiary, and part of the Big South Fork National River and Recreation Area.

The CRN EIS reported about 27,400 housing units were available for purchase or rent in the EIS's economic region, along with almost 10,000 hotel rooms, most of which are in the Knoxville metropolitan area, and close to 1,500 camping sites. Given that the CRN EIS was published in 2019 and data are unlikely to have changed significantly since that time, the NRC staff determined the numbers established in the CRN EIS are still relevant and can reasonably be assumed to be accurate. Therefore, the conditions associated with housing in the CRN EIS are incorporated here by reference (NRC 2019-TN6136 │ Section 2.5.2.6, Table 2-35).

Infrastructure assessments in the CRN EIS (TN6136) cover the following key points:

- The land planned for the proposed project is vacant land where former industrial buildings were razed, in an established industrial area, and no additional infrastructure (utilities, roadways, or rail systems) is needed to build or operate the proposed facilities
- The CRN EIS reported a current (2019) excess water capacity of over 65 mgd in the four-counties of its economic region, with the largest excess occurring in Knox County (55.7 mgd) and the smallest in Loudon County (a deficiency of about 0.2 mgd) (see Table 2-36).
- Public wastewater treatment systems in the four-county economic region indicated a similar trend, with a total excess capacity of about 33 mgd. Knox County had the highest excess capacity, with 22 mgd, and Loudon County had the lowest excess capacity, with 0.4 mgd (see Table 2-37).
- For the CRN EIS economic region, the NRC staff reported the 2019 law enforcement level at 1,300 officers and 800 civilian support staff, for a total of 2,100 law enforcement employees in the CRN four-county economic region. This results in 3.8 law enforcement officers for every 1,000 residents for Anderson County, 3.5 officers in Knox County, 2.3 officers in Loudon County, and 2.8 officers in Roane County. The national average is 2.8 officers for every 1,000 residents (see Table 2-38).
- The CRN EIS reports that the four-county economic region was served by 36 fire departments staffed by 1,167 firefighters. Anderson County has eight fire departments and 214 firefighters, for a ratio of 2.8 firefighters for every 1,000 residents. Knox County has eight fire departments and 592 firefighters, or 1.3 firefighters per 1,000 residents. Loudon

County has seven fire departments and 166 firefighters, for a ratio of 3.3 firefighters per 1,000 residents, and Roane County has 13 fire departments and 195 firefighters, for a ratio of 3.7 firefighters per 1,000 residents. The four-county economic region has a ratio of 544:1, or 544 residents for each firefighter.

- The social services network that is discussed in the CRN EIS also serves Morgan County.
- The CRN EIS economic region contains 151 public schools, with 86,300 students and 5,900 teachers. The NRC staff determined the same ranking shown for water and wastewater infrastructure also applies to schools, with Knox County having 90 schools and Loudon County having only 3 schools. The CRN EIS indicates the student-to-teacher ratios for each of the economic region counties were well within Tennessee's mandated 25:1 ratio (see Table 2-39).

Morgan County has three water service district providers—Plateau Utility, Sunbright Utility, and Wartburg Utility. Plateau Utility maintains a 2.4 mgd water plant and has a 150 million gal raw water reservoir in the Liberty area of Morgan County. Plateau has a total average daily water usage of 1 million gal and a 1.4 mgd excess capacity. Plateau Utility along with Cumberland Utility District provides around 240,000 gallons per day (gpd) of water for the Sunbright Utility District (NRC 2022-TN7962). The cities of Sunbright and Wartburg both have public sewer systems within their incorporated city limits. The Wartburg system has a current usage of 700,000 gpd and total system capacity of 1.3 mgd.

There are two police departments in Morgan County—a Ranger Station at the Frozen Head State Park and Natural Area, and the Wartburg Police Department—with a total of 402 officers. Compared to other counties, Morgan County, TN, has an unusually high number of residents working as Law Enforcement Workers Including Supervisors (5.7 times higher than expected), or more than 19 officers per 1,000 residents. There are 12 fire departments in Morgan County, TN, 10 volunteer departments serving individual communities, and 1 Federal fire department for the Division of Forestry—for a total of 150 firefighters or 7.1 firefighters for every 1,000 residents (Data USA 2022-TN7963). Morgan County School District is in Wartburg and has about 2,800 students in grades PK, K-12, and a student-teacher ratio of 14 to 1. This ratio is also well within Tennessee's mandated 25:1 student-teacher ratio (ECS 2014-TN5395).

Applying the same reasoning for accepting the 2019 CRN EIS data for housing, the staff concluded that the data for public infrastructure (transportation, water and sewerage; police, fire, and medical services; social services; schools; and hospitals) in the economic region for the proposed project has not changed significantly since the publication of the CRN EIS and is incorporated here by reference (Section 2.5.2.7).

3.6.1.2 Environmental Justice

In 1994, the President signed Executive Order 12898, "Federal Actions to Address Environmental Justice (EJ) in Minority Populations and Low-Income Populations," (59 Federal Register [FR] Part 7629) directing 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 EO 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: 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.

CEQ established the low-income status as being individuals or families living below the poverty level as defined by the U.S. Census Bureau's Current Population Reports, Series P-60 on Income and Poverty (CEQ 1997-TN452). Because the NRC is an independent agency, CEQ's guidance is not binding on it; however, the NRC does consider CEQ's guidance on EJ when performing this assessment.

Table 3-6 above displays the racial and ethnic distribution of populations in the economic region for the five counties identified by this EIS. Knox County has the largest total population and the largest population of minorities, with slightly more than 100,000 minority residents—about 22 percent of its total population. Morgan County has the smallest total population of the economic region with around 21,000 residents, with about 2,000 self-identifying as minorities—less than 10 percent of the total population. Anderson (14 percent minorities), Loudon (15 percent), and Roane (8 percent) Counties complete the list.

The staff's first step in the review of EJ issues was to examine each CBG that is fully or partially within the economic region to determine whether that CBG should be considered a potentially affected EJ community. If application of either of the two criteria discussed below identified a CBG, that CBG is a potentially affected EJ area.

- The EJ population for any one of the six EJ categories exceeded 50 percent of the total population of the CBG.

or

- The percentage of the EJ population in the CBG was at least 20 percentage points greater than that same EJ population's percentage in the block group's State.

The applicant established the demographic region for EJ purposes to be a 5 mi radius from the center of the proposed project and determined none of the 14 CBGs within the demographic region met either of the two percentage criteria listed above (Kairos 2023-TN8172 │ Sec 3.9). The applicant concluded "there are no minority populations subject to consideration as potential environmental justice communities of concern" in the demographic region.

The NRC staff guidance in LIC-203 Rev 4 states, "In determining the location of minority and/or low-income populations, the geographic area within a 50 mi radius is typically large enough to encompass the entire area of potential effect so the staff can perform its comparative analysis." (NRC 2020-TN6399 │ LIC-203 Rev 4). Consequently, the staff determined the applicant's 5 mi analysis was not appropriate for the assessment of EJ issues. Instead, due to the recent nature of the CRN EIS's assessment and the proximity of the proposed CRN site to the Hermes site (within 4 mi), the staff considers the CRN EIS EJ analysis to be a sufficient analysis of the EJ characteristics of the Hermes site and incorporates by reference the CRN EIS EJ analyses. The EJ discussion below provides an overview of the CRN EIS's EJ analysis (NRC 2019-TN6136 │ Table 2-40 and Figures 2-29 and 2-30).

The CRN EIS identified 760 CBGs within a 50 mi radius of the proposed site, with 3.6 percent of the population self-identifying as having an "Aggregate Minority" status and 2.1 percent as having a "Black or African American" status that exceeded the threshold established by LIC-203 for a potentially affected EJ population. The largest concentrations of both Aggregate Minority and Black populations in the 50 mi radius occurred in Knox County, primarily because of the concentration of Black residents. None of the CBGs studied had EJ populations that exceeded the LIC-203 criteria for Asian, Other Races, or Two or More Races. About 7.6 percent of the CBGs studied had a low-income population that exceeded one of the threshold criteria; the

greatest concentration of CBGs that exceeded one of the threshold criteria is in Knox County (NRC 2019-TN6136). The closest CBGs that exceeded an LIC-203 threshold are about 8 mi north of the CRN site. The CRN EIS review team did not identify any communities that have any subsistence or other unique practices that would provide a pathway for EJ effects from the proposed project.

3.6.2 Environmental Impacts of Construction

3.6.2.1 Socioeconomics

The applicant stated in its ER that "the construction phase of this project is estimated to require an estimated [sic] average of 212 onsite workers (425 at peak time)" over a two-year construction schedule (Kairos 2023-TN8172 | Sec 2.1). NRC staff practice for estimating the impact of workers migrating into the economic region considers only the impact of peak project employment, thereby establishing that parameter as an upper bound for both the impact of smaller workforce sizes and for the duration of that impact. For the CRN EIS, TVA estimated a total workforce of 3,300 at peak employment for a 6-month period near the middle of the 72-month construction schedule (NRC 2019-TN6136), approximately eight times the size of the anticipated Hermes workforce and three times the length of the construction period. Of the 3,300 peak employment workforce, the CRN EIS estimated about one-third of the workers (1,115 workers) would be in-migrating workers (NRC 2019-TN6136). However, the Kairos ER claimed that for the construction of the project, "[t]here are no estimated labor force deficiencies [in the economic region of interest]" (Kairos 2023-TN8172 | Sec 4.7.1.1). Based upon recent experience with assessing new reactor impacts, the staff does not agree with that assessment. To establish a reasonable upper bound for the magnitude of in-migrating specialized labor, the staff applied the assumptions of the CRN EIS as an upper bound for the impacts of the Kairos construction-related impacts analysis, given that the anticipated construction workforce for an advanced test reactor is expected to be smaller than that for a power reactor.

Table 3-7 shows the rate of unemployment for each of the five counties in the economic region and 8 displays the 2020 private employment for key industries in the economic region. Knox County had the lowest unemployment rate in 2020, with 5.4 percent, and Loudon had the highest, at 7 percent. On average across the economic region, the unemployment rate was 5.45 percent, representing about 19,000 workers. Even if all the workers needed for the project's construction phase were to come from that local unemployment pool, unemployment would decrease by only about 2 percent.

In 2020, the economic region held more than 14,000 construction workers, 85 percent of whom resided in Knox County. However, the construction of nuclear facilities requires the employment of highly specialized skilled labor that meets the quality assurance requirements of 10 CFR Part 50 Appendix B (NEI 2000-TN6268), Criteria I and II for certification of nuclear capable skills. Even though the area surrounding Oak Ridge is unique in that it contains a large representation of nuclear-related services and workers, it is not unreasonable to anticipate some of the nuclear qualified skilled labor needed for construction of the Hermes facilities would need to migrate into the area from more than 100 mi away, necessitating long-term relocation to the economic region. As an upper bound for the potential impacts of in-migrating workers, the NRC staff assumed a third of the maximum construction workforce (about 140 workers) would need to in-migrate, given that the anticipated construction workforce for an advanced test reactor is expected to be smaller than that for a power reactor. This increase in population for the economic region would fall well within the population growth rates anticipated by local governments.

Similarly, the impact on socioeconomic components of the economic region derives from changes resulting from the presence of in-migrating workers as they compete for local goods and services and provide additional congestion on local roads. Assuming each of the in-migrating workers came with their families, applying the Tennessee average household size of 2.53 people (USCB 2016-TN4965), the total number of in-migrating people for the two-year construction phase of the Hermes project would be about 350 people, an increase of one-twentieth of 1 percent of the current economic region population. Even if all the in-migrating workers and their families were to move to the least populated of the economic region's counties, Morgan County (21,000 people), the increase in population would still account for less than 2 percent of the county's resident population.

Traffic impacts are derived from the entire workforce, not only the in-migrating workers that affect other aspects of the economic region. At peak employment, the NRC staff expects 425 round trip employee commutes per day, as well as any additional traffic related to shipments and deliveries (about 220 per month). The applicant's ER indicates traffic in the vicinity of the ORR increased between 2014 and 2018 at an average rate of about 2 percent per year, far lower than the magnitude needed to reduce the Level of Service (LOS, a road quality ranking from A to F) of any route into the East Tennessee Technology Park (Kairos 2023-TN8172 │ Sec 3.7.2.3.1). AECOM reported a peak morning traffic magnitude of more than 2,200 vehicles per hour (NRC 2019-TN6136 │ Table 2-34). The distribution of an additional 425 construction workers commuting for a single-shift construction schedule would add about 20 percent to the traffic volume for the short morning and evening commute periods, potentially enough to reduce the LOS on some roads but not sufficient to reduce the LOS to a level below the "D" LOS established as acceptable by the State of Tennessee (AECOM 2015-TN5000). Deliveries and shipments during construction includes about 32,000 gal of fuel per month (about 224,000 lb, or 28 small tanker trucks at the 80,000 lb load limit) and occasional deliveries of equipment and supplies (Kairos 2023-TN8172 | Sec 4.4.3.1.1). Because the additional traffic from so few Kairos activities would be added to the existing traffic in the area, shipments and deliveries each month would not be noticeable given the industrial nature of the East Tennessee Technology Park. Additionally, prior to startup, the applicant expects delivery of 20 one-ton shipments of low-pressure molten salt coolant (Kairos 2022-TN7882). Given the one-time nature of these deliveries, the impact of the shipments on traffic in the vicinity may be noticeable, but as soon as the deliveries are completed, the disruption to traffic would cease.

3.6.2.2 Environmental Justice

Given the nearest potentially affected EJ populations are over 8 miles from the proposed Hermes site and given the small footprint of the proposed project, both physically and in terms of personnel, the NRC staff found no construction-related pathways by which an EJ impact could reach an EJ population. Similarly, as discussed in the CRN EIS (NRC 2019-TN6136 │ Sec 4.5.6), the staff identified no unique EJ population characteristics or practices that could be affected by construction of the proposed project.

3.6.3 Environmental Impacts of Operation

3.6.3.1 Socioeconomics

The applicant stated in its ER that "During operations, an estimated average of 38 workers per weekday (68 full time positions) are required for staffing" (Kairos 2023-TN8172 │ Sec 2.1). The NRC staff considers the construction workforce to establish an upper bound for the impacts from the in-migration of operations workers and their families for the duration of the anticipated

four-year operations period. Some of the in-migrating construction workers may find operations-related employment with the Hermes test reactor; but because many of the in-migrating construction workers would move out of the economic region to find other work, the transition from construction to operations should result in a net decrease in demographic impacts.

Given that 10 CFR 50.54(m)(2) (TN249) requires continuous onsite staffing, the NRC staff assumed the 38 weekday workers would cover one shift analogous to a "business day," and the remaining 30 workers would cover smaller evening and weekend shifts. During work commuting times, the addition of a maximum of 38 operation worker vehicles distributed across the 11 main routes into the ORR would constitute a de minimis increase in congestion and delay. Given the number of industrial-scale projects and operations on the ORR, shipments and deliveries should not be noticeable. Before the end of every 2 years of operations, the Hermes test reactor would require a resupply of 20 one-ton shipments of low-pressure molten salt coolant. As with the initial loading, the disruption to the quality of traffic during these deliveries in the vicinity would be of short duration.

3.6.3.2 Environmental Justice

The NRC staff considers the EJ impacts of construction to constitute an upper bound for the EJ impacts of operation on the potentially affected EJ populations within a 50 mi radius of the proposed project. Potential unique pathways for EJ impacts may exist due to the nature of the fuel and moderator used for the test reactor but, given the distance to the closest potentially affected EJ populations (about 8 mi) and the attenuation of impacts over distance and intervening terrain, the staff did not deem the potential for EJ impacts on those populations to be more than minimal.

3.6.4 Environmental Impacts of Decommissioning

3.6.4.1 Socioeconomics

The applicant's ER indicates the expected workforce for decommissioning would involve a peak employment level of 340 workers (Kairos 2023-TN8172 │ Sec 2.1). Because the decommissioning workforce would be smaller than the construction workforce, the NRC staff assumes the impacts from construction activities would establish an upper bound for the impacts from the decommissioning workforce. However, the decommissioning workforce would also be larger than the workforce needed for operation, and therefore the socioeconomic impacts from decommissioning might be slightly more noticeable than those from operations. One of the more noticeable aspects of decommissioning would relate to heavy haul traffic, with 174 monthly truck shipments or deliveries (Kairos 2023-TN8172 │ Sec 2.1), but the NRC staff expects a small increase over baseline traffic (about 30 percent greater than the current traffic volume, given the 2 percent per year estimate of the ER) would be absorbed into the overall volume of traffic and would not be noticeable.

3.6.4.2 Environmental Justice

Given that the nearest potentially affected EJ populations are more than 8 mi from the proposed Hermes site and given the small footprint of the proposed project both physically and in terms of personnel, the NRC staff found no decommissioning-related pathways by which an EJ impact could reach an EJ population. Similarly, as discussed in the CRN EIS (NRC 2019-TN6136 │ Sec 4.5.6), the staff identified no unique EJ population characteristics or practices that could be affected by the decommissioning of the proposed project.

3.6.5 Cumulative Impacts

The Hermes project would be a part of a continuous series of nuclear projects performed at Oak Ridge, including past completed projects (Buildings K-33 and K-31 at the proposed Hermes site), projects currently under way (the Ultra Safe Nuclear Corporation Pilot Fuel Manufacturing Facility, less than a mile to the southeast; the Spallation Neutron Source facility, about 5 mi to the east; and the S-50 Thermal Diffusion Plant, less than 2 mi to the south-southwest), and planned future projects, such as the proposed CRN approximately 4 mi to the east and the Atlas facility (see Sections 3.0 and 3.1 for more detail). The present and future projects would compete with the proposed Hermes project for nuclear skilled labor and resources; however, the interface within and between these other projects does not rise to a level that would result in an impact on socioeconomics and EJ to be above minimal. Projects farther away from the ORR that are extant or proposed have a diminishing level of impact as the distance increases between them. Consequently, the NRC staff determined the cumulative impacts on the socioeconomic and EJ aspects of the proposed project would be minimal.

3.6.6 Conclusions

The NRC staff concludes the potential direct, indirect, and cumulative socioeconomic and EJ impacts of the proposed action would be SMALL. This conclusion is based on three considerations: First, staff relied heavily on the Clinch River ESP EIS for each socioeconomic resource area because of that project's proximity in both time and space to the proposed project. Because the Hermes reactor is smaller than the footprint of the reactors that form the Clinch River ESP's plant parameter envelope, staff concluded the Clinch River ESP socioeconomic and EJ impacts form an upper bound to the impacts of the Hermes project. Second, the surrounding land is already in a state of industrial use and further disturbance of the proposed site would not be noticeable. Third, the applicant would not need any additional infrastructure (utilities, roadways, or rail systems) to build or operate the proposed facilities.

3.7 Human Health

3.7.1 Nonradiological Human Health

The following section addresses the potential effects of occupational hazards on the health of people working on or near the Hermes site, including those caused by physical, electrical, and chemical sources. Nonradiological waste is included in the chemical hazards addressed here and is discussed further in Section 3.9 of this EIS.

3.7.1.1 Affected Environment

According to the applicant, no radioactive or hazardous materials are currently stored on the site (Kairos 2023-TN8172 │ Sec 3.8.3). The applicant describes how DOE has remediated past contamination on the site, which previously accommodated Buildings K-31 and K-33 of the gaseous diffusion plants, to risk-based levels acceptable for transfer of the property for unrestricted industrial use (Kairos 2023-TN8172 │ Sec 3.8.4). However, the applicant acknowledges that residual radioactive and nonradioactive contaminants might still be present in soils and groundwater at the site above background levels but below risk-based standards for industrial uses (Kairos 2023-TN8172 │ Sec 3.8.3). The applicant provides relevant statistics for occupational injury and fatality rates for construction, operation, and decommissioning of similar facilities in the United States in Section 3.8.7 of the ER (Kairos 2023-TN8172).

3.7.1.2 Environmental Consequences of Construction

Other than the residual contamination left over from previous DOE uses of the site, the potential nonradiological occupational hazards would be those typical of construction sites when building new industrial facilities. The applicant explains in Section 4.8.1 of the ER how it expects its nonradiological effects on human health to be minimal (Kairos 2023-TN8172). The applicant expects that nonradioactive chemicals possibly present on its construction site could include (petroleum-based) fuels, oils, solvents, and other materials necessary for site preparation and building new facilities (Kairos 2023-TN8172 │ Sec 4.8.1.1). The applicant estimates that air emissions would be below 100 TPY for criteria pollutants under the Federal CAA (SO_2, NO_X, PM_{10}, CO, VOCs, and Pb) during construction and decommissioning, and it plans to send any liquid effluent releases to the City of Oak Ridge for municipal treatment (Kairos 2023-TN8172 │ Sec 4.8.1.4.1). Air emissions are discussed further in Section 3.2.1 of this EIS, and wastewater treatment is discussed further in Section 3.3 of this EIS.

Table 4.8-2 of the ER lists the potential types of physical, electrical, and chemical occupational hazards during the construction phase of the project (Kairos 2023-TN8172). The applicant plans to reduce or eliminate occupational physical hazards through implementation of safety practices, training, and physical control measures (Kairos 2023-TN8172 │ Sec 4.8.1.5). Construction debris and other solid waste would be subject to waste reduction, recycling, and waste minimization practices (Kairos 2023-TN8172 │ Sec 4.8.1.2.3). The applicant would not store or use highly hazardous chemicals on the site in quantities above the Threshold Quantities established by the U.S. Occupational Safety and Health Administration (OSHA) in Appendix A to 29 CFR 1910.119 (TN654), "List of Highly Hazardous Chemicals, Toxics and Reactives (Mandatory)" during construction (Kairos 2023-TN8172 │ Sec 4.8.1.6).

The NRC staff finds that the applicant's conclusion that the measures noted above would minimize the potential for serious occupational injury on or adjacent to the construction site for properly trained and qualified construction workers is reasonable. The physical hazards reported by the applicant to occur on the Hermes site during the construction phase of the project, as outlined in Table 4.8-2 of the ER (Kairos 2023-TN8172), are typical of industrial construction sites. Qualified construction workers could be readily trained to take the precautionary measures necessary to minimize the potential for serious injury from such hazards. For example, construction workers are routinely trained to wear hard hats, steel-toed boots, and safety goggles when around operating construction machinery.

Hearing injury caused by noise can be an occupational hazard at industrial sites. OSHA requires making hearing protection devices such as earmuffs and earplugs available to workers exposed to an eight-hour time-weighted average noise level of 85 dB or greater (29 CFR Part 1910-TN654). The applicant indicates that several pieces of construction equipment could generate maximum noise levels of 85 or more dBA at a distance of 50 ft (Kairos 2022-TN7912 │ Table 4.2-3. Even higher noise levels could be experienced by construction equipment operators who may have to sit or stand closer than 50 ft from the equipment to operate it. Although the applicant does not directly address hearing protection in its ER, compliance with health safety protections established in 29 CFR Part 1910 (TN654), "Process Safety Management of Highly Hazardous Chemicals," is mandatory. The NRC staff therefore expects that workers on the construction site would be provided access to suitable hearing protection devices and trained in their use.

3.7.1.3 Environmental Consequences of Operation

Most of the analysis presented above regarding nonradiological hazards to human health for construction would be true for operations as well. Because the Hermes facilities would not have

cooling towers or discharges to surface waters (other than stormwater), there would be no potential for health hazards caused by exposure to biocides or discharge streams, or from microbiological hazards resulting from warmed surface waters. Because the Hermes project would not involve building or operating high-voltage transmission lines or switchyards, there should be little potential for health hazards caused by electromagnetic fields. Stormwater discharges would be monitored as required by a National Pollutant Discharge Elimination System permit (Kairos 2023-TN8172 | Sec 4.4.3.1.2). There would be no potential for operation of Hermes to cause thermal discharges to surface waters capable of inducing the growth of pathogenic microorganisms, an issue described further in Section 3.9.3 of NUREG-1437 (NRC 2013-TN2654 | Sec 3.9.3). The applicant would prepare a Spill Control, Control, and Countermeasures plan if required for oil storage as part of the operations.

As with construction, air emissions from the proposed facilities during operation would be below 100 TPY for criteria pollutants under the Federal CAA (SO_2, NO_X, PM_{10}, CO, VOCs, and Pb) (Kairos 2023-TN8172 | Sec 4.8.1.4.1). See Section 3.2.1 of this EIS for more information. Nonradioactive liquid wastes from operations would be discharged to the municipal sewer system for treatment at the Rarity Ridge WWTP facility (Kairos 2023-TN8172 | Sec 4.8.1.2.1). See Section 3.3 of this EIS for more information. Nonradioactive gaseous wastes from operating areas would be passed through a high-efficiency particulate air filtration system before being vented to the atmosphere, and additional controls may be implemented as required by local permit conditions (Kairos 2023-TN8172 | Sec 4.8.1.2.2). Nonradioactive solid wastes are characterized in Section 4.8.1.2.3 of the ER and would be subject to waste reduction, recycling, and waste minimization practices (Kairos 2023-TN8172). Table 4.8-2 of the ER lists the potential types of physical, electrical, and chemical occupational hazards during the operational phase of the project (Kairos 2023-TN8172).

The applicant has stated that operations would adhere to the regulations and standards established by OSHA and National Institute of Occupational Safety and Health (NIOSH) regulations (Kairos 2023-TN8172 | Sec 4.8.1.5). OSHA regulations in 29 CFR Part 1910 (TN654) require implementation of specific training and notification processes to ensure the safety of workers and other persons on sites where hazardous materials and wastes are present. The NRC staff notes that compliance with the OSHA (and NIOSH) regulations is mandatory and expects that compliance would ensure the safety of properly qualified and trained site workers.

Flibe, a lithium, beryllium, and fluorine compound to be used as a low-pressure, molten salt coolant during operation of the Hermes reactor would be present on the site above the regulatory threshold quantity during operations and the applicant would therefore have to comply with 29 CFR 1910.119 (Kairos 2023-TN8172 | Sec 4.8.1.6). Although chemically stable, Flibe contains potentially toxic constituents, including beryllium (Kairos 2023-TN8398 | Sec 1.2.1). Workers could also be killed or injured if exposed to other chemicals used in the operation of industrial facilities such as Hermes. Flibe and most other process chemicals would be in liquid form and contained in tanks and pipes that would limit workforce exposure (Kairos 2023-TN8172 | Sec 4.8.1.6). Although not credited for mitigation of radiological releases during postulated events, the reactor building and ventilation system would function as confinement to manage and control beryllium hazards (Kairos 2023-TN8398 | Sec 1.2.1), as well as other nonradiological substances. The biological shield designed to protect workers and the public from radiological exposure, described in Section 4.4.1 of the PSAR (Kairos 2023-TN8398 | Sec 4.4.1), would also reduce the potential for exposure of reactor personnel to beryllium and other hazardous chemicals. The applicant designed the heating, ventilation, and air conditioning system of the reactor building to ensure that chemical hazards remain within regulatory limits

(Kairos 2023-TN8398 │ Sec 9.2.2). The NRC staff finds that compliance with the OSHA (and NIOSH) regulations and the design features noted above would help protect properly trained and qualified site workers from the hazards of working with and around Flibe. The potential hazards of worker exposure to Flibe and other chemicals used in operation of the Hermes facilities would be reconsidered at the OL stage once the applicant can provide more specific operational descriptions.

The applicant proposes in Section 4.8.1.7 of the ER to perform environmental monitoring as required by Tennessee State regulations, which may include requirements to monitor or inspect emergency management, environmental health, drinking water, water and sewage, pollution discharges, air emissions, and hazardous waste management (Kairos 2023-TN8172). The NRC staff notes that further consideration of possible nonradiological operational hazards specific to operation of the Hermes facilities may be necessary when the NRC staff conducts its environmental review of an OL application.

3.7.1.4 Environmental Consequences of Decommissioning

The analysis presented above related to construction and operations regarding nonradiological hazards to human health would apply to decommissioning as well. The NRC staff expects that impacts from decommissioning the Hermes facilities on nonradiological occupational safety would be bounded by the analyses reported for physical, chemical, ergonomic, and biological hazards in Section 4.3.10 of the decommissioning generic EIS (NRC 2002-TN7254), which concluded that the impacts would not be detectable. Further consideration of nonradiological health hazards may be necessary once the applicant applies for NRC approval for decommissioning.

3.7.1.5 Cumulative Impacts

Table 4.13-1 of the ER identifies past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts of the proposed action (Kairos 2021-Kairos 2023-TN8172). The NRC staff expects that each industrial facility in the surrounding area would comply with applicable OSHA and NIOSH regulations to ensure good occupational protection. Based on the staff's analysis of potential nonradiological human health impacts from the anticipated life cycle of the proposed Kairos Hermes facilities, the staff expects that the facilities would not substantially contribute to occupational hazards in the area. The applicant acknowledges that the nonradiological health impacts from emissions and discharges from past ORR operations in the area are noticeable, but that the incremental contribution from the proposed facilities would not be noticeable (Kairos 2023-TN8172 │ Sec 4.13.8.1). The NRC staff finds that the incremental contribution of nonradiological health impacts from the Hermes project would not be noticeable, as long as the applicant complies with applicable OSHA and NIOSH regulations and implements the mitigation measures described in Section 4.8.1.8 of the ER (Kairos 2023-TN8172 │ Sec 4.8.1.8).

3.7.1.6 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative impacts of the proposed action on nonradiological human health would be SMALL. This conclusion is based primarily on the applicant's plans to reduce the potential for occupational physical hazards through implementation of safety practices, training, and physical control measures (Kairos 2023-TN8172 │ Sec 4.8.1.5) and on the applicant's plans to reduce the potential for chemical exposure hazards through design of the Hermes facilities and practices to comply with

applicable regulations and limit potential exposure of workers. The NRC staff may have to reevaluate the potential for occupational hazards if the applicant submits more detailed design information for operations or decommissioning in subsequent applications. The applicant would not use cooling towers (Kairos 2023-TN8172 │ Sec 4.1.2) and thus would not discharge cooling tower blowdown to surface water where it could create chemical or thermal health hazards. Effluent would instead be released only to municipal sewers, where it would have to meet requirements established by the City of Oak Ridge or be trucked away to a suitable disposal location. The NRC staff recognizes that the applicant proposes to perform environmental monitoring to protect human health as required by permitting requirements (Kairos 2023-TN8172 │ Sec 4.8.1.7). The NRC staff expects that specific monitoring requirements would be called for by permits the applicant receives under the Resource Conservation and Recovery Act (TN1281), CAA (TN1141), and from the State. The NRC staff's conclusion also recognizes that the applicant has committed to implementation of administrative procedures and protective measures to ensure protection of human health and the environment, BMPs to minimize pollutant discharges and emissions, and waste reduction practices such as recycling and waste minimization (Kairos 2023-TN8172 │ Sec 4.8.1.8). The NRC staff expects that no additional mitigation measures will be necessary to prevent noticeable adverse nonradiological health impacts.

3.7.2 Radiological Human Health

3.7.2.1 Affected Environment

As discussed in the land use section of this EIS (Section 3.1), the proposed Hermes test reactor would be built within the footprint of the former K-31 and K-33 gaseous diffusion plants. These two gaseous diffusion plants had various levels of chemical and radiological contamination that DOE remediated as part of the demolition and decontamination of the areas prior to releasing them for industrial uses like the Hermes test reactor. DOE performed radiological surveys and environmental sampling under the DOE Environmental Management Program's Dynamic Verification Strategy process to assess the condition of the K-31 and K-33 property as documented in two documents, namely the covenant deferral requests for the title transfer of the former K-31 Area and K-33 Area at the East Tennessee Technology Park (DOE 2015-TN7964, DOE 2015-TN7965). As documented in these two title transfer reports, there were no exceedances of the measured maximum or average remediation level. If contamination above the remediation levels were discovered later, DOE would be required to take appropriate remediation actions. Based on the remedial actions and the environmental sampling, as documented in DOE 2015-TN7964 and DOE 2015-TN7965, the K-31 and K-33 Areas have a negligible or very low radiological risk to Hermes workers consistent with EPA's guidance for the protection of human health and the environment.

Ongoing activities on the ORR release small quantities of radionuclides to the environment. The ORR Annual Site Environmental Report (DOE 2021-TN7915) provides estimated annual doses to a hypothetical maximally exposed individual (MEI) from radionuclides released from all DOE facilities on the ORR considering all potential pathways. The most recent report estimates the maximum annual radiation dose to the MEI in 2020 to be about 0.4 millirem (mrem) from air pathways, approximately 2 mrem from water pathways (i.e., drinking, consuming fish, swimming and other recreational uses), and 0.07 mrem from wildlife consumption (e.g., two geese) harvested on ORR (DOE 2021-TN7915). The combined 2020 dose was estimated to be approximately 3 mrem (DOE 2021-TN7915). During the 5-year period from 2016 to 2020 the estimated annual all-pathways dose to the MEI averaged about 2.6 mrem except for 2019 with a dose of approximately 6.6 mrem with 4 mrem due to the sampling of fish (DOE 2021-TN7915).

In addition, several non-DOE radiological facilities on or near the ORR could potentially contribute to cumulative impacts on members of the public. Based on its review of responses for the years of 2016 and 2017 from 25 nearby non-DOE facilities regarding potential radiation doses to members of the public, DOE concluded the combined annual doses from both DOE and non-DOE sources would be significantly less than DOE's annual dose limit of 100 mrem, which is the same annual dose limit in 10 CFR 20.1301 (TN283), "Dose limits for individual members of the public" (DOE 2017-TN5081, DOE 2018-TN7989). Annual doses to members of the public from direct radiation from the non-DOE facilities ranged from 0 to 25 mrem in 2016 and from none to 2 mrem in 2017 (DOE 2017-TN5081, DOE 2018-TN7989).

Two main sources of natural background radiation exist: cosmic radiation produced by collisions of high-energy particles in the upper atmosphere, and naturally occurring terrestrial radionuclides in rocks and soils. The cosmic ray background varies with geomagnetic latitude and elevation; the cosmic ray dose rate in the region surrounding the East Tennessee Technology Park (elevation 600–1,200 ft) averages between 27 and 31 mrem per year (mrem/yr) (National Research Council 1980-TN5291). The dose rate from uranium, thorium, potassium, and related natural radionuclides depends on the underlying geology; the terrestrial dose rates in the region surrounding the East Tennessee Technology Park average between 35 and 75 mrem/yr (National Research Council 1980-TN5291). When combined with the cosmic ray contribution, direct natural radiation in this area of Tennessee ranges from 62 to 106 mrem/yr. Therefore, the naturally occurring background radiation dose rates at the East Tennessee Technology Park should be in the anticipated range of 62 to 106 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 200 mrem/yr for an average total natural background of approximately 300 mrem (3.0 millisievert [mSv]) per year.

3.7.2.2 Environmental Impacts of Construction

At certain times during construction, Kairos 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 used in compaction testing and radiography devices (Kairos 2023-TN8172). Use of such materials (devices) is not atypical for construction activities and is not unique to the construction of a nuclear facility. 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.

As discussed in Section 3.1 of this EIS, the site proposed for the Hermes test reactor is the former site of Buildings K-31 and K-33, which were part of the ORGDP complex for enriching large quantities of uranium from the 1950s until operations ceased in 1985 and the site was permanently shut down in 1987. These gaseous diffusion buildings were decontaminated, demolished, and the land was remediated of any residual radiological or chemical waste to allow for unrestricted use. However, DOE would retain responsibility for any corrective actions

regarding unanticipated discovery of legacy wastes, if found during the construction of the Hermes test reactor (DOE 2015-TN7964, DOE 2015-TN7965).

Therefore, based on the controls required for the use of radioactive devices or radioactive material during construction and DOE's remediation of the land prior to any Kairos construction activity, the NRC staff concludes 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 Hermes test reactor along with radiological environmental monitoring over its anticipated four-year licensing period. Based on the design of the Hermes test reactor, the expected exposure pathways to members of the public would principally be from radiological gaseous effluent release because a small volume of radioactive liquid effluent releases (i.e., water-based releases) would be discharged to the sewer lines in accordance with 10 CFR 20 Subpart K, specifically under 10 CFR 20.2003 (TN283), "Disposal by Release Into Sanitary Sewerage" and the limits of Table 3 of Appendix B to 10 CFR Part 20 (Kairos 2023-TN8172 | Sec 2.6.1.1). Additionally, Kairos will apply for a sanitary sewer and water supply permit (Kairos 2023-TN8172 | Table 1.4-1) which requires that any liquid radiological discharges into the City of Oak Ridge wastewater treatment system must meet Municipal Code 18-308 (City of Oak Ridge 2022-TN7941). Based on prior dose modeling applying the maximum releases under NRC regulation, the sanitary sewerage pathway would present a sufficiently low health and safety risk to the public under the current regulatory structure (70 FR 68350-TN7940). Because Kairos would release small amounts of liquid radiological wastes that would be within regulatory limits, the exposure from this pathway is expected to be negligible. Section 4.8 of the ER presents an analysis of the potential annual radiation doses to the MEI 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) (TN283), which limits dose to 0.1 rem/yr. However, 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 (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 Hermes test reactor is based on molten salt cooling (therefore a non-LWR) and would not produce electricity, this test reactor 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 Hermes test reactor. Regulations such as the dose limits in 10 CFR 20.1301(a) and the as low as is reasonably achievable 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

If an OL is issued to Kairos, they would need to control occupational doses to workers to the 5 rem annual limit as specified in 10 CFR 20.1201 and incorporate the low as is reasonably achievable provisions of 10 CFR 20.1101 (TN283) to ensure occupational doses would always be below this limit.

3.7.2.3.2 Doses from Radiological Gaseous Effluent Releases

Following the guidance in NUREG-1537 Part 1, Kairos presents an analysis of the radiological human health impacts in Section 4.8.2 of the ER (Kairos 2023-TN8172). This section of the ER discusses the various sources of radiation (gaseous, liquid, and solid) and baseline radiation levels within the facility before providing a detailed analysis of offsite 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 and, as discussed in Section 3.9 of this EIS for liquid radiological waste management, these effluents would be disposed via the WWTP sewerage per 10 CFR 20.2003 (TN283) with no exposure pathway to nearby residents. The Kairos radiological gaseous effluent release analysis in Section 4.8.2.4 of the ER is based on the guidance in RG 1.111 for atmospheric long-term dispersion coefficients (NRC 1977-TN5887) and RG 1.109 methodology (NRC 1977-TN90) for calculating annual doses to members of the public from the radiological effluent releases. Both analytical processes were performed by Kairos (Kairos 2023-TN8172 | Sec 4.8.2.4) with the application of the NRCDose modeling package programs XOQDOQ (Sagendorf et al. 1982-TN280) and GASPAR II (Sagendorf et al. 1982-TN280) and GASPAR II (Strenge et al. 1987-TN83,Sagendorf et al. 1982-TN280), respectively, through a graphical user interface (NRC 2021-TN7050).

The Kairos analysis of long-term dispersion coefficients shown in ER Tables 4.8-14 through 4.8-20 is based on 5 years of meteorological data from a nearby ORR meteorological tower, Tower L, 1 mi south-southeast of the Hermes facility site, for the years 2016 to the end of 2020 (Kairos 2023-TN8172). During the environmental audit of the Hermes ER, the NRC staff examined the input and output files of the XOQDOQ calculations (NRC 2022-TN7954). The results of these calculations for long-term dispersion coefficients were compared to the results found for the Clinch River ESP ER, as documented in TVA's ER and the staff's final EIS (TVA 2017-TN4921 | Sec 2.7.6, NRC 2019-TN6136). Based on this review, the staff found the resulting long-term dispersion coefficients being applied by Kairos to be reasonable for use in a radiological gaseous effluent determination concerning annual doses to individual members of the public.

Kairos calculated the gaseous pathway doses to the MEI at a location with the greatest modeled concentration and deposition from airborne emissions (i.e., 0.5 mi south-southeast). For the actual nearest resident located at approximately 1.1 mi north-northwest of the site, the greatest modeled concentration and deposition in the eastern direction was applied for this location (Kairos 2022-TN7882). Kairos applied the GASPAR II computer program to calculate the radiological doses to these individual members of the public. The following activities were considered in the 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. Because there would not be any residential or agricultural properties within the boundary of the East Tennessee Technology Park, doses at the site boundary and the MEI do not include contributions from the ingestion of milk, meat, or

vegetables. Meat and vegetable ingestion were included in the nearest resident's exposure pathways. Kairos did not identify any milk production in the vicinity of the Hermes site (Kairos 2022-TN7882). No milk production in the surrounding area was noted in the Clinch River ESP EIS either (NRC 2019-TN6136).

As a bounding calculation, Kairos applied the annual gaseous radiological release values from Table 3.5-4 of Revision 2 of the Clinch ESP ER (TVA 2017-TN4921) along with a bounding tritium emissions rate of approximately 62,500 curies per year (Ci/yr) (Kairos 2022-TN7902). Other parameters used as inputs to the GASPAR II program include vegetable production rates, meat production rates, long-term atmospheric dispersion factors, receptor locations, and consumption factors that the staff independently verified as being adequate for this analysis. Gaseous pathway doses at the site boundary to the MEI and the nearest resident, as calculated by Kairos, are shown in Table 3-9 of this EIS.

Table 3-9 Radiological Doses from Annual Radiological Gaseous Effluent Releases

Location	Pathway		Annual Dose Rate (mrem/yr)			Maximum Organ
			Total Body	Thyroid	Maximum Organ	
Site boundary (0.2 mi, north east)	External	Plume	5.7E-02	5.7E-02	1.8E-01	
		Ground	8.0E-02	8.0E-02	1.4E-01	Skin
		Subtotal	1.4E-01	1.4E-01	3.2E-01	
	Inhalation	Subtotal	4.3E-01	5.1E-01	5.1E-01	Thyroid
	Ingestion	Subtotal			N/A[a]	
	TOTAL		5.7E-01	6.5E-01	5.2E-01	Thyroid
MEI (0.5 mi, SSE)	External	Plume	1.5E-01	1.5E-01	4.9E-01	
		Ground	4.0E-02	4.0E-02	6.8E-02	Skin
		Subtotal	1.9E-01	1.9E-01	5.6E-01	
	Inhalation	Subtotal	1.2E+00	1.5E+00	1.5E+00	Thyroid
	Ingestion	Subtotal			N/A[b]	
	TOTAL		1.4E+00	1.7E+00	1.5E+00	Thyroid
Analytical nearest resident (1.1 mi, east)[c]	External	Plume	5.2E-02	5.2E-02	1.7E-01	
		Ground	2.2E-02	2.2E-02	3.8E-02	Skin
		Subtotal	7.4E-02	7.4E-02	2.1E-01	
	Inhalation	Subtotal	4.6E-01	5.5E-01	5.5E-01	Thyroid
	Ingestion	Subtotal	6.5E-01[d]	8.2E-01[d]	8.2E-01[d]	Thyroid
	TOTAL		1.2E+00	1.4E+00	1.6E+00	Thyroid

Key: mrem/yr = mrem per year; mi = miles; N/A = not applicable; χ = atmospheric dispersion factor(s); Q = annual average normalized air concentration value(s).

[a] The ingestion pathway at the site boundary is not applicable; there is no production of food products at the site boundary.

[b] The MEI location is within the boundary of the East Tennessee Technology Park; the ingestion pathway at the MEI location is not applicable; there is no production of food products inside the boundary of the East Tennessee Technology Park.

[c] The nearest residence is north-northwest at 1.1 mi from the reactor. Dose is calculated at 1.1 mi from the reactor in the direction of maximum χ/Q without decay (see ER Table 4.8-20), which was also the direction of maximum deposition.

[d] The ingestion pathway at the site boundary does not include dairy production. There is no identified production of dairy products in the area of the site. The cultivation of vegetables and livestock for the ingestion pathways considered is assumed to occur at the location of the analytical nearest resident.

Source: (Kairos 2022-TN7882 | Table 4.8-22).

Kairos states in the ER that the total body and organ dose estimates for the MEI from gaseous effluents at the Hermes site would not be in excess of 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) (TN283). The TEDE annual doses at several locations from the combined external dose and radiological gaseous effluents are presented in Table 3-10. Based on the fact that the Hermes reactor itself is in a heavily shielded area within the Hermes Reactor Building, direct radiation dose rates in the vicinity of facility are expected to be generally undetectable and less than 1 mrem/yr. This is based on the monitoring experience at LWR site boundaries (NRC 2013-TN2654). For this EIS, the NRC staff completed an independent evaluation of Kairos's NRCDose calculations by reviewing the inputs and subsequent results, allowing for further comparisons to the radiological dose analysis conducted under the Clinch River ESP ER, and found that the Kairos Hermes analysis was adequate. As indicated in Table 3-10, 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 300 mrem.

Table 3-10 Annual Total Effective Dose Equivalent to the Individual Members of the Public

Dose Receptor	Annual TEDE	Annual TEDE Dose Regulation Limits
Gaseous Effluents		
Site boundary	0.57 mrem (0.0057 mSv)	
MEI in an unrestricted area (0.5 mi)	1.4 mrem (0.014 mSv)	10 mrem(a) (0.1 mSv)
Nearest full-time resident	1.2 mrem (0.012 mSv)	
Total Dose (Combined External Dose and Gaseous Effluent)		
Site boundary	1.6 mrem (0.016 mSv)	
MEI in an unrestricted area (0.5 mi)	2.4 mrem (0.024 mSv)	100 mrem(b) (1.0 mSv)
Nearest full-time resident	2.2 mrem (0.022 mSv)	

Key: TEDE = total effective dose equivalent; mrem = millirem; mSv = millisievert; MEI = maximally exposed individual; mi = miles.

(a) 10 CFR 20.1101(d) (TN283) for airborne emissions.

(b) 10 CFR 20.1301(a)(1) (TN283) for licensed operations.

(c) Includes ingestion of meat and vegetable produced at the analytical nearest resident location.

(d) Dose is modeled at the distance of the analytical nearest resident but in the direction of the maximum deposition.

(e) The external dose was not modeled and is conservatively assumed to be 1 mrem/yr (Section 4.8.2.4.1).

Source: (Kairos 2023-TN8172 | Table 4.8-3).

3.7.2.3.3 Radiological Environmental Monitoring

Kairos discusses radiological environmental monitoring in accordance with 10 CFR 20.1302 (TN283) in PSAR Section 11.1.7 and ER Section 4.8.3 to demonstrate compliance with the dose limits for individual members of the public in 10 CFR 20.1301 (Kairos 2023-TN8172). Kairos 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 onsite, site perimeter, and offsite locations considering the guidance followed by LWRs, namely RG 4.1 (NRC 2009-TN3802) and NUREG-1301 (Kairos 2023-TN8172 | Sec 4.8.3.2).

To monitor the direct radiation pathway, Kairos would post thermoluminescent dosimeters at several locations onsite, at the site boundary, and at an offsite location to capture the

background dose as a control measurement. Groundwater sampling would be established at locations based on the groundwater gradient where some existing East Tennessee Technology Park test wells could be used in support of the Hermes test reactor operations for addressing potential leaks and spills. Based on evaluated meteorological conditions and monitoring of the airborne exposure pathway, monitoring stations at three locations near the facility site boundary, a fourth air sampling location at a nearby community, and a fifth location farther away from the facility to provide background (i.e., control) readings, would be established. The ingestion exposure pathway would be established to monitor for deposition of PM onto edible produce in the vicinity of the facilities and specifically for the monitoring of milk, if being produced nearby. In the case of the East Tennessee Technology Park site, no dairy or goat milk production occurs within 5 mi, so milk sampling would only occur if such production were found to exist within the mentioned 5 mi.

The NRC staff will review the finalized monitoring locations and other monitoring requirements provided with the OL application. During the OL application phase, the NRC safety staff will determine whether the operational radiological environmental monitoring program will be adequate for the evaluation of environmental impacts related to operating the Hermes test reactor at the East Tennessee Technology Park site.

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 below the appropriate dose limits in 10 CFR Part 20 (TN283). Additionally, the NRC staff will perform an independent safety review of Kairos's plans for exposure control and radiological effluent monitoring and its compliance with applicable regulatory requirements of 10 CFR Part 20, such as 10 CFR 20.1301 (TN283). The NRC staff's independent safety review will be documented in its Safety Evaluation (SE). Based upon the discussion above and the staff's completion of a thorough independent safety review and evaluation of the applicant's information that states Kairos will comply with applicable requirements, the NRC staff concludes that the environmental impacts from radiological gaseous effluent releases would not be significant and 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, spent TRI-structural ISOtropic [TRISO] fuel, and radioactive material from decontamination operations) and shipped to licensed disposal sites. While some trace amounts of tritium could be expected to diffuse out of such storage containers, radiation area monitoring would continue to ensure safe storage 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 Decommissioning Generic Environmental Impact Statement (GEIS) discusses the expected radiological impacts that could occur during decommissioning of a large LWR (1,130 MWe pressurized water reactor or a 1,100 MWe boiling water reactor), including the appropriate practices to minimize radiological exposure to workers, and found that impacts would be small and that no additional mitigation measures are likely to be sufficiently beneficial to be warranted (NRC 2002-TN7254). The Hermes test reactor is a small fraction of a large LWR (35 MWt versus approximately 3,300 MWt LWR) and would have a proportionally small fraction of the radiological impacts discussed in the Decommissioning GEIS. Based on the small size of the Hermes test reactor and on the radiological impacts

discussed in the Decommissioning GEIS, the staff concludes that Hermes radiological environmental impacts during decommissioning would be negligible.

3.7.2.5 Cumulative Impacts

Table 4.13-1 of the ER identifies past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts of the proposed action (Kairos 2023-TN8172). In addition to impacts from construction and operations, 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 50 mi radius of the Hermes site. The NRC staff finds this metric to be acceptable because historically the NRC has used the 50 mi radius as a standard bounding geographic area to evaluate population doses from routine releases from nuclear power plants (NPPs). This region contains several radiological projects or facilities. Within the geographic area of interest, reasonably foreseeable planned Federal projects on the ORR include the Sludge Processing Mock Test Facility at the Transuranic Waste Processing Center, the Uranium Processing Facility at the Y-12 Complex, and a new disposal area to replace the DOE's Environmental Management Waste Management Facility. Other major currently operating ORR nuclear facilities include the High Flux Isotope Reactor, a nuclear research reactor located at ORNL, and the ORNL Spallation Neutron Source. Other radiological projects or facilities outside of ORR but within the geographic area of interest identified by Kairos in ER Table 4.13-1 include TVA's Watts Bar Units 1 and 2 (30 mi southwest), TVA's proposed CRN site (3.5 mi south-southeast), Energy*Solutions* Bear Creek Processing Facility, which processes low-level radioactive waste for permanent disposal (2 mi southeast), and the proposed Coquí Pharma medical isotope production facility (0.75 mi south) (Kairos 2023-TN8172 | Table 4.13-1). As identified in the CRN ESP final environmental impact statement, there is the former American Nuclear Corporation site, closed since 1970, where radioactive materials are being allowed to decay in place (NRC 2019-TN6136 | Table 7.1). Additionally, another nearby facility with radioactive materials is the Ultra Safe Nuclear Corporation Pilot Fuel Manufacturing facility. The NRC is reviewing a TRISO fuel fabrication facility application from X-Energy Corporation for their TRISO-X fuel that would be sited at the nearby Horizon Center site (TRISO-X, LLC. 2022-TN7987). Both facilities would be processing unused natural or enriched uranium, would monitor and control releases, and are expected to have very low radiological impacts.

These facilities have the potential to contribute to cumulative radiation exposures in conjunction with the Hermes test reactor. However, given the small radiological doses from the Hermes test reactor and the fact the radiation doses from facilities discussed in the above affected environment for this section have been shown to be low, the staff concludes that there would not be a noticeable increase in the cumulative radiological impacts of the above projects or facilities by the Hermes test reactor for the geographic area of interest.

3.7.2.6 Conclusions

The staff concludes that the potential direct, indirect, and cumulative radiological human health impacts of the proposed action during the 4 years of operation and during decommissioning, along with cumulative impacts would be SMALL. This conclusion is based primarily on the fact that the proposed Hermes test reactor 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 and because occupational doses would be less than annual dose limits under 10 CFR Part 20 (TN283) regulations.

3.8 Nonradiological Waste

3.8.1 Affected Environment

Section 3.1 of this EIS, "Land Use and Visual Resources," provides a detailed physical description of the proposed Hermes site and its surrounding vicinity. Figures 3.1-2 and 3.1-3 of the applicant's ER provide maps detailing the current land use categories, including croplands, forested areas, and developed lands within the 5 mi region surrounding the site (Kairos 2023-TN8172). The proposed Hermes site is presently undeveloped, with portions used by DOE for construction laydown (Kairos 2023-TN8172 │ Sec 3.1.1.1). There are no chemical plants, refineries, mining or quarrying facilities, or military facilities within 5 mi of the site (Kairos 2023-TN8172 │ Sec 3.1.1.2). The applicant indicates there are no radioactive or hazardous materials currently stored on the site but acknowledges the potential for residual radioactive or hazardous contamination could be present at levels above background but below risk-based standards because the site was once the home of the K-31 and K-33 gaseous diffusion plants. Section 3.9 of this EIS discusses radiological waste management and the Uranium Fuel Cycle.

3.8.2 Environmental Impacts of Construction

Nonradiological waste hazards may arise from normal activities (emissions, discharges, and solid waste) during the construction phase of the proposed project, as well as from accidental releases in solid, liquid, or gaseous states. The applicant states all normal activity releases will be managed in accordance with applicable Federal, State, and local laws and regulations and permit requirements (Kairos 2023-TN8172 │ Sec 4.8.1).

The applicant characterizes waste to be generated during construction in Section 4.9.1.1 of the ER (Kairos 2023-TN8172 │ Sec 4.9.1.1). Solid nonradiological waste would include construction and demolition waste such as scrap lumber, bricks, sandblast grit, glass, wiring, non-asbestos insulation, roofing materials, building siding, scrap metal, concrete with reinforcing steel, and other similar materials (Kairos 2023-TN8172 │ Sec 4.9.1.1). Typical liquid nonradiological waste produced during normal activities would include fuels, oils, solvents, paints and stains, and other chemicals. The most common liquid waste would be human waste, which would be discharged via municipal sewers to the Rarity Ridge Wastewater Treatment Facility (Kairos 2023-TN8172 │ Sec 4.8.1.2.1). Other liquid chemicals would be treated onsite before shipment to the Rarity Ridge Wastewater Treatment Facility to ensure that the facility's requirements are met. The applicant estimates air emissions from the facility would fall below the 100 TPY threshold established by the TDEC for criteria pollutants (SO_2, NOx, PM_{10}, $PM_{2.5}$, CO, VOCs, and Pb) during the projected two-year construction period (Kairos 2023-TN8172 │ Sec 4.2.1.1). Management of solid waste would involve waste reduction efforts, recycling, and BMPs during all phases of the project.

3.8.3 Environmental Impacts of Operation

Although the applicant plans to register the facilities as a Small Quantity Generator under the Resource Conservation and Recovery Act (TN1281), it expects that there would be no significant sources of hazardous waste during operations (Kairos 2023-TN8172 │ Sec 4.9.1.2). The applicant plans to manage any hazardous waste, including universal wastes, in accordance with a waste management plan that conforms with applicable Federal and State regulations (Kairos 2023-TN8172 │ Sec 4.9.1.2). Operation of the reactor building would generate gaseous effluents, which would be passed through a high-efficiency particulate air filtration system prior to discharge through the ventilation stack (Kairos 2023-TN8172 │ Sec 4.8.1.2.2). Solid waste

from operations would include operations, maintenance, and demolition debris; food waste and food product packaging waste; and disposable office items. As stated in the applicant's ER, solid waste would be collected and stored temporarily onsite and either disposed of at a nearby sanitary site or recycled. Management of solid waste would involve waste reduction efforts, recycling, and BMPs (Kairos 2023-TN8172 │ Sec 4.8.1.2.3). The facilities would not release nonradioactive liquid chemicals to the environment (Kairos 2023-TN8172 │ Sec 4.8.1.4.2); and, as noted above in Section 3.3 of this EIS, wastewater discharges would be sent to a municipal WWTP for treatment.

3.8.4 Environmental Impacts of Decommissioning

The applicant plans to address waste management during decommissioning in a license termination plan prepared in accordance with NUREG-1757, *Consolidated Decommissioning Guidance*, Volumes 1-3, and submitted to the NRC for approval (Kairos 2023-TN8172 │ Sec 4.9.1.3). The NRC staff expects decommissioning to generate nonradiological solid waste materials such as building rubble and debris, concrete and structural materials, wood, glass, metals, gypsum and other finished materials, and office equipment, materials, and supplies. The NRC staff expects that the applicant would use BMPs to limit the amount of dust and other airborne particles. Liquid wastes from chemicals, solvents, and cleaning solutions would produce small amounts of volatilized chemicals, but BMPs would minimize their contribution to degradation of local air quality.

3.8.5 Cumulative Impacts

Table 4.13-1 of the ER identifies past, present, and reasonably foreseeable future projects that could exacerbate the environmental impacts of the proposed action (Kairos 2023-TN8172). The NRC staff expects that each industrial facility in the surrounding area would comply with applicable EPA and State regulations to ensure proper disposal of nonradiological waste. Based on the NRC staff's analysis of potential nonradiological waste impacts from the Kairos Hermes facilities, the NRC staff expects that the facilities would not substantially contribute to waste impacts in the area, due to its relatively small size and operating staff.

3.8.6 Conclusions

The NRC staff reviewed the applicant's ER and performed its own independent assessment of the nonradiological waste management discussion through a combination of independent research and the review of other NRC EISs, including the 2019 NUREG-2226 (NRC 2019-TN6136), *Environmental Impact Statement for an Early Site Permit (ESP) at the Clinch River Nuclear Site*, a project located approximately 4 mi to the east of the proposed site. The staff finds the conclusions of the Hermes nonradiological waste component to be consistent with those of the CRN EIS and finds that during all three life-cycle phases of the proposed Hermes project, the nonradiological waste impact from liquid, gaseous, and solid wastes would be SMALL, and mitigation would not be needed for releases during normal activities. As long as proper training and management practices are maintained the potential for accidental releases and environmental impact of accidental releases would also be minimal.

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, Table of Uranium Fuel Cycle Environmental Data, as the basis for uranium fuel cycle environmental effects. While the Hermes reactor is not a light-water-cooled nuclear power reactor, Kairos will rely upon the same uranium fuel cycle addressed by Table S-3. Thus, this section presents the Hermes reactor's contribution to the environmental effects of the current uranium fuel cycle with respect to Table S-3.

The License Renewal (LR) GEIS, NUREG-1437 Revision 1, 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 EIS (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 10 CFR 51.51 (TN250), namely 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 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 Hermes reactors. First, the Hermes reactor is designed to use a maximum enrichment of 19.55 wt% uranium-235 (Kairos 2023-TN8172 | Sec 2.3 and Sec 4.1.1.1). Uranium enriched to this level is known as High-Assay Low Enriched Uranium or HALEU. Additionally, the source of HALEU for the Kairos TRISO fuel has not been finalized (Kairos 2023-TN8172 | Sec 4.1.1.1). Kairos is expecting approximately 0.93 metric tons of uranium (MTU) would be needed over the four-year licensed operating life (Kairos 2023-TN8398) compared to an average of 20 to 33 metric tons of uranium per year (MTU/yr) for the 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 (AEC 1974-TN23) and Table S-3 would still be bounding. Regarding the source of HALEU for the Hermes reactor, one potential source for the needed 0.93 MTU would be from the DOE. The DOE is supporting efforts regarding availability of HALEU for civilian domestic research, development, demonstration, and commercial use in the United States to prevent reliance on Russia or other foreign suppliers to fuel the next generation of nuclear power (87 FR 71055-TN7945). At this time, Kairos expects that HALEU material would be provided by an external source (Kairos 2023-TN8172 | Sec 2.7.1).

The second aspect concerns the Kairos Hermes reactor fuel type, which is designed to use TRISO fuel, a type of fuel that is not used in large LWRs. The source of fresh TRISO fuel may be provided from existing manufacturers or from a TRISO fuel fabrication facility built by Kairos. The manufacturing process for the Kairos-designed TRISO fuel involves three major manufacturing phases: kernel manufacturing, coated particle manufacturing, and pebble manufacturing (Kairos 2021-TN7944). Kernel manufacturing converts triuranium octaoxide (U_3O_8) powder into spherical uranium oxycarbide (UCO) kernels (a mixture of uranium dioxide [UO_2], uranium carbide [UC], and uranium dicarbide [UC_2] phases). Using chemical vapor deposition, multiple layers are added to the kernels. The final manufacturing phase is building the pebbles by pressing the kernels to a graphite core, adding a fuel-free outer matrix shell, with a final machining step. Because of the difference in chemical processes for TRISO fuel

fabrication from the chemical processes described in Appendix E of WASH-1248 (AEC 1974-TN23), the Kairos TRISO manufacturing line would have fewer impacts because Kairos would employ a simpler process for converting uranium hexafluoride (UF_6) to UCO; the mechanical processes of building the TRISO pebbles (Kairos 2021-TN7944) is less extensive than the UO_2 pellet process of pelletizing, sintering, grinding, and washing; and the 0.93 MTU going through the fuel fabrication process is less than the 900 MTU/yr as assessed in Appendix E of WASH-1248 (AEC 1974-TN23). Thus, Kairos's TRISO fuel fabrication process would have fewer impacts than a more traditional UO_2 fuel fabrication process and Table S-3 would also be bounding for TRISO fuel fabrication.

Kairos has no plans for reprocessing spent TRISO fuel and would store the spent TRISO fuel onsite upon cessation of 4 years of operation until final disposition (Kairos 2023-TN8172 | Sec 2.7.1). Kairos would have enough spent TRISO fuel storage capacity within the Reactor Building to support four years of licensed reactor operation (Kairos 2022-TN7882). While Kairos has no plans at this time to use an external dry storage system, if such a decision is made after the cessation of operations, approval for building and operating such a dry storage system on an external pad would need to be sought prior to implementation of such a spent TRISO fuel management plan. Depending on other nuclear industry and DOE actions in the future, Kairos may be able to ship the spent TRISO fuel offsite for interim storage or disposal. As noted by Kairos in ER Sections 2.7 and 4.10.3.1 (Kairos 2023-TN8172), transportation of spent TRISO would be conducted in a transportation package that is certified by the NRC under 10 CFR Part 71, which would meet NRC requirements and U.S. Department of Transportation regulations (TN301).

Kairos states in ER Section 4.9 that storage systems associated with continued storage of TRISO fuel would not be significantly different than those considered for LWR storage systems and "…the environmental impacts for continued storage of LWRs described in NUREG–2157 are considered to bound any impacts of the Hermes fuel storage" (Kairos 2023-TN8172). The NRC staff notes that NUREG-2157 states the Fort Saint Vrain spent fuel continues to be stored at an NRC-licensed Independent Spent Fuel Storage Installations (ISFSI) in Plattesville, Colorado, and is within the scope of the Continued Storage GEIS (NRC 2014-TN4117). Fort Saint Vrain used prismatic-block graphite fuel elements containing a form of TRISO fuel particles made from a mixture of the carbides of thorium and uranium (NWTRB 2020-TN7966, ORNL 2003-TN7950). These carbide particles of thorium and uranium were then coated with highly retentive coatings of pyrolytic carbon (C) and silicon carbide (SiC) to form the fuel particles, or kernels, much like the TRISO kernels by Kairos. These TRISO-like fuel kernels and a carbonaceous matrix were combined to form a bonded prismatic-block graphite fuel element for the Fort Saint Vrain reactor core. DOE has approximately 23 MTU of spent Fort Saint Vrain fuel in an NRC-licensed ISFSI (NWTRB 2020-TN7966). The Kairos Hermes fuel begins in a similar manner, with a UCO TRISO fuel kernel, but instead of being combined with a carbonaceous matrix, the TRISO fuel kernels are embedded in an annular shell surrounding an inner graphite core and then further coated with layers of pyrolytic C, SiC, and an outer pyrolytic C layer to form a TRISO pebble (Kairos 2023-TN8398). In Section 2.1.1.3 of NUREG-2157, the staff states that "[t]he Fort Saint Vrain spent fuel continues to be stored at an NRC-licensed ISFSI in Plattesville, Colorado, and is within the scope of this GEIS" (NRC 2014-TN4117). Because the Kairos TRISO fuel is similar to the Fort Saint Vrain coated fuel kernels, Kairos would be managing a much smaller amount of spent fuel (0.93 MTU from Hermes versus 23 MTU from Fort Saint Vrain), and the Fort Saint Vrain spent fuel is within the scope of the Continued Storage GEIS, the Kairos spent TRISO storage environmental impacts after cessation of operations would be bounded by the Continued Storage GEIS environmental impacts provided in NUREG-2157 Tables ES-3, ES-4, and ES-5 (NRC 2014-TN4117).

3.9.2 Radiological Waste Management

Liquid and solid radioactive waste-management systems would be used for collection, processing, packaging, and storage of the radioactive materials produced as byproducts during operation and decommissioning of the Hermes test reactor. Waste processing systems would be designed to meet the design objectives of 10 CFR Part 50 (TN249), "Domestic Licensing of Production and Utilization Facilities," and 10 CFR Part 20 (TN283), "Standards for Protection Against Radiation."

Kairos describes in ER Section 2.6.1 the Hermes test reactor waste systems to collect, process, store, monitor, and appropriately address the disposal of the radioactive waste. While not expecting to need a gaseous radioactive waste system (Kairos 2023-TN8172 | ER Table 2.6-1), ER Table 2.6-1 lists the estimated types and quantities of the other radioactive wastes to be generated and disposed of, and a majority of them are classified by Kairos as solid low-level radioactive waste (LLRW) (Kairos 2023-TN8172).

3.9.2.1 Liquid Radiological Waste Management

Because the Hermes reactor design does not depend on water cooling in any of the engineering systems, the only potential water-based liquid radiological waste would be from vent condensation, drains, and decontamination (Kairos 2023-TN8172 | Sec 2.6.1.1). Based in part on the fission product confinement capabilities of the TRISO fuel, the quantity and radiological content are expected to be low enough such that this waste stream could be released under 10 CFR 20.2003 to the WWTP as monitored and disposed of within the limits of 10 CFR Part 20 (TN283), Appendix B, Table 3 (release limits to sewers), such as 1×10^{-2} micro-curies per milli-liter (µCi/mL) for tritium. Because the management of this radiological waste stream would be performed within the limits set in 10 CFR Part 20 (TN283), the environmental impacts on members of the public would be negligible over the 4 years of operation of the Hermes reactor.

The other liquid radiological waste stream involves molten salt wastes that would have their own individual radiological waste systems for the handling of Flibe. As noted in Section 3.7 of this EIS, Flibe molten salt generates relatively large quantities of tritium when exposed to neutrons. Thus, a major waste stream-based radiological hazard would be from tritium, along with some fission, transuranics, and activation products (Kairos 2023-TN8172 | Table 2.6-1). At the end of operations, the Flibe would be collected in containers, solidified as the salts cool during storage with a low radionuclide gamma activity such that radiation decomposition of the Flibe would not be of concern (Kairos 2022-TN7902). As discussed in Section 3.11 of this EIS, as much as approximately 40 tons (T) of Flibe would be shipped to a LLRW disposal site as Class B or C LLRW during decommissioning. The solidified Flibe could be classified as Class C LLRW due to the presence of the C-14 radionuclide at greater than 0.8 but less than 8.0 curies per meter cubed (Ci/m^3) along with other radionuclides being controlled by the technical specifications provided in PSAR Table 14.1.-1 (Kairos 2023-TN8398). The only commercial Class B and C LLRW disposal site is the Waste Control Specialist site west of Andrews, Texas. Since this liquid radiological waste stream would be solidified, contained, monitored, and safely stored onsite within shielded spaces inside the Reactor Building, the environmental impacts on members of the public would be negligible over the 4 years of operation.

3.9.2.2 Solid Radiological Waste Management

The solid radioactive waste system would manage typical nuclear facility operational wastes, originating as dry or wet wastes. The dry waste stream would contain the following contaminated items (Kairos 2023-TN8172 | Sec 2.6.1.2):

- personal protective equipment;
- rags, paper, and paper towels;
- plastic containers;
- laboratory apparatus;
- small parts and equipment;
- tools;
- cold traps; and
- air filters.

Filters and sieves from the inert gas system, chemistry control system, and inert gas system oxygen and moisture absorbers would constitute the wet solid wastes (Kairos 2023-TN8172 | Sec 2.6.1.2). Both solid waste streams would be appropriately packaged for onsite storage and eventual shipping to a LLRW disposal site. Even though Hermes is a test reactor, these types of solid radioactive waste are similar to those generated at operational NPPs. The estimated annual amount of solid radioactive waste, or dry activated waste, expected to be generated by Hermes operation, namely less than 8,800 cubic feet (ft^3) annually (Kairos 2023-TN8172 | Table 2.6-1), would be less than the LLRW volume generated by an operational NPP, which is on average approximately 10,600 ft^3/yr (NRC 2013-TN2654). The LR GEIS determined for operational NPPs that the environmental impacts from this form of radiological waste management are small (NRC 2013-TN2654). Currently operating LLRW disposal facilities available to Kairos (i.e., Waste Control Specialist in Andrews County, Texas and Energy*Solutions* at Clive, Utah) have adequate capacity to accommodate the quantity of LLRW expected to be generated by the four year-operation of the Hermes test reactor (TCEQ 2020-TN7967, Energy*Solutions* 2016-TN7990). Thus, the associated radiological impacts on the environment from solid radioactive waste generated by Hermes operation would also be small.

3.9.2.3 Tritium Waste Management

To control tritium within the Kairos Hermes test reactor facility and to minimize the release of tritium to the surrounding environment, Kairos would install a tritium management system (TMS) for capturing tritium releases from the Flibe molten salt. As described in PSAR Section 9.1.3 and discussed in ER Section 2.6.1.2.3, the TMS manages tritium generated in the reactor and provides for recovery and storage of tritium from various systems (Kairos 2023-TN8398 | PSAR Sec 9.1.3.1, ER Sec 2.6.1.2.3, and Figure 2.6-1). The TMS consists of two separate system components:

- an inert gas capture system for separating tritium from the argon gas flow that is provided as a noncorrosive cover gas to multiple locations in the reactor vessel; and
- a reactor cavity tritium capture system for tritium separation from dry air in Reactor Building cells.

These systems use either metal hydride or molecular sieves to capture and hold the tritium. The process for accomplishing such separations is described in PSAR Section 9.1.3 for each capture system and is incorporated by reference in this EIS (Kairos 2023-TN8398). Once the metal hydride or molecular sieves become saturated, they would be replaced and appropriately stored in preparation for shipment to a LLRW disposal site. Since the expected concentration of tritium is greater than the 40 Ci/m^3 limit for Class A LLRW per 10 CFR 61.55(a)(4) (TN5452), the material would need to be disposed as Class B LLRW, and the Waste Control Specialist site near Andrew, Texas, can accept this form of LLRW from the Hermes test reactor (Kairos 2022-TN7902). While tritium is a commercially available radionuclide, Kairos has no current plans to sell the tritium captured by the TMS (TN7902).

3.9.2.4 Spent TRISO Waste Management

Section 9.3 of the PSAR provides a detailed description of the pebble handling and storage system (PHSS) and a description of PHSS operations is provided in Section 2.7.1 of the ER (Kairos 2023-TN8398, Kairos 2023-TN8172). Both sections are incorporated by reference in this EIS. The storage portion of the PHSS (i.e., a cooling pool and an air cooled storage bay) would be designed to meet multiple principal design criteria to ensure the safe handling and storage of spent TRISO fuel in sealed containers for occupational and public safety. After 4 years of operation and reaching a burnup level of approximately 57 gigawatt-days per metric ton of uranium (GWd/MTU), Kairos could have approximately 155,200 spent TRISO pebbles to be stored in containers held in the storage portion of the PHSS (Kairos 2022-TN7902). Each container could hold approximately 1,900 to 2,100 spent TRISO fuel pebbles (Kairos 2023-TN8172). The PHSS air-cooled storage bay is sized to store all spent TRISO fuel in approximately 74 to 82 containers over the four-year licensing period. This process of managing spent TRISO fuel during the operational licensing period is similar to spent fuel management at operating NPPs, namely it involves a cooling pool supplemented with dry storage using air cooling. Sections 3.11.1.2 and 4.11.1.2 of the LR GEIS, Revision 1 of NUREG-1437, discuss the onsite storage process and the environmental impacts of spent nuclear fuel for operating NPPs for storing in a specifically designed water-cooled spent fuel pool with subsequent dry cask storage (NRC 2013-TN2654). The LR GEIS concluded that the current and potential environmental impacts from spent fuel storage onsite at the current reactor sites have been studied extensively, are well understood, and the environmental impacts were found to be small. The process of managing spent TRISO fuel would be similar to the process used for the current LWRs (i.e., initial wet storage for a set time followed by dry storage with air cooling). Additionally, spent TRISO fuel would be regulated in the same manner as at the current LWRs, and the amount of MTU of spent TRISO fuel is far less than at an operational LWR. Therefore, the environmental impacts presented in the LR GEIS for spent nuclear fuel would bound the onsite storage of spent TRISO fuel for the Hermes reactor.

3.9.2.5 Gaseous Radiological Waste Management

Kairos states in the PSAR and ER that there is no anticipated need for a gaseous radioactive waste system based on the use of the TMS, and no production, storage, or disposal of radioactive gaseous waste is expected. (Kairos 2023-TN8398 | Sec 11.2.2.1, Kairos 2023-TN8172 | Sec 2.6.1.3). Radioactive gases, such as tritium gas not captured by the TMS but diffused out of various materials, would be discharged to the Reactor Building heating, ventilation, and air conditioning system, where they pass through a high-efficiency particulate air filter, and tritium gas diffusing out of the heat rejection subsystem. Both systems exhaust through their respective stacks and are monitored prior to release (Kairos 2023-TN8398 |

Sec 11.2.3, Kairos 2023-TN8172 | Sec 2.6.1.3). Impacts related to such gaseous releases of tritium during normal operations are addressed in Section 3.7 of this EIS.

3.9.3 Conclusions

The NRC staff concludes that the uranium fuel cycle impacts and radiological waste management impacts from operation and decommissioning of the Kairos Hermes reactor would be SMALL. This conclusion is based on the following:

- The relatively low quantity of uranium (0.93 MTU) to be used during the license period of four years is far less than the annual amount used to assess Table S-3 impacts.
- The TRISO fuel processes (i.e., HALEU enrichment and fuel fabrication) for the Hermes reactor are bounded by Table S-3 limits.
- The spent TRISO fuel environmental impacts from storage onsite or offsite upon cessation of operations are bounded by the Continued Storage GEIS.
- Any liquid or gaseous radiological waste stream releases would be in accordance with and within regulatory limits of 10 Part 20 (TN283).
- The estimated volume of LLRW from operation of the Hermes reactor would be comparable to or less than the LLRW volumes from an NPP; there is adequate capacity at LLRW disposal sites; and the waste form, especially the chemical form, is acceptable at a LLRW disposal site.

Based on the above, the onsite storage of spent TRISO fuel would be similar to current LWRs and must meet the same regulatory safety requirements.

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 East Tennessee Technology Park site, shipment of LLRW and mixed waste to offsite disposal facilities during operations, and shipment of spent fuel to an interim storage facility or a permanent geologic repository during decommissioning. For the purposes of these analyses, the NRC staff considered the proposed Yucca Mountain, Nevada, repository site as a surrogate destination for a monitored retrievable storage facility or permanent geologic repository.

3.10.1 Environmental Impacts from Operation

The NRC performed a generic analysis of the environmental effects of the transportation of fuel and waste to and from LWRs in the *Environmental Survey of Transportation of Radioactive Materials To and From Nuclear Power Plants* (AEC 1972-TN22) and in a supplement to WASH-1238 (NRC 1975-TN216), and found the impact to be small. These documents summarize the environmental impacts of 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.

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 NPPs. 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, NUREG-0170, and other LWR transportation assessments by the staff form the basis of assessment of the transportation of radioactive material to and from the Hermes test reactor.

3.10.1.1 Fresh TRISO Fuel Shipments

Over the life of the Hermes test reactor, a number of shipments of fresh TRISO fuel would periodically take place. Section 4.10.2.1 of the ER provides details about the uranium content of fresh TRISO pebbles, how many would be consumed on an annual and lifetime basis (38,800 pebbles annually and 155,200 pebbles over 4 years), the type of existing transport packages that ship the fresh TRISO pebbles (Versa-Pac [VP]-55 or VP-110, manufactured by DAHER Group, Transport Logistics International, Inc.) (NRC 2021-TN7968), and the expected number of annual shipments using the VP-55 package to meet the needs of the Hermes test reactor operating at 35 MWt (three truck shipments per year) (Kairos 2022-TN7882).

As noted in Section 4.10.2.1 of the ER, a decision about the sourcing of fresh TRISO fuel has not been made at the time this EIS was published (Kairos 2023-TN8172). The source of fresh TRISO fuel may be provided by existing manufacturers or by a TRISO fuel fabrication facility built by Kairos, which could be near the Hermes test reactor on the East Tennessee Technology Park site (Kairos 2023-TN8172 | Sec 4.10.2.1 and Sec 4.13.1). Thus, the transportation impacts of fresh TRISO fuel could be negligible if the fuel fabrication facility is also located at the East Tennessee Technology Park site, or noticeable if the transportation distance could be significant if fuel is shipped from a distant nuclear fuel fabricator. Kairos elected for evaluation purposes in the ER to assume fresh TRISO fuel would be shipped by truck from the location of the farthest nuclear fuel manufacturer in the United States from the Hermes test reactor site, located in Richland, Washington (Kairos 2023-TN8172 | Sec 4.10.2.1). Based on an independent assessment, the NRC staff finds that shipments from such a location would bound the fresh TRISO fuel transportation impacts.

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 fabrication facility and the Hermes site 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. Calculations to estimate these low levels are completed with very conservative assumptions.

The NRC staff has performed a number of environmental evaluations of the shipment of fresh uranium fuel for LWRs operating at larger power levels than the Hermes test reactor. Incident-free, or normal operation, transportation impact analysis assumed the transportation package meets the regulatory maximum dose rate of 10 CFR 71.47 (TN301), "External radiation standards for all packages." The accident analyses involving unirradiated fuel shipments accounted for radiological doses and nonradiological fatalities and injuries were due to the physical impacts of an accident. Staff reviewed the evaluation for the nearby Clinch River ESP final EIS, where environmental impacts of fresh uranium fuel shipment incident-free and accident impacts of an 800 MWe small modular reactor from Richland, Washington were discussed in Section 6.2 and found to be small (NRC 2019-TN6136).

Another Federal agency has also evaluated fresh TRISO fuel shipments. Specifically, the U.S. Department of Defense, acting through the Strategic Capabilities Office, has analyzed the transportation of high-activity low-enriched uranium TRISO fuels in VP-110 packages from Lynchburg, Virginia, to Idaho in the Project Pele mobile microreactor final EIS, published by DOE. This final EIS determined that the risks would be low based on 10 shipments from BWX Technologies, Inc. in Virginia to the Idaho National Laboratory site in Idaho (DOE 2022-TN7969 | Table 4.12-4). Incident-free impacts were 1.3 person-rem to populations along the route (which can be large numbers of people receiving a small dose). The Project Pele microreactor final EIS predicted the accident risks related to fresh TRISO fuel shipments would only be approximately 6×10^{-9} latent cancer fatalities. Therefore, based on small impacts in the CRN ESP final EIS and DOE final EIS, the low level of radioactivity found in unirradiated enriched uranium no matter the form (i.e., LWR or TRISO fuel), and the fact that Kairos would only need three fresh TRISO fuel shipments per year (compared to 10 for Project Pele), the NRC staff finds these prior transportation evaluations are applicable and demonstrate that the Kairos fresh TRISO fuel transportation impacts would be SMALL.

3.10.1.2 LLRW 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 Energy*Solutions* disposal facility at Clive, Utah, is licensed by the State of Utah to accept Class A LLRW from all regions of the United States. The Waste Control Specialists, LLC (WCS) site in Andrews County, Texas, is licensed to accept Class A, B, and C LLRW from the Texas Compact generators (Texas and Vermont) and from outside generators with permission from the Texas Compact. Energy*Solutions* Barnwell Operations located near Barnwell, South Carolina, accepts waste from the Atlantic Compact states (Connecticut, New Jersey, and South Carolina) and is licensed by the State of South Carolina to dispose of Class A, B, and C LLRW. U.S. Ecology, located near Richland, Washington, accepts LLRW from the Northwest and Rocky Mountain Compact states (Washington, Alaska, Hawaii, Idaho, Montana, Oregon, Utah, Wyoming, Colorado, Nevada, and New Mexico) and is licensed by the State of Washington to dispose of Class A, B, and C waste. The two LLRW disposal sites that could accept LLRW shipments from Kairos Hermes facilities are the Energy*Solutions* disposal facility at Clive, Utah, accepting Class A LLRW and the WCS site in Andrews County, Texas for Class A, B, and C LLRW. In 2020, there was a total of approximately 1,010,300 ft^3 (28,610 cubic meter [m^3]) of Class A LLRW shipped to both LLRW disposal sites and 2,050 ft^3 (58 m^3) of Class B LLRW shipped to the WCS disposal site (DOE 2022-TN7991).

As provided in ER Table 2.6-1, Kairos estimates each year of operation could result in approximately 8,800 ft^3 (249 m^3) of Class A LLRW to be shipped to either the Energy*Solutions*, Clive, Utah or the WCS LLRW sites and approximately 670 ft^3 (19 m^3) of Class B LLRW to be shipped to the WCS LLRW disposal site (Kairos 2022-TN7882). This volume of LLRW from Hermes operation would be a small fraction of the annual shipments of Class A LLRW to either the Energy*Solutions* or the WCS LLRW disposal facilities or of Class B LLRW to the WCS LLRW disposal facility.

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 Commission 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 operation of the Hermes facilities would be a small fraction of the annual volume of LLRW shipped to licensed disposal facilities and performed in compliance with U.S. Department of Transportation and NRC regulations, the NRC staff concludes that the impacts from transportation of LLRW during Kairos Hermes operation would be SMALL.

3.10.2 Environmental Impacts from Decommissioning

Spent TRISO fuel would be stored in the Reactor Building of the Hermes test reactor over the four-year life span of the facilities (Kairos 2022-TN7882). Following cessation of operations, the spent TRISO fuel would have to be further stored at the East Tennessee Technology Park site or shipped offsite to an interim storage facility or a permanent geologic repository. There would also be quantities of LLRW to be addressed during decommissioning for disposal at one or more commercial LLRW disposal sites in the same manner as previously discussed during the operational lifetime of the Hermes test reactor.

For decommissioning of the Hermes test reactor, options for addressing the spent TRISO fuel could be maintaining the spent fuel in a separate storage facility at the East Tennessee Technology Park site or shipping the spent fuel to an interim storage facility or a permanent geologic repository. The NRC has licensed two consolidated interim storage facilities (NRC 2021- Interim Storage Partners referenced below (ML21188A096), and NRC 2023-Holtec International Inc (NRC 2023-TN8284), but the distance to the once-proposed Yucca Mountain geologic repository is greater and is the disposal location that Kairos selected for analysis. Based on an independent assessment, the NRC staff finds shipping to this location would have larger impacts than shipping to a licensed interim storage facility.

The NRC staff has extensively analyzed shipments of spent LWR fuel in a number of new reactor licensing reviews to the once-proposed Yucca Mountain and for three away-from-reactor interim storage facility licensing reviews (i.e., Private Fuel Storage Facility, Holtec International Consolidated Interim Storage Facility, and the Interim Storage Partners Consolidated Interim Storage Facility). Prior NRC transportation analyses of spent LWR fuel environmental impacts in support of license renewal for burnup levels up to 62 GWd/MTU[6] were found to still be

[6] Burnup level is a good indicator of the radionuclide inventory quantity contained in spent nuclear fuel.

bounded by Table S-4 of 10 CFR 51.52 (TN250), as documented in NUREG-1437, Revision 1, the LR GEIS (NRC 2013-TN2654). The staff also assessed LWR spent fuel shipments in NUREG-2125, which demonstrate that the NRC regulations continue to provide adequate protection of public health and safety during the transportation of spent nuclear fuel (NRC 2014-TN3231).

Regarding the number of spent TRISO shipments during decommissioning, Kairos would need to package and ship up to 155,200 irradiated, or spent, TRISO pebbles after 4 years of Hermes operation (Kairos 2022-TN7882). As noted in Section 3.9 of this EIS, a spent TRISO fuel container could hold 1,900 to 2,100 spent TRISO pebbles. Thus, Kairos could have approximately 74 to 82 containers to be shipped to a disposal site during decommissioning. A modified NAC International Inc. legal weight certified truck package holding two sealed spent TRISO canisters may be used because this transportation package has been certified for and used in other spent fuel shipments (Kairos 2022-TN7902). This would result in up to 41 spent TRISO shipments. For comparison purposes, the analysis used to support Table S-4 assumed 60 normalized annual spent LWR shipments. The CRN ESP final EIS transportation analysis assessed 137 normalized annual spent LWR shipments to the once-proposed Yucca Mountain geologic repository (NRC 2019-TN6136 | Table 6-10). Therefore, the CRN ESP final EIS transportation analysis is conservative and will be applied to bound the impacts of the expected spent TRISO shipments during decommissioning of the Hermes test reactor.

As discussed for fresh TRISO fuel shipments in the above environmental impacts from operation, incident-free impacts from the shipment of spent TRISO fuel is 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 provided in the CRN ESP final EIS for spent TRISO fuel shipments, namely that the once-proposed Yucca Mountain geologic repository is a surrogate disposal location for bounding these impacts. As such, with the number of spent TRISO fuel truck shipments being less than the number assessed in the CRN ESP final EIS Section 6.2, both the incident-free and the nonradiological accident impacts of the Hermes test reactor spent TRISO shipments are bounded by the results in the CRN ESP final EIS and impacts would be SMALL.

For consideration of the radiological impacts from potential transportation accidents, the structure of TRISO is such that multiple barriers associated with the TRISO kernels and pebbles must be broken before a release of radioactive material from a shipping package could become possible. As discussed in Section 3.9 of this EIS, after reaching a burnup level of approximately 57 GWd/MTU, Kairos would place the spent TRISO pebbles into sealed canisters for storage during operation. Additionally, the structure of the types of sealed canister into which spent TRISO pebbles would be placed would provide added levels of robustness, or an additional defense-in-depth layer than already provided by the coated TRISO particles and the coated TRISO pebbles, for withstanding physical impacts beyond the thin-walled single barrier offered by the fuel pin for LWR spent fuel assembly shipments. Based on structural and thermal analyses, NUREG-2125, *Spent Fuel Transportation Risk Assessment*, showed that spent fuel within an inner welded canister in the shipping package (referred to in NUREG-2125 as canistered fuel) does not rupture even under the most severe accidents analyzed, so no radioactive material would exit the cask (NRC 2014-TN3231 | Sec E.4.3). Thus, the type of spent fuel shipping packaging being proposed by Kairos would be very similar in performance to the canistered fuel analyzed in NUREG-2125 and therefore can be expected to provide similar levels of protection.

For a significant release of radioactive material to occur as the result of a transportation accident that could breach the shipping package, a very large number of spent TRISO kernels must have their coatings cracked within a given number of TRISO pebbles, which also must have significant cracking of their pebble coatings. The internal pressure in the TRISO kernels must then be enough to move the fission products and transuranic elements out of the kernel, into the annular region of each pebble and out through the cracks in the TRISO pebbles into the inner spaces of the TRISO containers. The TRISO containers, with their more significant structure than an irradiated LWR fuel pin, must also be broken to allow the radioactive material to enter the inner volume of the shipping package and then out through the breach of that final barrier. Therefore, because of the nature of the differences in the number of barriers that must be broken for a release of radioactive material from a spent TRISO shipment versus a spent LWR fuel assembly shipment, it would be more difficult for a transportation accident involving spent TRISO to have the same environmental impact from accidents involving spent LWR fuel assembly shipments. Thus, the prior small impacts of spent LWR fuel assembly shipments transportation accidents provided in the CRN ESP final EIS (which had impacts of SMALL) would bound the spent TRISO shipments transportation accidents.

Decommissioning activities would also address disposal of all remaining LLRW with shipments to licensed LLRW disposal facilities. Outside of contaminated systems, structures, and components, such as the reactor vessel and TRISO handling equipment, the same LLRW generated during operations would be present at the time of cessation of operations and would be handled and shipped to LLRW disposal sites in the same manner as previously described, such as the tritium capture materials and dry active wastes as Class A and B LLRW. For the Flibe molten salt, this material would be classified and disposed as either Class B and potentially Class C LLRW, as set by the concentration of tritium and other radionuclides in the Flibe and as controlled by the Hermes technical specifications of PSAR Table 14.1-1. Kairos is expected to have up to approximately 40 T of Flibe to dispose of during decommissioning, which would translate to between 16 and 20 m^3 of material (Kairos 2022-TN7902). The total amount of Class B and Class C LLRW shipped to WCS from all sources varies between 150 to 350 m^3. Thus, the amount of Flibe material to be disposed of is a small fraction of what WCS receives in a given year. Additionally, Kairos confirmed that this material is acceptable in all aspects for disposal at the WCS facility (TN7902). 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 facilities and performed in compliance with U.S. Department of Transportation and NRC regulations, the NRC staff concludes that the impacts from transportation of Flibe during Kairos Hermes decommissioning would be SMALL.

The impacts associated with transporting equipment and materials (radiological and nonradiological) offsite during decommissioning of a 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 transported offsite would include all contaminated wastes generated onsite from deconstruction of the Hermes facilities. Radiological impacts would include 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 that the transportation impacts would not be destabilizing. The Hermes facilities are significantly smaller that the LWR evaluated in the Decommissioning GEIS and would have less contaminated material to be shipped to LLRW disposal sites. The nonradiological decommissioning transportation impacts would also be less than those presented in the Decommissioning GEIS due to the smaller size of the Hermes facility. Therefore, the potential transportation impacts during decommissioning of the Hermes facilities would also be SMALL.

3.10.3 Conclusions

Based the quantity of nuclear material and waste, the material form would be acceptable for disposal, and would employ certified transport packages in accordance with NRC and DOT regulations, the NRC staff concludes that the transportation of fuel and waste impacts from operation and decommissioning of the Hermes reactor would be SMALL.

3.11 Postulated Accidents

3.11.1 Environmental Impacts of Operation

This section discusses the potential offsite radiological consequences of the Maximum Hypothetical Accident (MHA) that could only occur during operations. The results of the analysis are compared to the NRC's dose reference values for test reactor siting given in 10 CFR 100.11 (TN282), "Determination of exclusion area, LPZ, and population center distance." The MHA is a conservative evaluation and represents the bounding consequences for potential design basis accidents (DBAs) at Kairos's proposed Hermes facilities.

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 DBAs at the proposed Hermes facilities. The MHA is based on events unique to the design of the proposed Hermes facilities that hypothetically could release radioactive materials into the environment. Kairos provides an analysis of postulated accidents and the resulting MHA doses in PSAR Chapter 13 (Kairos 2023-TN8398). A summary of the postulated events and consequences, consistent with PSAR Chapter 13, is provided in ER Section 4.11 (Kairos 2023-TN8172).

The NRC staff has conducted a thorough independent review of the safety-related structures, systems, and components, are documented in its SE (NRC 2023-TN8414). The NRC staff will determine whether the safety-related structures, systems, and components 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, in its SER, that Kairos has met all of the NRC regulatory requirements described above in order to clearly demonstrate that the Hermes test reactor would meet the regulatory standard of demonstrating adequate protection of public health and safety, then the likelihood of accidents would be reliably controlled.

The calculated dose of 227 mrem (2.27 mSv) as shown in Table 4.11-1 of the ER, as supplemented for the MHA at the proposed Hermes facilities' Exclusion Area Boundary (EAB) at a distance of 250 meters (m), would be significantly below the whole body total radiation dose reference value of 25 rem (250 mSv) for two-hours immediately following onset of the release specified for DBAs in 10 CFR 100.11(a)(1) (Kairos 2023-TN8172, Kairos 2022-TN7883). While at the LPZ distance of 800 m, the MHA dose of 59 mrem (0.59 mSv) would be well below the dose reference values specified for DBAs in 10 CFR 100.11(a)(2) (TN282) and within the annual TEDE limit of 100 mrem (1.0 mSv) in 10 CFR 20.1301(a) (Kairos 2023-TN8172, Kairos 2022-TN7883). The respective thyroid doses are also significantly below the dose criterion of 300 rem as specified in 10 CFR 100.11(a)(1) and 100.11(a)(2) (TN282) for both locations. The dominant contributors to the MHA whole body and thyroid doses, both at the EAB and in the LPZ, are from gaseous radionuclides (Kairos 2022-TN7902). Since the nearest resident is located approximately 1,770 m (1.1 mi) from the site (Kairos 2022-TN7902) and the release is predominately gaseous, dispersion of the release between 800 m and 1,127 m would reduce the airborne concentrations, resulting in a lower dose at this location than the 59 mrem at the

LPZ distance. Thus, the dose at the LPZ distance would bound any dose received offsite by the nearest resident or any other member of the public further away from the site.

Based on an independent safety review and a detailed evaluation of the applicant's information, the NRC staff must determine whether the applicant appropriately evaluated the potential events, including the radiological consequences of unplanned releases, that are relevant for the Hermes test reactor. The detailed results of the NRC staff's safety review for accidents is available in the SE (NRC 2023-TN8414).

As indicated in the previous discussion, an independent evaluation of the applicant's information by the NRC staff found the MHA doses at the EAB and the LPZ are below the reference doses required in 10 CFR 100.11 (TN282). Therefore, the NRC staff concludes that the environmental impacts from potential radiological accidents would be SMALL and further mitigation would not be warranted. Additionally, as an indicator of the low risks from postulated accidents, the MHA dose at the LPZ is a fraction of the annual background radiation dose of approximately 310 mrem and below other regulatory radiation limits that adequately protect public health and safety.

3.11.2 Cumulative Impacts

Table 4.13-1 of the ER identifies past, present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts of the proposed action (Kairos 2023-TN8172). 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 50 mi of the Hermes site. The 50 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. Key past and present actions affecting land resources in the affected area include Sequoyah Units 1 and 2, Watts Bar Units 1 and 2, and DOE facilities on the ORR, such as Y-12. As discussed in the CRN ESP final EIS Section 7.10 (NRC 2019-TN6136), which analyzed the environmental impacts of building and operating two small modular reactors at a site in close proximity to the Hermes site, the cumulative impacts of a reactor larger than the Hermes test reactor when considered along with these same facilities were found to be SMALL. Given the small doses from any postulated accident from the Hermes reactor, the lower power level, and the prior cumulative analysis for the CRN ESP, the NRC staff concludes that the cumulative risks of severe accidents at any location within 50 mi of the Hermes 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 proposed Hermes test reactor must meet the NRC requirements for postulated accidents where potential doses at the EAB and in the LPZ are below the dose reference values of 10 CFR Part 100 (TN282) for test reactor siting. The potential doses, as determined by Kairos, meet the requirements of 10 CFR 100.11 (TN282) and therefore demonstrate adequate protection of the public health and safety. Additionally, as another indication of the low level of environmental impacts, the nearest resident dose from accidents is also below the radiation dose limits for individual members of the public in 10 CFR 20.1301(a) (TN283).

3.12 Climate Change

The NRC staff has determined that it is reasonably foreseeable that climate change may alter the affected environment described in this section. Climate change is a global phenomenon that the construction, operation, and decommissioning of the proposed Hermes facilities would not appreciably alter. However, climate change could provide a new environment that may result in changed impacts from the proposed Hermes project. The NRC previously analyzed the potential changes to the Oak Ridge region as a result of climate change as part of the CRN ESP final EIS, in Appendix L of that document (NRC 2019-TN6136). That appendix presented the NRC staff's assessment of the potential effects of climate change on its evaluation of the environmental impacts of the proposed action for the CRN ESP and is summarized in the paragraph below.

The appendix in the CRN ESP final EIS has three sections: (1) description of the assessment process, (2) potential climate change impacts in the region, and (3) assessment summary (NRC 2019-TN6136). The NRC considered the 2014, 2017, and 2018 U.S. Global Change Research Program (GCRP) reports when developing the analysis (USGCRP 2014-TN3472, USGCRP 2017-TN5848, USGCRP 2018-TN5847), and no new GCRP reports have been issued since 2018. The analysis considered the GCRP projections for the 2071−2099 period to be bounding for assessing the effects of climate change for the CRN project (NRC 2019-TN6136). The potential changes in the region as a result of climate change are discussed in Section L.3 (NRC 2019-TN6136). The following resource areas were analyzed in the assessment: land use, hydrology, terrestrial and wetland ecology, aquatic ecology, socioeconomics, environmental justice, historic and cultural resources, meteorology and air quality, nonradiological health, radiological impacts, nonradioactive waste, accidents, and transportation of radiological materials. For all the resource areas considered, the analysis concluded there would be no change in the construction and operation impact conclusions of the CRN project proposed action as a result of climate change (NRC 2019-TN6136).

Because of the proximity of the proposed Hermes facilities to the CRN site, the potential changes in the region as a result of climate change can be expected to be the same for both the Clinch river proposed small modular reactors site and the proposed Hermes site. The NRC staff adopts the analysis from the CRN ESP EIS (NRC 2019-TN6136) for purposes of evaluating climate effects on the Hermes project. Additionally, the proposed Hermes facilities are much smaller with smaller magnitudes of impact, and use of the analysis in the CRN ESP EIS is further considered conservative because the proposed Hermes facilities are anticipated to operate for only 4 years compared to the 60 years analyzed for CRN (20 years for the ESP and 40 years for the combined license). Therefore, the potential changes to the affected environment analyzed in the CRN ESP EIS would not be fully realized during the anticipated operation of the proposed Hermes facilities, and the staff concludes that none of the impact conclusions in this EIS for the Hermes facilities would change as a result of climate change.

4.0 ALTERNATIVES

This section describes alternatives to granting a construction permit for the proposed Hermes test reactor and the environmental impacts of those alternatives. The need to compare the proposed action with alternatives arises from the requirement in Section 102(2)(C)(iii) of the National Environmental Policy Act of 1969 (NEPA), as amended (42 United States Code [U.S.C.] 4321 *et seq*. TN661). NEPA states that an environmental impact statement (EIS) shall include an analysis of alternatives to the proposed action. The U.S. Nuclear Regulatory Commission (NRC) implements this requirement through regulations in Title 10 of the *Code of Federal Regulations* Part 51 (TN250) and in the Interim Staff Guidance to NUREG–1537 (NRC 2012-TN5527, NRC 2012-TN5528), which state that the EIS will include an analysis that considers and weighs the environmental effects of the proposed action, the environmental impacts of alternatives to the proposed action, and alternatives available for reducing or avoiding adverse environmental effects.

For the licensing of non-power reactors, the NRC staff considers a no-action alternative and a range of reasonable alternatives that may include alternative sites, alternative layouts of proposed facilities within a site, modification of existing facilities instead of building new facilities, alternative technologies, and alternative transportation methods (NRC 2012-TN5527, NRC 2012-TN5528). The applicant followed a systematic process for identifying a range of reasonable alternative sites for the proposed Hermes project, as outlined in Sections 5.2 and 5.3 of the Environmental Report (ER) (Kairos 2023-TN8172). The process involved systematic consideration of possible sites, leading to identification of two reasonable sites: the proposed site in the East Tennessee Technology Park in Oak Ridge, Tennessee, and an alternative site in Eagle Rock, Idaho. The applicant did not consider alternative layouts of the proposed facilities on either site. Land disturbance on the proposed site in Oak Ridge would be limited to lands previously disturbed by the former Oak Ridge Gaseous Diffusion Plant (ORGDP). Furthermore, the proposed site at the Oak Ridge site is situated in an existing industrial park already served by existing roadways and other infrastructure. Hence, consideration of other sites in the Oak Ridge area, or alternative layouts of the new buildings within the proposed site in Oak Ridge, do not offer opportunities to reduce environmental impacts. The Eagle Rock site is a large tract of relatively uniform undeveloped rangeland and cropland (Kairos 2023-TN8172 │ Sec 5.4.1.1.1) without wetlands or surface water features (Kairos 2023-TN8172 │ Sec 5.4.1.5.3). There are many possible layouts for the proposed facilities within the site, but none would substantially differ with respect to environmental impacts. Because neither site presently contains existing facilities, the applicant did not consider opportunities to repurpose existing facilities in lieu of building new facilities.

Because the purpose of the Hermes project is to demonstrate and test specific new technologies, specifically the Kairos Power Fluoride Salt-Cooled High Temperature Reactor (KP-FHR) technologies, the applicant did not consider alternative technologies for the Hermes reactor (Kairos 2023-TN8172 │ Sec 5.3). The Hermes project does not require building offsite transmission lines, pipelines, or access roads, so the applicant did not identify proposed or alternative rights-of-way to serve either site. The applicant stated that transportation alternatives to the proposed site are limited to using existing road and rail facilities already servicing the East Tennessee Technology Park, which are adequate for the new facility (Kairos 2023-TN8172 │ Sec 5.3). The Eagle Rock site is served only by roads and is not served by resources capable of supporting alternative transportation such as waterways or railroads (Kairos 2023-TN8172 │ Sec 5.4.1.7.1).

The NRC staff evaluated the applicant's process for identifying reasonable alternatives to the proposed action and finds, as described below, the applicant's process to be reasonable. The staff finds that the applicant's process is analytical, logical, appropriate to the purpose and need identified in Section 1.0 of this EIS, and in keeping with the spirit and intent for identifying a range of reasonable alternatives for analysis in an EIS. Section 4.1 below addresses the environmental impacts from a no action alternative; and Section 4.2 addresses the potential alternative sites for the Hermes project, including environmental impacts from the Eagle Rock site.

4.1 No-Action Alternative

Under the no action alternative, the NRC would not issue a construction permit to Kairos Power, LLC (Kairos) to build a test reactor to demonstrate the KP-FHR technology. The applicant could not build the proposed Hermes reactor and would therefore not have an opportunity to test the KP-FHR technologies, design features, and safety functions at a reduced scale relative to an anticipated commercial power reactor (Kairos 2023-TN8172 │ Sec 5.1). While forgoing the opportunities provided by Hermes might not necessarily preclude future development of reactors using the KP-FHR technologies, it could slow or impede safe and efficient development of the technology. None of the environmental effects described in Section 3.0 of this EIS would occur under the no action alternative. But because Section 3.0 characterizes all potential environmental impacts of the proposed action as SMALL, any environmental benefits from selecting the no action alternative instead of the proposed action would be minimal. Additionally, under the no action alternative, the proposed site would remain available for other government or private industrial development projects, and many of the environmental impacts resulting from land disturbance and building new industrial facilities on the site might still occur at some time in the future.

4.2 Site Alternatives

The NRC staff identified one site alternative for detailed evaluation based on the applicant's ER and other information provided by the applicant. This alternative site, termed the Eagle Rock site, is situated approximately 20 miles (mi) west of Idaho Falls, Idaho, on federally owned property in eastern Idaho. Figure 5.4-1 of the ER (Kairos 2023-TN8172) depicts the location of the Eagle Rock site and its proximity to the City of Idaho Falls and tracts of nearby Federal land managed by U.S. Department of Energy (DOE) and other agencies. As reported in Section 5.4 of the ER (Kairos 2023-TN8172), the applicant identified the Eagle Rock site as the only reasonable alternative site warranting detailed evaluation. The NRC staff reviewed the applicant's process for screening potential sites, outlined in Sections 5.3.1 and 5.3.2 of the ER (Kairos 2023-TN8172). The staff finds that the applicant used a logical approach to identify the range of reasonable alternative sites meeting the purpose and need of the Hermes project. Section 4.2.1 below summarizes the applicant's process; while Section 4.2.2 summarizes the potential environmental impacts of constructing, operating, and decommissioning the Hermes project at the Eagle Rock site.

4.2.1 Process for Identifying Reasonable Alternative Sites

The applicant followed the process described in Section 5.3.1 of the ER to evaluate potential sites for the proposed facilities (Kairos 2023-TN8172). The process follows the outline presented by the Electric Power Research Institute (EPRI) in *Advanced Nuclear Technology: Site Selection and Evaluation Criteria for New Nuclear Power Generation Facilities* (EPRI 2015-TN5285). This process involves defining a region of interest (ROI) and candidate areas within

the ROI, identifying specific candidate sites for evaluation and scoring, and finally selecting sites for detailed evaluation (Kairos 2023-TN8172 │ Sec 5.3.1). The applicant conducted the process using reconnaissance-level data available in the public domain with limited consultation of stakeholders (Kairos 2023-TN8172 │ Sec 5.3.1).

The results of the applicant's siting process are summarized in Section 5.3.2 of the ER (Kairos 2023-TN8172). The applicant's ROI consisted of the continental United States, based on a preference for future deployment in geographic regions with a strong nexus to future domestic power markets and on the fact that the applicant does not have a specific service territory (Kairos 2023-TN8172 │ Sec 5.3.2). Key site screening criteria used by the applicant included the availability of high-quality site data to support licensing and design, proximity to a national laboratory capable of supporting test plans, and connectivity to the targeted commercial reactor market (Kairos 2023-TN8172 │ Sec 5.3.2). As presented in Table 5.3-1 of the ER, the applicant identified 11 potential sites in 5 candidate areas meeting the screening criteria: Eastern Tennessee; the Pacific Northwest; Eastern Idaho; Piketon, Ohio; and southeastern United States (Kairos 2023-TN8172). The key criteria used by the applicant to score the potential sites are (Kairos 2023-TN8172 │ Sec 5.3.2):

- connectivity to future commercial reactor markets;
- access to construction resources;
- ability for timely acquisition;
- the existing local transportation and utility infrastructure;
- strong local community support;
- water availability;
- minimizing conflict with other major projects;
- minimizing reliance on the DOE as the landowner;
- avoiding sensitive environmental resources such as wetlands; and
- access to existing nuclear testing and research.

This process ultimately led the applicant to identify two reasonable alternative sites for a more detailed environmental analysis, consisting of the proposed Oak Ridge and Eagle Rock sites.

Although the applicant identified only one site in Oak Ridge (the proposed site in the East Tennessee Technology Park) for detailed evaluation, the applicant also considered two other sites near Oak Ridge (Kairos 2022-TN7902). One site, identified in Table 5.3-1 of the ER as Site 1.1, was the Clinch River Nuclear site approximately 2 mi south of the East Tennessee Technology Park for which the Tennessee Valley Authority received an early site permit from NRC for possible future construction and operation of small modular reactors (NRC 2019-TN6136). The other site, identified as Site 1.3, was another parcel on the Oak Ridge Reservation recently evaluated by DOE for another project. The proposed site was identified as Site 1.2 in ER Table 5.3-1. Of the three sites near Oak Ridge, only the proposed site provides an opportunity to limit land disturbance to previously industrialized lands lacking natural surface soils and vegetation. Therefore, the other two sites were not considered for detailed analysis.

4.2.2 Affected Environment and Environmental Consequences for Eagle Rock Site

4.2.2.1 Affected Environment:

The applicant characterized the affected environment at the Eagle Rock site in Section 5.4 of the ER (Kairos 2023-TN8172). Key aspects of the affected environment at the Eagle Rock site that substantially differ from those described in Section 3.0 for the proposed site in Oak Ridge are summarized below.

The Eagle Rock site constitutes approximately 4,200 acres (ac) of undeveloped land within Bonneville County, in eastern Idaho (Kairos 2023-TN8172). At the Eagle Rock site, the applicant has stated that the Hermes facilities would be built somewhere within a 592 ac portion of the site formerly evaluated by the NRC (NRC 2011-TN6812) for the proposed Eagle Rock Enrichment Facility (Kairos 2022-TN7902).

As depicted in Figure 5.4-5 of the ER, the 4,200 ac site presently consists of irrigated cropland, non-irrigated pasture, and natural sagebrush steppe vegetation (Kairos 2023-TN8172). Multiple wilderness study areas, national natural landmarks, national forests, national monuments, and national wildlife refuges are located within 50 mi of the site (Kairos 2023-TN8172). According to the NRC (NRC 2011-TN6812 │ Sec 3.2.1), the Eagle Rock site is zoned as G-1 Grazing by Bonneville County, which allows for industrial development. The NRC notes that sagebrush steppe habitat has experienced more than a 98 percent decline since European settlement in North America, but the sagebrush steppe cover on the Eagle Rock site has been affected by grazing, resulting in soil disturbance and reduced cover by herbaceous species other than cheatgrass (*Bromus tectorum*) (NRC 2011-TN6812 │ Sec 3.8.1). The site and surrounding counties are attainment areas under the Clean Air Act (Kairos 2023-TN8172 │ Sec 5.4.1.2.1). Class I areas designated under the Clean Air Act near the site include the Craters of the Moon National Monument (47 mi to the west), Grand Teton National Park (65 mi to the east), and Yellowstone National Park (65 mi to the northeast). There are no rivers, lakes, streams, wetlands, or 100-year or 500-year floodplains on the site, although there are a few small drainage features that periodically carry water from irrigated agricultural areas (Kairos 2023-TN8172 │ Sec 5.4.1.4.1).

A search by the applicant of the U.S. Fish and Wildlife Service Information for Planning and Consultation (IPaC) database on February 2, 2022, identified no threatened or endangered species or critical habitat listed under the Endangered Species Act (Endangered Species Act of 1973-TN1010) for an action area consisting of that portion of the site where facilities would be built under this alternative (Kairos 2023-TN8172 │ Sec 5.4.1.5.2). The action area used for the IPaC search consisted of the entirety of the 592 ac of land containing the area subject to disturbance by the Hermes facilities, plus any necessary access roads (Kairos 2022-TN7902). Because the land subject to disturbance by the Hermes facilities construction would constitute only a small part of the action area, the search conservatively addressed lands adjacent to as well as within the area where the facilities would be built. Significant archaeological resources are known to be present on the site, and some have already been identified to be eligible for listing in the National Register of Historic Places (Kairos 2023-TN8172 │ Sec 5.4.1.6).

The Eagle Rock site is situated in a socioeconomic ROI defined by the applicant as three counties in Idaho (Bingham, Bonneville, and Jefferson Counties) located approximately 20 mi from the metropolitan area of Idaho Falls and part of the Idaho Falls-Rexburg-Blackfoot Combined Statistical Area (Kairos 2023-TN8172 │ Sec 5.4.1.7.1). The applicant characterizes the demography, economy, community characteristics, public services, and transportation

facilities in Section 5.4.1.7 of the ER (Kairos 2023-TN8172). For an area surrounding the Eagle Rock site extending out by a 5 mi radius, the applicant identified no low-income populations subject to consideration as potential environmental justice communities of concern (Kairos 2023-TN8172 │ Sec 5.4.1.10).

4.2.2.2 Environmental Consequences of Construction

Building the proposed Hermes facilities at the Eagle Rock site would involve the temporary disturbance of approximately 95 ac of cropland, sagebrush, pasture, and upland grasslands; including some prime farmland, of which 30 ac would remain permanently in industrial use once the new facilities are built (Kairos 2023-TN8172 │ Sec 5.4.1.1.1). These land use types are abundant in eastern Idaho, and the loss of 95 ac of prime farmland typical of the surrounding landscape would not affect the ability of the region to contribute to agricultural production. Based on information about the site's zoning, as reported by the NRC (NRC 2011-TN6812), the NRC staff believes that no zoning changes would be necessary. However, the visual changes to the landscape in the surrounding relatively undeveloped, flat, and treeless natural setting would be noticeable. Building a cluster of industrial buildings in a rural area with few previously established industrial or urban lands could noticeably alter scenic vistas extending long distances into the mostly flat and treeless landscape. The applicant notes that building the project could noticeably alter views from U.S. Route 20 as it passes through what is now a rural area with an undisturbed natural appearance (Kairos 2023-TN8172 │ Sec 5.4.1.1.2).

Air emissions would be the same as those described for the proposed site in Oak Ridge in Section 3.2 of this EIS and low enough to be offset by mitigation, and below the threshold required for Class I area modeling (Kairos 2023-TN8172 │ Sec 5.4.1.2.1). Noise generation would be at levels indicated for the same facilities on the proposed site in Oak Ridge, as described in Section 3.2 of this EIS, but the applicant expects the noise generated at the Eagle Rock site to be imperceptible to the nearest residence, which is approximately 4.8 mi away (Kairos 2023-TN8172 │ Sec 5.4.1.2.2). The NRC staff expects that the noise is unlikely to disturb residents living at that distance. The applicant proposes to use best management practices to minimize adverse impacts on soils and other landscape features (Kairos 2023-TN8172 │ Sec 5.4.1.3). Building the new facilities would not involve physical disturbance of any surface water features, wetlands, or floodplains (Kairos 2023-TN8172 │ Sec 5.4.1.4.1). The applicant would have to develop groundwater supply wells, although usage rates would be substantially below the annual water right appropriation (Kairos 2023-TN8172 │ Sec 5.4.1.4). Municipal water sources and municipal wastewater treatment facilities are not available.

Loss and disruption of sagebrush steppe habitat and other natural vegetation within the 95 ac subject to temporary disturbance could noticeably affect wildlife (Kairos 2023-TN8172 │ Sec 5.4.1.5.2). Unlike at the proposed site in Oak Ridge, ground disturbance at the Eagle Rock site would not be limited to soils previously graded and used for previous industrial development. Grading could disturb four archaeological sites located on the Eagle Rock site and possibly other uncharacterized archaeological sites (Kairos 2023-TN8172 │ Sec 5.4.1.6). Unlike at the proposed site in Oak Ridge, soils on the Eagle Rock site have not been previously graded and disturbed for past industrial development. Site preparation therefore has a greater potential to disturb subsurface archaeological resources.

For certain resource areas, the environmental impacts during construction at the Eagle Rock site would resemble those at the proposed site in Oak Ridge, as presented in Section 3.0. Nonradiological and radiological human health (Section 3.8 of this EIS) and nonradiological waste management (Section 3.9 of this EIS) would have similar construction impacts. The

applicant would control nonradiological and radiological hazards to human health during construction in compliance with applicable regulations and standards (Kairos 2023-TN8172 │ Sec 5.4.1.8). There are no low-income populations subject to consideration as potential environmental justice communities of concern within 5 mi of the Eagle Rock site (Kairos 2023-TN8172 │ Sec 5.4.1.10), and hence there is no potential for environmental justice impacts.

4.2.2.3 Environmental Consequences of Operation

As would also be true for the proposed site in Oak Ridge, approximately 30 ac of land at the Eagle Rock site would remain permanently in industrial use over the four-year operational life of the proposed Hermes facilities (Kairos 2023-TN8172 │ Sec 5.4.1.1.1). There would be no further visual changes to the site resulting from operation of the proposed facilities, and there would be no additional physical disturbance to natural habitats or subsurface cultural resources. Water usage for operations at the proposed site in Oak Ridge would generally be in quantities indicated in the Section 3.3 of this EIS, but the water supply would be obtained from onsite groundwater wells, remaining substantially below the annual water right appropriation (Kairos 2023-TN8172 │ Sec 5.4.1.4.2). According to the applicant, sanitary wastewater and nonradiological liquid waste generated over the life cycle of the Hermes facilities if built at the Eagle Rock site would be handled by portable systems or discharged to a yet to be constructed municipal wastewater treatment facility, and stormwater would be collected in a lined retention basin where it would ultimately evaporate (Kairos 2022-TN7902).

Air emissions due to operation of the Hermes facilities would be as described for the proposed site in Oak Ridge and be low enough to be offset by mitigation, and below the threshold for required Class I area modeling (Kairos 2023-TN8172 │ Sec 5.4.1.2.1). Noise would be as described for the proposed site in Oak Ridge, but is expected to be imperceptible to the nearest residence, which is approximately 4.8 mi away (Kairos 2023-TN8172 │ Sec 5.4.1.2.2). Operation of the proposed Hermes facilities would constitute only a very small portion of the total employment in the area surrounding the Eagle Rock site (Kairos 2023-TN8172 │ Sec 5.4.1.7.1). Occupational hazards and nonradiological and radiological sources, wastes, and effluents would be controlled in compliance with applicable regulations and standards (Kairos 2023-TN8172 │ Sec 5.4.1.8).

The environmental impacts during operations at the Eagle Rock site would be similar to those at the proposed site in Oak Ridge, as presented in Section 3.0 of this EIS. During operations, the nonradiological and radiological human health (Section 3.8 of this EIS), nonradiological \\waste management (Section 3.9 of this EIS), uranium fuel cycle and radiological wastes (Section 3.10 of this draft EIS), and accidents (Section 3.12 of this EIS) would have impacts at the Eagle Rock site similar to those at the proposed site in Oak Ridge. Regarding transportation of radioactive material, the NRC staff recognizes that the Eagle Rock site is in a different geographic region of the continental United States. However, the transportation analysis in Section 3.10 of this EIS for the proposed site in Oak Ridge would still bound the transportation impacts for the Eagle Rock site, if one applies the same assumptions (e.g., that fresh TRI-structural ISOtropic [TRISO] high-assay low-enriched uranium fuel is shipped from the farthest NRC-licensed fuel fabrication facility, the BWX Technologies, Inc. fuel fabrication facility in Lynchburg, VA, located at a distance of approximately 2,200 mi). The analysis would still be bounding for shipping shorter distances (e.g., shipping waste from the Eagle Rock site in Idaho to the Energy*Solutions* low-level radioactive waste [LLRW] disposal site in the adjacent state of Utah, or to the LLRW disposal site of Waste Control and Storage Services in Texas, a distance of approximately 1,200 mi). As discussed previously in this EIS, there would be no potential for environmental justice impacts based on the operation of the Hermes facilities.

4.2.2.4 Environmental Consequences of Decommissioning

The NRC staff expects that decommissioning of the Hermes facilities at the Eagle Rock site would proceed as described for decommissioning the same facilities at the proposed site in Oak Ridge. The staff expects that potential environmental impacts would generally resemble those described for the construction phase of the project. The staff recognizes that additional land disturbance outside of the 30 ac used during operations would be necessary during decommissioning. However, the staff believes that the additional disturbance could be readily accommodated by the remainder of the site, most likely within the 95 ac of land previously subjected to temporary disturbance during construction. For the reasons stated above for construction, there would be little potential for additional disturbance of ecological resources or subsurface cultural resources.

Potential impacts from transportation of radioactive material during decommissioning would also be bounded by the transportation impacts, as described in Section 3.10 of this EIS, because the LLRW disposal sites are closer to the Eagle Rock site than the proposed site in Oak Ridge. The Eagle Rock site is approximately 300 mi from the Energy*Solutions* LLRW disposal site and approximately 1,200 mi from the Waste Control and Storage Services LLRW disposal site, compared to 1,860 mi and 1,200 mi between the proposed site in Oak Ridge and each LLRW disposal site, respectively. This also holds true for the shipments of spent TRISO fuel, as these shipments would be going into the adjacent state of Nevada rather than being shipped across the United States from the proposed site in Oak Ridge.

The NRC staff expects that decommissioning impacts on most other environmental resources would be bounded by the analyses in the Decommissioning GEIS (NRC 2002-TN7254). The generic EIS concludes that impacts from decommissioning nuclear power facilities on aesthetics (including visual resources), water resources, air quality, noise, socioeconomics, human health (radiological and occupational), and transportation are typically SMALL (at most minimal) (NRC 2002-TN7254). It concludes that decommissioning impacts on land use, ecology (including threatened and endangered species), and cultural resources are typically minimal within areas used during operations; but it does not reach a conclusion regarding impacts on those resources outside of the operational area. However, the NRC staff expects that most of the effects on land use, ecology, and cultural resources from decommissioning would generally be confined to areas previously affected by site preparation. It also does not reach a generic conclusion regarding environmental justice. But as noted for construction, there are no low-income populations subject to consideration as potential environmental justice communities of concern within 5 mi of the Eagle Rock site (Kairos 2023-TN8172 │ Sec 5.4.1.10), and hence there are no potential environmental justice impacts.

4.2.2.5 Cumulative Impacts

The Eagle Rock site is located in a sparsely populated rural area where past and present environmental impacts are largely limited to agriculture and ranching. Table 5.4-20 of the ER identifies three reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts of the Hermes project if it were sited at the Eagle Rock location (Kairos 2023-TN8172). These include two transmission line projects and the proposed Carbon-Free Power Project (CFPP) at the Idaho National Laboratory in Idaho Falls. The NRC staff recognizes that the environmental impacts from these other major projects might be noticeable in the context of their immediate surroundings. However, the staff finds that the incremental effects of the Hermes project added to the effects of these other proposed projects would be minimal for each environmental resource, except for visual resources, ecological, and cultural

resources. The cumulative adverse visual effects of the Hermes project when combined with the CFPP and new transmission lines could be noticeable in the flat, largely treeless landscape with no substantial prior industrial or urban development. Similarly, the combined loss of sagebrush and other terrestrial habitats and combined disturbance of subsurface cultural resources from building the Hermes project at the Eagle Rock site and from the other nearby major projects could be noticeable.

4.2.2.6 Conclusions

Based on the analysis presented above, the NRC staff concludes that the potential direct, indirect, and cumulative impacts of construction, operation, and decommissioning the Hermes project at the Eagle Rock site would be SMALL for each environmental resource considered, with the exceptions that the visual, ecological, and cultural resource impacts from the construction would be MODERATE. Building even a small industrial project in a rural, treeless, flat landscape that has no previous industrial or urban development could noticeably alter the area's visual characteristics. Clearing sagebrush steppe vegetation could affect increasingly rare wildlife species dependent on this specialized habitat, such as the greater sage grouse (*Centrocercus urophasianus*). Grading previously undisturbed soils such as those at the Eagle Rock site could disturb archaeological resources. Otherwise, the small size and limited land disturbance of the Hermes project, abundance of land on the Eagle Rock site, presence of similar land cover in the surrounding rural area, low employment levels and water demands of the Hermes project, and absence of sensitive natural and hydrological features at the site suggest that implementing the project at the Eagle Rock site would have at most minimal adverse environmental impacts. Furthermore, although rural and remote, the Eagle Rock site is still proximate to the City of Idaho Falls and the Idaho National Laboratory, a DOE facility with technical staff and capabilities much like those in Oak Ridge.

4.3 Cost-Benefit of the Alternatives

As required by 10 CFR 51.71(d) (TN250), an EIS must include "a consideration of the economic, technical, and other benefits and costs of the proposed action and alternatives." A principal objective of NEPA is to require each Federal agency to consider, in its decision-making process, the environmental impacts of each proposed major action and the available alternative actions. Specifically, Section 102 of NEPA (TN661) requires all Federal agencies to the fullest extent possible to:

> (B) identify and develop methods and procedures, in consultation with the Council on Environmental Quality established by Title II of this Act, which will ensure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations (TN661).

However, neither NEPA nor the Council on Environmental Quality requires the costs and benefits of a proposed action or alternatives to be quantified in dollars or any other common metric. The purpose of this section is not to identify and quantify all the potential societal benefits and compare them to the potential costs of the proposed actions and alternatives. Instead, this section focuses only on those benefits and costs of such magnitude or importance that their inclusion in this analysis can inform the decision-making process. This section compiles and compares the pertinent analytical conclusions reached in earlier chapters of this EIS.

4.3.1 Benefits

In most cases, the most apparent benefit of the construction and operation of a nuclear power plant is that it generates power for thousands of residential, commercial, and industrial customers. However, the proposed Hermes project is planned as a demonstration project only and would not produce electricity. Consequently, the benefits from approval of the Hermes application include the following:

- Proof of concept: Once the test reactor is up and running, the Hermes project would be able to stimulate commercial interest in a new nuclear technology.
- Mass production of many of the components of the reactor may provide "off the shelf" standardized components that could over time potentially help reduce the cost of construction and maintenance, making the full-sized KP-FHR cost-competitive with other generation methods, such as natural gas generation, in the U.S. market.
- Nuclear power is inherently carbon-free power, which would aid in achieving the United States' climate change goals.
- Some limited economic stimuli would come from project-related incomes during the construction, operation, and decommissioning of the proposed project. However, the small scale of the construction crew (less than 500 workers) and operations crew (less than 100 workers), and the fact that most of the skills needed for construction and operations are available locally, indicate that any increase in tax revenues derived from the proposed project would be minimal and relatively short termed (6 years from groundbreaking to cessation of operations).

4.3.2 Costs

The Hermes reactor is a scaled down KP-FHR, which is an advanced reactor technology that leverages TRISO fuel in pebble form combined with a low-pressure fluoride-lithium-beryllium (Flibe) salt coolant. The applicant won $303 million in funding from the DOE's Advanced Reactor Demonstration Program to build a prototype (NEI 2021-TN7970). The Hermes reactor would produce 35 megawatts thermal (MWt) but would not produce any commercially valued product, such as electricity. Consequently, this cost analysis acts as a placeholder for any future submittal by Kairos that includes more detailed cost estimates.

Land use costs include approximately 185 ac of land, of which the applicant identifies about 30 ac as "permanently disturbed for operations of the facility" (Kairos 2023-TN8172). No offsite lands would be disturbed or used, considering that the purpose of the project does not include transmission of electrical power, or the need for any pipelines or access roads. Because the proposed area of disturbance comprises previously disturbed soils and ruderal vegetation only, ecological costs and costs to cultural resources would be minimal.

As described in Section 3.2 of this EIS, emissions from diesel generators, equipment, and vehicles to the air would have a minimal impact on workers and residents. Emissions sources would be operated intermittently and would be managed in accordance with Federal, State, and local air quality limits. The NRC staff expects negligible impacts from sulfur dioxide, nitrogen oxide, carbon monoxide, carbon dioxide, and particulate matter, relative to other activities in the Oak Ridge area.

4.3.3 Summary of Benefits and Costs

On the basis of the assessments summarized in this EIS, the NRC staff concludes that building, operating, and decommissioning the proposed Hermes reactor (with the appropriate mitigation measures identified by the NRC staff), would have accrued benefits that most likely would outweigh its economic, environmental, and social costs. The staff draws this conclusion regardless of whether the project is sited at the proposed site in Oak Ridge or at the Eagle Rock site.

4.4 Comparison of the Potential Environmental Impacts

Table 4-1 tabulates the NRC staff's conclusions regarding the significance of potential environmental impacts for each environmental resource affected by each alternative evaluated in detail in this EIS. Each conclusion presented in the table is inclusive of direct, indirect, and cumulative impacts and reflects the full life cycle of the Hermes project, including construction, operation, and decommissioning. Potential environmental impacts from the no action alternative and the proposed action would be SMALL for each environmental resource identified for evaluation in this EIS. Potential environmental impacts from the Eagle Rock alternative would be SMALL for most environmental resources but would be MODERATE for land use and visual resources, ecological resources, and historic and cultural resources. These MODERATE conclusions reflect the fact that building the proposed Hermes facilities at the Eagle Rock site would require disturbance of soils supporting natural vegetation and potentially containing subsurface archaeological resources. Additionally, the visual appearance of the Hermes facilities could be noticeably intrusive in the rural setting of the Eagle Rock site. In contrast, building the Hermes facilities at the Oak Ridge site under the proposed action would disturb only soils previously disturbed by past industrial development of the now-razed ORGDP and would take place within an existing industrial park (the Heritage Center in the East Tennessee Technology Park) that already contains industrial infrastructure and buildings.

Table 4-1 Comparison of Cumulative Environmental Impacts for Alternatives Evaluated in Detail

Resource	No Action	Proposed Action (Oak Ridge Site)	Alternative Action (Eagle Rock Site)
Land use and visual resources	SMALL	SMALL	MODERATE
Air quality and noise	SMALL	SMALL	SMALL
Geological environmental and water resources	SMALL	SMALL	SMALL
Ecological resources	SMALL	SMALL	MODERATE
Historic and cultural resources	SMALL	SMALL	MODERATE
Socioeconomics	SMALL	SMALL	SMALL
Environmental justice	SMALL	SMALL	SMALL
Human health	SMALL	SMALL	SMALL
Nonradiological waste	SMALL	SMALL	SMALL
Fuel Cycle and radiological waste management	SMALL	SMALL	SMALL
Transportation	SMALL	SMALL	SMALL
Accidents	SMALL	SMALL	SMALL

Based on the analysis presented above, and the significance conclusions presented in Table 4-1, the NRC staff concludes that there are no environmentally preferrable alternatives to the proposed action that meet the purpose and need of the proposed licensing action. Although the no action alternative might avoid some of the impacts described for the proposed action in

Section 3.0, the no action alternative would not meet the purpose and need for the Hermes project. Furthermore, the analyses in Section 3.0 demonstrate that none of the impacts from the proposed action would be greater than SMALL, thus avoidance of the impacts would not be substantially preferable from an environmental perspective. Because the NRC staff did not identify any environmentally preferrable alternatives that meet the purpose and need of the proposed action, the staff concludes that there are no obviously superior alternatives to the proposed action from an environmental perspective.

5.0 CONCLUSIONS AND RECOMMENDATIONS

This environmental impact statement (EIS) describes the environmental review conducted by U.S. Nuclear Regulatory Commission (NRC) staff for a Kairos Power, LLC (Kairos) application for a construction permit (CP) under Title 10 of the *Code of Federal Regulations* Part 50 (TN249) that would allow construction of the Hermes non-power test reactor facilities on a 185 acre (ac) site within the Heritage Center Industrial Park (Heritage Center) in Oak Ridge, Tennessee. This EIS follows the requirements in 10 CFR Part 51 (TN250), which are the NRC's regulations that implement the National Environmental Policy Act of 1969 (NEPA, TN661). This section presents conclusions and recommendations based on the NRC staff's environmental review of the CP application. Section 5.1 summarizes the environmental impacts from construction, operation, and decommissioning of the Hermes project. Section 5.2 compares the environmental impacts of the proposed action against reasonable alternatives identified by the NRC staff. Section 5.3 discusses the unavoidable impacts of the proposed action and identifies resource commitments. Section 5.4 presents the NRC staff's conclusions and recommendations.

5.1 Environmental Impacts of the Proposed Action

As indicated in Section 1.1 of this EIS, the proposed action is the NRC issuing a CP to Kairos authorizing construction of the proposed Hermes non-power test reactor facilities on a site in the Heritage Center in Oak Ridge, Tennessee. Section 1.2 presents the purpose and need of the Federal action, which is to demonstrate key technology of the Kairos Power Fluoride Salt-Cooled, High Temperature Reactor for possible future deployment. Section 3.0 of this EIS summarizes the direct, indirect, and cumulative impacts from construction, operation, and decommissioning the proposed Hermes facilities on the proposed site. As indicated in that section, the NRC staff concludes that the potential impacts from the proposed facilities would be SMALL for each potentially affected environmental resource. The staff based its conclusions on independent reviews of information provided in Kairos's application for the CP, including an Environmental Report (ER) and preliminary safety analysis report, as well as other relevant information sources. Table 5-1 summarizes the environmental impacts and the staff's conclusions for each resource considered.

Table 5-1 Summary of Environmental Impacts from Construction, Operation, and Decommissioning of Proposed Hermes Facilities

Resource Area	EIS Section	Summary of Impact	Impact Level
Land use and visual resources	3.1	Temporary disturbance of 138 ac of land previously occupied by industrial U.S. Department of Energy (DOE) buildings during construction and possibly during decommissioning. Permanent occupation of 30 ac of the same land. Limited land use options for the entire 185 ac Hermes site, which would be designated as an exclusion area throughout operation. The site is within an established industrial park. The setting is already industrial, and of low scenic quality. Facilities would have an industrial appearance compatible with an existing industrial park. The Hermes project is compatible with existing City of Oak Ridge zoning. Site has been remediated by DOE and privatized for industrial reuse, with restrictions.	SMALL

Table 5-1 Summary of Environmental Impacts from Construction, Operation, and Decommissioning of Proposed Hermes Facilities (Continued)

Resource Area	EIS Section	Summary of Impact	Impact Level
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 be used to 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 would be limited to previously disturbed soils. Best management practices (BMPs) would be employed for soil erosion and sediment control. Water demands would be met through municipal or commercial suppliers. There would be no use of groundwater and no direct use of surface water. No cooling towers, ponds, or reservoirs would be involved. Wastewater would be discharged for treatment to municipal wastewater treatment facilities. There would be limited, temporary dewatering of building excavations for construction. Dewatering water would be dispositioned in accordance with DOE requirements per the quit claim deed for the site. Stormwater would be managed using BMPs.	SMALL
Ecological resources	3.4	Ground disturbance would be limited to areas of previously disturbed soils that lack vegetation or support only ruderal early successional vegetation. There would be no disturbances to forest cover or other natural vegetation growing on natural soils, wetlands, surface waters, shorelines, or riparian lands. No Clean Water Act Section 404 permit would be required. BMPs would be used to control stormwater runoff that might reach wetlands or aquatic habitats. Localized, minor increases in noise may affect wildlife, but area wildlife already experience industrial noise. Limited potential exists for wildlife to collide with new structures or be injured by vehicles. The Federally endangered gray bat (*Myotis grisescens*) and Indiana bat (*M. sodalis*) and Federally threatened northern long-eared bat (*M. septentrionalis*) are known to occur in the Oak Ridge area and may forage transiently on the site, but no potential roosting or breeding habitat would be disturbed, and foraging individuals can be expected to avoid areas of human activity. On January 27, 2023 (NRC 2022-TN8156), the U.S. Fish and Wildlife Service (FWS) concurred with the NRC staff's conclusions drawn in Table 3-5 of this EIS regarding resources protected under the Endangered Species Act (Endangered Species Act of 1973-TN1010).	SMALL
Historic and cultural resources	3.5	No adverse effects to historic properties as none are known to exist in the direct effects area of potential effects (APE). Kairos is developing an Archaeological Resources Monitoring and Unanticipated Discovery Plan establishing stop work and notification procedures to address unexpected discovery of human remains or archaeological material in compliance with the Quitclaim deed	SMALL

Table 5-1 Summary of Environmental Impacts from Construction, Operation, and Decommissioning of Proposed Hermes Facilities (Continued)

Resource Area	EIS Section	Summary of Impact	Impact Level
		requirements and Tennessee State law. The National Register of Historic Places-eligible Manhattan Project National Historical Park is located in the indirect effects APE but will not be adversely affected, because the setting of the proposed Kairos project is in keeping with the current industrial setting of the Manhattan Project National Historical Park.	
Socioeconomics and environmental justice (EJ)	3.6	Construction of the Hermes project would involve an average of 212 site workers per year over a two-year period with an estimated peak of 425 workers. Staffing during the four-year operational phase would average 38 workers per weekday (68 full-time positions). Decommissioning would involve an estimated peak employment level of 340 workers. These 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 Hermes project and the distance of the site from the closest Census Blocks with populations meeting EJ criteria (over 8 miles [mi] away) indicate little potential for EJ effects.	SMALL
Human health	3.7	The site was formerly occupied by buildings that were part of the DOE Oak Ridge Gaseous Diffusion Plant used to enrich uranium, but DOE has already razed the buildings and remediated the site for unrestricted industrial reuse. DOE retains responsibility for remediation following any unanticipated discovery of legacy wastes. Based on information in the CP application, the NRC staff expects that 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). The applicant 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	Kairos would develop and implement a plan to manage wastes generated by the Hermes facilities. Management of solid waste, including construction and demolition wastes, would involve waste reduction efforts, recycling, and BMPs. Liquid wastes would be discharged for municipal treatment at a wastewater treatment plant or trucked offsite for proper disposal. Gaseous emissions would comply with Tennessee Department of Environment and Conservation regulations.	SMALL
Uranium fuel cycle and radiological	3.9	A low quantity of uranium would be used during the four-year operational period. TRI-structural ISOtropic (TRISO) fuel processes (including enrichment and fuel fabrication) are bounded by Table S-3 in 10 CFR 51.51 (TN250),	SMALL

Table 5-1 Summary of Environmental Impacts from Construction, Operation, and Decommissioning of Proposed Hermes Facilities (Continued)

Resource Area	EIS Section	Summary of Impact	Impact Level
waste management		developed by NRC to protect human health and the environment. Environmental impacts from the storage of spent TRISO fuel from Hermes is bounded by the analysis in the Continued Storage Generic EIS. The estimated volume of low-level radioactive waste (LLRW) is less than or comparable to that from a light water reactor, and the staff determined that there is adequate capacity at LLRW disposal sites and that LLRW sites would accept the LLRW from Hermes. Onsite storage of spent TRISO fuel would have to meet the same regulatory requirements as currently licensed light water reactors.	
Transportation	3.10	Transportation of radioactive fuels and wastes to and from Hermes would be performed in compliance with U.S. Department of Transportation and NRC regulations and constitute only a small percentage of the total materials of these types shipped each year.	SMALL
Accidents	3.11	The NRC staff is conducting an independent review of the consequences of accidents and has documented it in its Safety Evaluation (SE). To receive a CP, the Hermes test reactor would have to meet the NRC requirements for postulated accidents, where potential doses at the exclusion area boundary and in the low population zone are below the dose reference values of 10 CFR Part 100 (TN282) for test reactor siting. Additionally, as another indication of the low-level of environmental impacts, the nearest resident dose from accidents is also below the radiation dose limits for individual members of the public in 10 CFR 20.1301(a) (TN283).	SMALL

5.2 Comparison of Alternatives

In Section 4.0 of this EIS, the NRC staff considered two alternatives to construction, operation, and decommissioning of the proposed Hermes facilities at the proposed site in the Heritage Center in Oak Ridge, Tennessee:

- the no action alternative; and
- construction, operation, and decommissioning of the Hermes facilities at a site in Eagle Rock, Idaho (the Eagle Rock alternative).

The NRC staff independently reviewed information concerning other potential alternatives, including other alternative sites, and determined that there were no other reasonable alternatives warranting detailed evaluation. Because the Hermes project is designed to test a specific energy generation technology, alternatives involving other energy generation processes would not meet the project's purpose and need and hence were not analyzed in detail. Table 4-1 presents the staff's conclusions about the no action alternative, proposed action, and Eagle Rock alternative. The staff concluded that environmental impacts from the no action alternative and the proposed action would both be SMALL. The staff concluded that impacts on many environmental resources from the Eagle Rock alternative would likewise be SMALL, but impacts on land use and visual resources, ecological resources, and historic and cultural

resources would be MODERATE. Building the Hermes facilities at the proposed site in Oak Ridge would introduce new industrial buildings to a previous industrial site within an existing industrial park of low aesthetic quality, whereas building the same facilities at the Eagle Rock site would introduce new industrial buildings to an open rural landscape free of previous urban encroachment. The new industrial buildings would noticeably alter the visual character of the existing open rural Idaho landscape. Furthermore, while land disturbance to build the Hermes facilities at the proposed site in Oak Ridge would be confined to areas of previously disturbed soils within the footprint of former industrial development, building the Hermes facilities at the Eagle Rock site would involve disturbance of natural vegetation, possibly including shrub-steppe vegetation, and natural soils known to contain subsurface archaeological resources. These disturbances would noticeably degrade the quality of existing ecological and cultural resources present on the site and possibly affect those qualities in the surrounding region.

The no action alternative would not meet the purpose and need identified for the Hermes project, as presented in Section 1.0 of this EIS. Of the alternatives considered that would meet the purpose and need for the Hermes project, the proposed action would result in fewer environmental impacts than the Eagle Rock alternative and is therefore the environmentally preferrable alternative. The proposed site, which is the former location of two large industrial buildings that have been razed and the land remediated to allow industrial reuse, offers an opportunity to build new industrial buildings without disturbing sensitive natural or cultural resources or introducing industrial activity to areas lacking an industrial presence.

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 EIS.

5.3.1 Unavoidable Adverse Environmental Impacts

NEPA Section 102(2)(C)(ii) (TN661) requires that an EIS include information about any adverse environmental effect that cannot be avoided if the proposal is implemented. Unavoidable adverse impacts are predicted adverse environmental impacts that cannot be avoided and that have no practical means of further mitigation. The applicant addresses unavoidable adverse environmental impacts in Section 6.1 of the ER (Kairos 2023-TN8172) and summarizes the unavoidable impacts and proposed mitigation in Tables 6.1-1 and 6.1-2 of the ER (Kairos 2023-TN8172).

As noted in Section 3.0 of this EIS, the NRC staff concluded that impacts on all resources from construction, operation, and decommissioning of the Hermes facilities at the proposed site would be SMALL. 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 impacts from construction, operation, and decommissioning of the proposed Hermes facilities in Table 5-2, including mitigation and control measures intended to lessen adverse effects. Unless noted otherwise, the mitigation measures presented in Table 5-2 are taken from Section 6.1 of the applicant's ER, including Tables 6.1-1 and 6.1-2 (Kairos 2023-TN8172).

Table 5-2 Unavoidable Adverse Environmental Impacts for Kairos Hermes Project

Resource Area	Unavoidable Adverse Impact	Mitigation Measures
Land use and visual resources	Approximately 30 ac of unbuilt industrial land would be occupied from initiation of construction through decommissioning. An additional 108 ac may be temporarily occupied during construction and decommissioning. Limited land use options exist for the entire 185 ac Hermes site, which would be designated as an exclusion area throughout operation. New industrial buildings could be distantly visible from some nearby parks and residences.	Lands temporarily disturbed for parking or staging would be restored with native plants or landscaping when no longer needed (Kairos 2023-TN8172 | Sec 6.1.1). The applicant would establish fencing, retain trees near the site perimeter, and install landscaping (Kairos 2023-TN8172 | Sec 6.1.2 and Table 6.1.1). BMPs would control erosion and runoff (Kairos 2023-TN8172 | Table 6.1.1). The applicant would have to comply with City of Oak Ridge zoning ordinances.
Air quality and noise	Emissions of criteria pollutants would be below 100 TPY and hazardous air pollutants below 10 TPY individually and 25 TPY combined. Fugitive dust releases would be possible during site preparation and decommissioning. Temporary, localized noise would be generated by some construction equipment.	BMPs would control dust (Kairos 2023-TN8172 | Table 6.1.1). Construction equipment and vehicles would be properly maintained (Kairos 2023-TN8172 | Sec 6.1.1). Post speed limits, traffic controls, and administrative measures such as staggered shift hours to reduce traffic noise would be implemented (Kairos 2023-TN8172 | Sec 6.1.1 and Table 6.1.1).
Hydrogeology and water resources	Minor demands for water would be met through municipal or commercial suppliers. Limited, temporary dewatering would be necessary for the pit excavated to build the test reactor building. Stormwater would be managed using BMPs.	BMPs would be used to manage stormwater and control erosion and runoff (Kairos 2023-TN8172 | Table 6.1.1). The applicant would develop and implement a stormwater pollution prevention plan (Kairos 2023-TN8172 | Sec 6.1.2). Water from dewatering processes would be disposed of in accordance with DOE requirements established in the deed to the site (Kairos 2022-TN7902).
Ecological resources	Localized, minor increases in noise that may affect wildlife in surrounding areas of existing industrial park. Limited potential exists for wildlife to collide with new structures or be injured by vehicles. Exposed soils create the potential for sedimentation of aquatic habitats.	No mitigation is proposed with respect to wildlife. BMPs would control runoff and sedimentation of aquatic habitats adjoining the site (Kairos 2023-TN8172 | Table 6.1.1).

Table 5-2 Unavoidable Adverse Environmental Impacts for Kairos Hermes Project (Continued)

Resource Area	Unavoidable Adverse Impact	Mitigation Measures
Historic and cultural resources	There is a potential for deeply buried archaeological deposits to be encountered during excavation.	Development of an Archaeological Resources Monitoring and Unanticipated Discovery Plan would establish stop work and notification procedures to address unexpected discoveries of human remains and archaeological material (Kairos 2023-TN8172 | ER Sec 4.6.1 and Kairos 2022-TN7902).
Socioeconomics and EJ	Construction would involve an average of 212 site workers per year over a two-year period, with an estimated peak of 425 workers. Staffing during the four-year operational period would average 38 workers per weekday (68 full-time positions). Staffing during the four-year operational period would average 38 workers per weekday (68 full-time positions). Little potential exists for EJ effects.	No mitigation proposed.
Human health	Potential exists for physical and chemical hazards typical of any industrial facility. Workers and members of the public entering the Hermes facilities could be exposed to radiation.	BMPs would control human exposure to dust (Kairos 2023-TN8172 | Table 6.1.1). Site-specific training of workers would minimize potential for injuries (Kairos 2023-TN8172 | Table 6.1.1). The NRC staff expects that the applicant would implement normal safety practices contained in Occupational Safety and Health Administration regulations in 29 CFR Part 1910 (TN654).
Nonradiological waste management	Hermes would be a small quantity generator of hazardous waste.	The applicant would implement recycling and reuse programs (Kairos 2023-TN8172 | Table 6.1.1).
Uranium fuel cycle and radiological waste management	A low quantity of uranium would be used during the four-year operational period. TRISO fuel processes (including enrichment and fuel fabrication) are bounded by Table S-3 in 10 CFR 51.51 (TN250), developed by NRC to protect human health and the environment. The estimated volume of LLRW is less than or comparable to that from a nuclear power plant, and the staff determined that there is adequate capacity at LLRW disposal sites and that LLWR sites would accept the LLRW from Hermes.	Onsite storage of spent TRISO fuel must meet the same regulatory requirements as currently licensed light water reactors.

Table 5-2 Unavoidable Adverse Environmental Impacts for Kairos Hermes Project (Continued)

Resource Area	Unavoidable Adverse Impact	Mitigation Measures
Transportation	Transportation of radioactive fuels and wastes to and from Hermes would be performed in compliance with U.S. Department of Transportation and NRC regulations and would constitute only a small percentage of the total materials of these types shipped each year.	No mitigation measures proposed.
Accidents	The NRC staff is conducting an independent review of the consequences of accidents and has documented it in its SE. Additionally, as another indication of the low level of environmental impacts, the nearest resident dose from accidents is also below the radiation dose limits for individual members of the public as mentioned in 10 CFR 20.1301(a) (TN283).	To receive a CP, the Hermes test reactor would have to meet the NRC requirements for postulated accidents, where potential doses at the exclusion area boundary and in low population zone are below the dose reference values of 10 CFR Part 100 (TN282) for test reactor siting.

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

The construction, operation, and decommissioning of the proposed Hermes facilities under the proposed action would result in short-term uses of environmental resources. "Short-term" is the period of time during which construction, operation, and decommissioning activities would take place. As noted in Section 2.0 of this EIS, Kairos plans to begin construction as early as 2023 (Kairos 2023-TN8172 │ Sec 2.1) with an operational life of four years (Kairos 2022-TN7881). While the applicant indicates that decommissioning would commence once the facilities reach the end of their licensed life (Kairos 2023-TN8172 | Sec 2.1), the applicant does not indicate how long decommissioning would take. Applicants for the licensing of new reactors typically do not develop a plan for decommissioning when applying for CPs and/or operating licenses.

As indicated in Section 3.1 of this EIS, construction, operation, and decommissioning of the proposed Hermes facilities would require the short-term use of approximately 30 ac of industrial land over the life of the project. This land would not be available for other uses during that time but could be available for other uses after decommissioning. Construction would require the temporary use of as much as 108 ac of additional previously used industrial land, and decommissioning may require the temporary use of all or part of the additional land for a second time. This additional land may be available for other uses beyond construction and decommissioning. The applicant has designated the entire 185 ac Hermes site as the exclusion area (Kairos 2023-TN8398 │ Sec 2.1.1), within which it would have to limit land uses during operation to ensure that no significant hazards to public health and safety are possible (10 CFR Part 100-TN282). As indicated in Sections 3.1 and 3.5 of this EIS, the new facilities might be distantly visible over the life of the Hermes project from nearby parks and residential areas, but they would be part of a cluster of existing and new industrial facilities that are also part of the East Tennessee Technology Park Heritage Center. Once the new facilities are razed as part of decommissioning, they would no longer be visible.

As indicated in Sections 3.2 and 3.7 of this EIS, air emissions from construction, operation, and decommissioning of the Hermes facilities would introduce small amounts of criteria pollutants, greenhouse gas emissions, hazardous air pollutants, and radiological emissions at the facility site. However, such 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. Emission levels will be below all regulatory thresholds for major sources. Noise emitted by construction, operation, and decommissioning activities would increase the ambient noise levels onsite and in adjacent offsite areas. However, increases in noise levels are not expected to be noticeable, other than for temporary periods during construction and decommissioning. Any noticeable increases in noise levels would be brief and temporary.

As indicated in Section 3.3 of this EIS, the Hermes project would require the use of only small quantities of water, supplied by municipal or commercial sources, which would not even place short-term substantial demands on surface water or groundwater resources. As explained in Section 3.4 of this EIS, unlike projects that require the conversion of natural habitat to urban land uses, thereby displacing wildlife and reducing the availability of wildlife habitat over the life of the project, the Hermes project would be limited to empty but previously developed land that still retains foundation rubble and other industrial features from previous Department of Energy (DOE) uses. Any short-term ecological effects would be minor and cease prior to completion of decommissioning.

Increased employment, expenditures, and tax revenues generated during construction, operation, and decommissioning activities directly benefit local, regional, and State economies over the short term. As noted in Section 3.10 of this EIS, worker vehicles and the 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 Oak Ridge and the surrounding areas. But these demands and traffic increases would be short-term and expected during peak construction and decommissioning activities and during work shifts. Therefore, these demands and traffic increases would not affect long-term productivity.

As indicated in Sections 3.7 and 3.8 of this EIS, management and disposal of low-level radioactive waste, 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. The contribution of Hermes to these reductions would be minimal.

While the uses of, and impacts on, environmental resources would be minimal over the short term, the long-term benefits from implementation of the Hermes project could be substantial. Operation of the Hermes facilities could help demonstrate the commercial viability of the Kairos Power Fluoride Salt-Cooled High Temperature (KP-FHR) technology and may generate data helpful in future commercial deployment of the technology. Successful future deployment of the technology could help the United States develop another economically viable source of energy and help the nation meet its climate change objectives. Use of the technology may help the United States meet its 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 impact on landscapes and seascapes and physical injury to terrestrial or aquatic wildlife.

5.3.3 Irreversible and Irretrievable Commitment of Resources

This section describes the irreversible and irretrievable commitment of resources that have been noted in this EIS. Resource losses or degradation are irreversible when primary or secondary impacts limit future options for a 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 construction, operation, and decommissioning of a non-power test reactor facility such as Hermes include the commitment of water, energy, raw materials, and other natural and human-made resources. In general, the commitment of capital, energy, labor, and material resources for a project such as Hermes are also irreversible.

Building, operating, and decommissioning the proposed Hermes facility at the proposed site in Oak Ridge, Tennessee (proposed action), or at the alternative Eagle Rock site near Idaho Falls, Idaho (alternative action considered in detail in this EIS), would entail the irreversible and irretrievable commitment of energy, water, chemicals, fossil fuels, and other natural and human-made resources. Building the Hermes facilities at either site would consume concrete, structural steel, steel sheet pilings, precast piles, precast panels, asphalt, stone, roofing/siding, and temporary tent structures, as quantified by the applicant in Table 2.1-1 of the ER (Kairos 2023-TN8172). These materials would be irretrievable unless Kairos recycles them during decommissioning (e.g., finds another facility to use such materials). Any disturbance of the buried 1949 surface or deeply buried paleosols that could contain archaeological deposits has a potential to affect historic and cultural resources. Historic and cultural resources, especially archaeological sites, are sensitive to ground disturbance and are nonrenewable. However, Kairos is developing Archaeological Resources Monitoring and Unanticipated Discovery Plan that would establish stop work and notification procedures to address unexpected discoveries of human remains and archaeological material.

During operation, the reactor core would be fueled using 4 centimeter (cm) diameter graphite pebbles with embedded coated TRISO particle fuel, with each particle comprising a uranium fuel kernel with a maximum uranium enrichment of 19.55 wt% (Kairos 2023-TN8172 │ Sec 2.3). The availability of uranium ore and existing uranium stockpiles, including downblending of highly enriched uranium, in the United States and from foreign sources (e.g., Australia and Canada) that could be processed into fuel is sufficient to support the operation of the Hermes test reactor (WNA 2022-TN7971). Thus, the irreversible and irretrievable commitment of the quantity of uranium (0.93 metric tons [MT] of uranium) to be used in the Hermes test reactor would have a negligible impact on United States uranium supplies. Over the anticipated four-year operational period, the applicant estimates that 155,200 used TRISO pebbles would be produced as waste (Kairos 2022-TN7881 │ Sec 2.6.1.2.4). These used TRISO fuel pebbles would be an irretrievable use of fuel and would not be available to fuel other advanced reactors.

As described in Section 3.3 of this EIS, the water demands of the Hermes facilities at either site would be minimal and readily met by municipal and commercial sources. These water resources are readily available at both sites, and the amounts required are not expected to deplete available supplies or exceed available system capacities. As described in Section 3.4 of this EIS, a small number of birds and other wildlife could be killed or injured by collision with the Hermes structures or collision with vehicles used on either site or by workers traveling to either site. These losses of wildlife would be minor in terms of irreversibly affecting wildlife populations in the surrounding area, and any affected populations can be expected to subsequently recover. As noted in Section 4.2.2 of this EIS, building the Hermes facilities at the Eagle Rock site would disturb approximately 95 ac of cropland, sagebrush, pasture, and upland

grasslands, including some prime farmland. Although the affected land could be restored to rural uses after the Hermes project, some of the desirable ecological properties of the sagebrush and agricultural quality of the prime farmland soils may not be fully restorable, and hence would be irreversible. Irreversible losses of natural habitat or agricultural land would not be a possibility at the proposed Oak Ridge site, because, as described in Section 3.4 of this EIS, soils within all of the land subject to disturbance for the Hermes project have been heavily disturbed by past industrial development and currently support only ruderal vegetation. Any disturbances to subsurface cultural resources at the Eagle Rock site could be irreversible.

As noted in Section 3.7 of this EIS, nonradiological irreversible commitments to occupational human health resources may occur. Such impacts would be similar to potential hazards that occur at any industrial construction site. Energy expended would be in the form of fuel for equipment, vehicles, and facility operation and electricity for equipment and facility operation. Electricity and fuel would be acquired from offsite commercial sources.

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 Recommendation

After weighing the environmental, economic, technical, and other benefits against environmental and other costs, and considering reasonable alternatives, the NRC staff recommends, unless safety issues mandate otherwise, that the NRC issue the CP to Kairos for the Hermes facility once the NHPA Section 106 process is complete. The NRC staff based its recommendation on the following:

- the NRC staff's review of Kairos's ER, information gathered during the environmental audit, and responses to requests for clarifying information;
- consideration of public comments received during the environmental review;
- the NRC staff's communications with, and comments received from, Federal, State, and local agencies, as well as Tribal officials; and
- the NRC staff's independent environmental review and assessment summarized in this EIS.

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APPENDIX A

CONTRIBUTORS TO THE ENVIRONMENTAL IMPACT STATEMENT

Members of the U.S. Nuclear Regulatory Commission (NRC) Office of Nuclear Material Safety and Safeguards (NMSS); Division of Rulemaking, Environmental, and Financial Support (REFS); and Environmental New Reactor Branch (ENRB) prepared this environmental impact statement (EIS). Staff from other NRC branches and from Pacific Northwest National Laboratory (PNNL) provided supplemental technical support and technical editing. Table A-1 below identifies each contributor's name and affiliation, summary of education and experience, and indication of function or expertise contributed to the document.

Table A-1 List of Preparers

Name & Affiliation	Education/Experience	Function or Expertise
Anderson, David PNNL	M.S. Forest Resources B.S. Forest Resources 30 years of relevant experience	Socioeconomics Environmental Justice Cost-Benefit Analysis
Barnhurst, Daniel NRC	B.S. Environmental Geology M.S. Geology 16 years of relevant experience	Project Management
Carlon, Teresa PNNL	B.S. Information Technology 25 years of relevant experience	Reference Coordinator
Casto, Mary NRC	B.S. Environment & Natural Resources 1 year of relevant experience	Licensing Support
Davis, Jennifer NRC	B.A. Historic Preservation & Classical Civilization (Archaeology) 20 years of relevant experience	Historic and Cultural Resources
Day, Justin PNNL	M.S. Library and Information Science B.S. Chemistry/Writing 11 years of relevant experience	Comment Database
Doub, Peyton NRC	M.S. Plant Physiology B.S. Plant Sciences (Botany) Professional Wetland Scientist Certified Environmental Professional Duke NEPA Certificate 35 years of relevant experience	EIS Technical Lead Proposed Action Land Use Noise Ecology Nonradiological Health Cumulative Impacts Alternatives
Dozier, Tamsen NRC	M.S. Civil Engineering/Water Resources B.S. Civil Engineering Duke NEPA Certificate 22 years of relevant experience	Lead Environmental Project Manager
Ennor, Susan PNNL	B.A. Journalism 38 years of relevant experience	Technical Editing
Erwin, Kenneth NRC	M.S. Nuclear Engineering B.S. Nuclear Engineering 20 years of relevant experience	Branch Chief
Folk, Kevin NRC	M.S. Environmental Biology B.A. Geoenvironmental Studies 31 years of relevant experience	Audit Coordination

Table A-1 List of Preparers (Continued)

Name & Affiliation	Education/Experience	Function or Expertise
Giacinto, Joseph NRC	M.S. Hydrology B.S. Geology (Geophysics) Professional Geologist Duke NEPA Certificate 25 years of relevant experience	Geology Water Resources Climate Change
Glowacki, Brian NRC	B.S. Environmental Engineering 2 years of relevant experience	Comment Processing Licensing Support
Helvenston, Edward NRC	M.S. Environmental Engineering B.S. Nuclear Science and Engineering 4 years of relevant experience	Radiological Health Accidents
Kautzky, Kevin PNNL	B.S. English 20 years of experience in project management, stakeholder engagement, strategic communications, writing, editing, and document architecture	PNNL Deputy Team Lead, Comment Database
Kennedy, Ellen PNNL	M.A. Anthropology B.A. Historic Preservation & Anthropology 25 years of relevant experience	Historic and Cultural Resources
LaHaye, Nicole PNNL	Ph.D. Nuclear Engineering M.S. Nuclear Engineering B.S. Physics 5 years of relevant experience	PNNL Deputy Team Lead Comment Database
McFarland, Douglas PNNL	M.S. Cultural Resource Management B.S. Anthropology Registered Professional Archaeologist 25 years of relevant experience	Historic and Cultural Resources
Montgomery, Sadie A PNNL	B.S. Mathematics 9 years of relevant experience	Comment Database
Mussatti, Daniel NRC	M.S. Industrial Economics M.A. Environmental Economics M.S. Natural Resource & Env. Economics B.S. Economics and Mathematics 35 years of relevant experience	Socioeconomics Environmental Justice Nonradiological Waste Cost-Benefit Analysis
Nagel, Madelyn NRC	B.A. Environmental Science & Policy B.A. Political Science 1 year of relevant experience	Licensing Support
O'Neill, Tara PNNL	M.B.A. Business Administration B.A. Anthropology 31 years of relevant experience	Historic and Cultural Resources
Palmrose, Donald NRC	Ph.D. Nuclear Engineering M.S. Nuclear Engineering B.S. Nuclear Engineering Duke NEPA Certificate 36 years of relevant experience	Radiological Health Postulated Accidents Uranium Fuel Cycle Radiological Waste Transportation of Rad. Material
Parker, Mike PNNL	B.S. English Literature & Creative Writing 25 years of relevant experience	Technical Editing Document Architecture

Table A-1 List of Preparers (Continued)

Name & Affiliation	Education/Experience	Function or Expertise
Pitter, Shelley NRC	M.S. Biotechnology M.B.A Business Administration B.S. Biotechnology PMP Level 1 11 years of relevant experience	Licensing Support
Saulsbury, Bo PNNL	M.S. Planning B.A. History 35 years of relevant experience	PNNL Team Lead Comment Database
Sen, Kacoli PNNL	Ph.D. Cancer Biology M.S. Zoology (Ecology) B.S. Zoology Diploma in Environmental Law 6 years of relevant experience	Technical Editing Formatting
Willingham, Laura NRC	B.S. Environmental Sciences 17 years of relevant experience	Air Quality Greenhouse Gases Climate Change

APPENDIX B

AGENCIES, ORGANIZATIONS, TRIBES, AND INDIVIDUALS CONTACTED

The U.S. Nuclear Regulatory Commission (NRC) is providing electronic copies of the Kairos Hermes Test Reactor Construction Permit Environmental Impact Statement to the agencies, organizations, Tribes, and individuals listed n Table B-1 below. The NRC will also send copies to citizens that provided comments and contact information during the scoping period and the draft EIS comment period. The NRC will provide copies to other interested organizations and individuals upon request.

Table B-1 List of Agencies, Organizations, Tribes, and Persons to Whom Copies of this Environmental Impact Statement Are Sent

Name	Affiliation	Contact Information
	Federal and State Agencies	
Reid Nelson	Advisory Council on Historic Preservation	401 F Street NW, Suite 308 Washington DC 20001-2637
E. Patrick McIntyre	State Historic Preservation Office	2941 Lebanon Pike Nashville, TN 3721 4 section.106@tn.gov
Larry Long	U.S. Environmental Protection Agency, Region 4	NEPA Program Office USEPA Region 4 61 Forsyth Street SW Atlanta, GA 30303 long.larry@epa.gov
Mary Jennings	US Fish and Wildlife Service	U.S. Fish and Wildlife Service Tennessee Ecological Services Field Office 446 Neal Street Cookeville, TN 38501-4027 mary_e_jennings@fws.gov
Kris Kirby	National Park Service: Manhattan Project National Historical Park	12795 West Alameda Parkway P.O. Box 25287 Denver, Colorado 80225-0287 nps_environ_rev@nps.gov
Niki Nicholas	National Park Service: Manhattan Project National Historical Park	niki_nicholas@nps.gov
Billy Freeman and Mariza Gonzalez	Tennessee Department of Environment and Conservation	Division of Radiological Health, TDEC Knoxville Field Office 3711 Middlebrook Pike Knoxville, TN 3792
Bryan Davidson	Tennessee Department of Environment and Conservation	Office of Policy and Planning, TDEC William R. Snodgrass Tennessee Tower 312 Rosa L Parks Ave, 2nd Floor Nashville, TN 37243
Dave Adler	Department of Energy	david.adler@orem.doe.gov

Table B-1 List of Agencies, Organizations, Tribes, and Persons to Whom Copies of this Environmental Impact Statement Are Sent (Continued)

Name	Affiliation	Contact Information
	Tribes	
John Raymond Johnson, Governor	Absentee Shawnee Tribe	2025 S. Gordon Cooper Drive Shawnee, OK 74801
Nita Battise, Tribal Council Chairwoman	Alabama-Coushatta Tribe of Texas	571 State Park Road 56 Livingston, TX 77351
Wilson Yargee, Chief	Alabama-Quassarte Tribal Town	P.O. Box 187 Wetumka, OK 74883
Chuck Hoskin, Jr., Principal Chief	Cherokee Nation	P.O. Box 948 Tahlequah, OK 74465
Richard Sneed, Principal Chief	Eastern Band of Cherokee Indians	Qualla Boundary P.O. Box 1927 Cherokee, NC 28719
Glenna J. Wallace, Chief	Eastern Shawnee Tribe of Oklahoma	12705 South 705 Road Wyandotte, OK 74370
Brian Givens, Town King	Kialegee Tribal Town	P.O. Box 332 Wetumka, OK 74883
David Hill, Principal Chief	Muscogee (Creek) Nation	P.O. Box 580 Okmulgee, OK 74447
Greg P. Chilcoat, Principal Chief	Seminole Nation of Oklahoma	P.O. Box 1498 Wewoka, OK 74884
Marcellus W. Osceola, Jr., Chairman	Seminole Tribe of Florida	6300 Stirling Road Hollywood, FL 33024
Benjamin Barnes, Chief	Shawnee Tribe	P.O. Box 189 Miami, OK 74354
Ryan Morrow, Town King	Thlopthlocco Tribal Town	P.O. Box 188 Okemah, OK 74859
Joe Bunch, Chief	United Keetoowah Band of Cherokee Indians of Oklahoma	P.O. Box 746 Tahlequah, OK 74465
David Sickey, Chairman	Coushatta Tribe of Louisiana	P.O. Box 818 Elton, LA 70532
B. Cheryl Smith, Principal Chief	Jena Band of Choctaw Indians	P.O. Box 14 Jena, LA 71432
	Other Organizations and Individuals	
Mark Watson	City of Oak Ridge	mwatson@oakridgetn.gov
Amy Fitzgerald	City of Oak Ridge	afitzgerald@oakridgetn.gov
Ron Woody	Roane County	ron.woody@roanecountytn.org
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Table B-1 List of Agencies, Organizations, Tribes, and Persons to Whom Copies of this Environmental Impact Statement Are Sent (Continued)

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Christine Michaels	Oak Ridge Chamber of Commerce	president@orcc.org
Wade Creswell	Roane County Executive	Roanecountytn.gov
Brad Parish	Advanced Technologies & Laboratories	bparish@atlintl.com
Rani Franovich	The Breakthrough Institute	rani@thebreakthrough.org

APPENDIX C

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 for the Kairos Hermes Test Reactor. 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 Document Access and Management Systems (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 Public Document Room staff at 1-800-397-4209.

September 29, 2021	Letter to NRC from Peter Hastings, Kairos Power, Submitting the Preliminary Safety Evaluation Report for the Kairos Power Fluoride Salt-Cooled, High Temperature Non-Power Reactor (Hermes) (Rev 0). (Package Accession No. ML21272A375)
October 28, 2021	Letter to NRC from Peter Hastings, Kairos Power, Submitting the Environmental Report for the Kairos Power Fluoride Salt-Cooled, High Temperature Non-Power Reactor (Hermes) (Rev 0). (Package Accession No. ML21306A131)
October 29, 2021	*Federal Register* Notice - NRC Receipt of Kairos Hermes Test Reactor Construction Permit Application (86 FR 60077)
November 29, 2021	Letter from NRC to Peter Hastings, Kairos Power, Acceptance for Docketing Application for Hermes Non-Power Test Reactor Construction Permit Application. (Accession No. ML21319A354)
December 1, 2021	*Federal Register* Notice - Construction Permit Application; Acceptance for Docketing. (86 FR 68290)
December 15, 2021	Letter from NRC to Peter Hastings, Kairos Power, Regarding the Kairos Hermes Construction Permit Application Review Schedule and Resource Estimate. (Accession No. ML21343A214)
February 2, 2022	Kairos Hermes Construction Permit Environmental Report Audit Plan. (Package Accession No. ML22056A064)
February 8, 2022	Letter from NRC to Peter Hastings, Kairos Power, Application for Construction Permit Hermes Test Reactor, Notice of Hearing, Opportunity to Petition for Leave to Intervene, and Associated Federal Register Notice. (Package Accession No. ML21364A012)
February 9, 2022	*Federal Register* Notice - Notice of Hearing and Opportunity to Petition for Leave to Intervene; Order Imposing Procedures. (87 FR 7503)

February 10, 2022	Letter to NRC from Peter Hastings, Kairos Power, Transmittal of Changes to the Construction Permit Application. (Package Accession No. ML22042A095)
February 18, 2022	Letter from NRC to Peter Hastings, Kairos Power, Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Related to an Early Site Permit for the Clinch River Nuclear Site. (Package Accession No. ML22053A010)
February 18, 2022	*Federal Register* Notice of Intent to Conduct Scoping Process and Prepare an Environmental Impact Statement. (87 FR 9394)
February 18, 2022	Letter to NRC from Peter Hastings, Kairos Power, Transmittal of Construction Permit Application Changes. (Package Accession No. ML22049B555)
March 1, 2022	Letter to NRC from Peter Hastings, Kairos Power, Transmittal of Changes to Maximum Hypothetical Accident Dose Results in Hermes Construction Permit Application. (Accession No. ML22060A272)
March 4, 2022	Letter from NRC to E. Patrick McIntyre, Jr., Tennessee Historical Commission, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee (Accession No. ML22031A288)
March 4, 2022	Letter from NRC to Reid Nelson, Advisory Council on Historic Preservation, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee (Accession No. ML22031A286)
March 4, 2022	Letter from NRC to Niki Nicholas, Manhattan Project National Historic Park, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee (Accession No. ML22031A287)
March 4, 2022	Letter from NRC to Mary Jennings, U.S. Fish and Wildlife Service, Request For Participation In The Environmental Scoping Process And A List Of Protected Species Within The Area Under Evaluation For The Proposed Kairos Hermes Test Reactor Construction Permit Application Review. (Accession No. ML22033A241)
March 4, 2022	Letter from NRC to Larry Long, Environmental Protection Agency, Request For Participation In The Environmental Scoping Process For the Proposed Kairos Hermes Test Reactor Construction Permit Application Review. (Accession No. ML22033A246)

March 4, 2022	Letter from NRC to John Raymond Johnson, Absentee Shawnee Tribe, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee. (Accession No. ML22031A289)
March 4, 2022	Letter from NRC to Ms. Nita Battise, Alabama-Coushatta Tribe of Texas, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee. (Accession No. ML22031A289)
March 4, 2022	Letter from NRC to Mr. Wilson Yargee, Chief, Alabama-Quassarte Tribal Town, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee. (Accession No. ML22031A289)
March 4, 2022	Letter from NRC to Mr. Chuck Hoskin, Jr., Principal Chief, Cherokee Nations, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee. (Accession No. ML22031A289)
March 4, 2022	Letter from NRC to Mr. Bill Anoatubby, Chickasaw Nation, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee. (Accession No. ML22031A289)
March 4, 2022	Letter from NRC to Mr. Richard Sneed, Principal Chief, Eastern Band of Cherokee Indians, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee. (Accession No. ML22031A289)
March 4, 2022	Letter from NRC to Ms. Glenna J. Wallace, Chief, Eastern Shawnee Tribe of Oklahoma, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee. (Accession No. ML22031A289)
March 4, 2022	Letter from NRC to Mr. Brian Givens, Town King, Kialegee Tribal Town, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee. (Accession No. ML22031A289)
March 4, 2022	Letter from NRC to Mr. David Hill, Principal Chief, Muscogee (Creek) Nation, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee. (Accession No. ML22031A289)

March 4, 2022	Letter from NRC to Ms. Stephanie A. Bryan, Tribal Chair, Poarch Band of Creek Indians, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee. (Accession No. ML22031A289)
March 4, 2022	Letter from NRC to Mr. Greg P. Chilcoat, Principal Chief, Seminole Nation of Oklahoma, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee. (Accession No. ML22031A289)
March 4, 2022	Letter from NRC to Mr. Marcellus W. Osceola, Jr., Seminole Tribe of Florida, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee. (Accession No. ML22031A289)
March 4, 2022	Letter from NRC to Mr. Benjamin Barnes, Chief, Shawnee Tribe, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee. (Accession No. ML22031A289)
March 4, 2022	Letter from NRC to Mr. Ryan Morrow, Town King, Thlopthlocco Tribal Town, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee. (Accession No. ML22031A289)
March 4, 2022	Letter from NRC to Mr. Joe Bunch, Chief, United Keetoowah Band of Cherokee Indians, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee. (Accession No. ML22031A289)
March 4, 2022	Letter from NRC to Mr. David Sickey, Chairman, Coushatta Tribe of Louisiana, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee. (Accession No. ML22031A289)
March 4, 2022	Letter from NRC to Ms. B. Cheryl Smith, Principal Chief, Jena Band of the Choctaw Indians, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee. (Accession No. ML22031A289)
March 4, 2022	Letter from NRC to Ms. Deborah Dotson, President, Delaware Nation, Request to Initiate Section 106 Consultation and Scoping Process for the Kairos Hermes Non-Power Test Reactor Construction Permit Review in Roane County, Tennessee. (Accession No. ML22031A289)

March 11, 2022	Letter to NRC from E. Patrick McIntyre, Jr., Tennessee Historical Commission, Regarding Construction of Kairos Power, LLC. Hermes Non-Power Test Reactor, ETTP, Oak Ridge, Roane County, TN. (Scoping Comment) (Accession No. ML22082A294)
March 31, 2022	Letter to NRC from Lisa Johnson., Chickasaw Nation, Regarding Kairos Hermes Construction Permit. (Scoping Comment) (Accession No. ML22090A055)
March 31, 2022	Email from NRC to Darrel Gardner, Kairos Power, Transmittal of Requests for Confirmatory Information for the Review of the Hermes Environmental Report. (Package Accession No. ML22090A060)
April 4, 2022	Letter to NRC from Paul Barton., Eastern Shawnee Tribe of Oklahoma, Project Review, Kairos Power Hermes Non-Power Test Reactor Construction Permit. (Scoping Comment) (Accession No. ML22094A125)
April 4, 2022	Email to NRC from Erin Thompson-Paden, Delaware Nation, Regarding Kairos Hermes Construction Permit. (Scoping Comment) (Accession No. ML22095A221)
April 4, 2022	Email to NRC from Larry Haikey, Poarch Band of Creek Indians, Regarding Kairos Power Hermes Non-Power Test Reactor Construction Permit Review. (Scoping Comment) (Accession No. ML22095A224)
April 6, 2022	Email to NRC from Ben Yahola, Seminole Nation of Oklahoma, Regarding Kairos Power Hermes Non-Power Test Reactor Construction Permit Review. (Scoping Comment) (Accession No. ML22109A188)
April 12, 2022	Letter to NRC from Niki Nicholas, Manhattan Project National Park, Regarding Kairos Hermes Construction Permit. (Scoping Comment) (Accession No. ML22105A022)
April 15, 2022	E-mail to NRC from Steven Alexander, U.S. Fish & Wildlife Service, Regarding Kairos Power, LLC Hermes Reactor at DOE ORR ETTP (Heritage Center) (Scoping Comment) (Accession No. 22119A261)
April 22, 2022	Letter to NRC from Peter Hastings, Kairos Power, Transmittal of Responses to NRC Requests for Confirmatory Information for the Review of the Hermes Environmental Report. (Package Accession No. ML22115A204)
April 27, 2022	Letter to NRC from Peter Hastings, Kairos Power, Transmittal of Supplemental Information for NRC Information Need HCUL-10 for the Hermes Environmental Review. (Package Accession No. ML22117A215)
April 27, 2022	Letter to NRC from Peter Hastings, Kairos Power, Transmittal of Changes to Hermes Environmental Report Resulting from NRC Environmental Review Audit. (Package Accession No. ML22117A218)

May 5, 2022	NRC Memorandum: Summary of March 23, 2022 Public Outreach Meeting on the Proposed Kairos Hermes Test Reactor with Designated Period for Receipt of Environmental Scoping Comments (Package Accession No. ML22110A018)
June 30, 2022	Letter to NRC from Peter Hastings, Kairos Power, Transmittal of Changes to the Construction Permit Application. (Package Accession No. ML22181B157)
August 01, 2022	Environmental Impact Statement Scoping Process Summary Report: Kairos Hermes Test Reactor Construction Permit Application (Package Accession No. ML22194A014)
August 24, 2022	NRC Memorandum: Summary Report for the Environmental Audit of the Kairos Hermes Test Reactor Construction Permit Application (Package Accession No. ML22196A387)
September 26, 2022	Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor: Draft Report for Comment, at https://www.nrc.gov/reactors/non-power/new-facility-licensing/hermes-kairos/documents.html
September 26, 2022	Letter from NRC to Peter Hastings, Kairos Power, LLC, Regarding Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Non-Power Test Reactor in Oak Ridge, TN. (Accession No. ML22243A251)
September 26, 2022	Letter from NRC to Larry Long, U.S. Environmental Protection Agency, Region 4, Regarding Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22243A148)
September 26, 2022	Letter from NRC, to Mary Jennings, U.S. Fish and Wildlife Service, Tennessee Ecological Service Field Office, Regarding Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22243A153)
September 26, 2022	Letter from NRC to E. Patrick McIntyre, Jr., Tennessee Historical Commission, Regarding Section 106 Consultation and Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22243A152)
September 26, 2022	Letter from NRC to Reid Nelson, Advisory Council on Historic Preservation, Regarding Section 106 Consultation and Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22243A147)

September 26, 2022	Letter from NRC to Niki Nicholas, National Park Service, Regarding Section 106 Consultation and Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22243A151)
September 26, 2022	Letter from NRC to Glenna J. Wallace, Eastern Shawnee Tribe of Oklahoma, Regarding Section 106 Consultation and Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22243A150)
September 26, 2022	Letter from NRC to Mr. Chuck Hoskin, Jr., Principal Chief, Cherokee Nations, Regarding Section 106 Consultation and Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22243A149)
September 26, 2022	Letter from NRC to Rick Sylestine, Alabama-Coushatta Tribe of Texas, Regarding Section 106 Consultation and Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22249A084)
September 29, 2022	*Federal Register* Notice – NRC Draft Environmental Impact Statement; Request for Comment and Public Comment Meeting. (87 FR 59124)
September 29, 2022	Email from E. Patrick McIntyre, Tennessee Historical Commission, to NRC, Regarding Comments on the draft EIS for the Kairos Hermes Test Reactor Construction Permit Application. (Accession No. ML22285A203)
October 6, 2022	Letter from NRC to John Raymond Johnson, Governor, Absentee Shawnee Tribe, Regarding Section 106 Consultation and Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22278A315)
October 6, 2022	Letter from NRC to Nita Battise, Alabama-Coushatta Tribe of Texas, Regarding Section 106 Consultation and Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22278A315)
October 6, 2022	Letter from NRC to Wilson Yargee, Chief, Alabama- Quassarte Tribal Town, Regarding Section 106 Consultation and Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22278A315)

October 6, 2022	Letter from NRC to Richard Sneed, Principal Chief, Eastern Band of Cherokee Indians, Regarding Section 106 Consultation and Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22278A315)
October 6, 2022	Letter from NRC to Brian Givens, Town King, Kialegee Tribal Town, Regarding Section 106 Consultation and Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22278A315)
October 6, 2022	Letter from NRC to David Hill, Principal Chief, Muscogee Creek Nation, Regarding Section 106 Consultation and Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22278A315)
October 6, 2022	Letter from NRC to Greg P. Chilcoat, Principal Chief, Seminole Nation of Oklahoma, Regarding Section 106 Consultation and Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22278A315)
October 6, 2022	Letter from NRC to Marcellus W. Osceola, Jr., Chairman, Seminole Tribe of Florida, Regarding Section 106 Consultation and Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22278A315)
October 6, 2022	Letter from NRC to Benjamin Barnes, Chief, Shawnee Tribe of Oklahoma, Regarding Section 106 Consultation and Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22278A315)
October 6, 2022	Letter from NRC to Ryan Morrow, Town King, Thlopthlocco Tribal Town, Regarding Section 106 Consultation and Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22278A315)
October 6, 2022	Letter from NRC to Joe Bunch, Chief, United Keetoowah Band of Cherokee Indians of Oklahoma, Regarding Section 106 Consultation and Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22278A315)

October 6, 2022	Letter from NRC to David Sickey, Chairman, Coushatta Tribe of Louisiana, Regarding Section 106 Consultation and Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22278A315)
October 6, 2022	Letter from NRC to B. Cheryl Smith, Principal Chief, Jena Band of Choctaw Indians, Regarding Section 106 Consultation and Notification of the Issuance of the Draft Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor in Oak Ridge, TN. (Accession No. ML22278A315)
October 7, 2022	*Federal Register* Notice – Environmental Protection Agency Environmental Impact Statement Notice of Availability. (87 FR 61014)
December 6, 2022	E-mail to NRC, from Ntale Kajumba, Environmental Protection Agency Region 4, Regarding EPA Comments on the Kairos draft EIS. (Accession No. ML22340A580)
December 6, 2022	E-mail to NRC, from Bryan Davidson, Tennessee Department of Environment and Conservation, Regarding TDEC Comments on the NRC draft EIS for the Construction Permit for the Kairos Hermes Test Reactor (Accession No. ML22341A022)
January 27, 2023	Concurrence Notification from Daniel Elbert, U.S. Fish and Wildlife Service, Tennessee Ecological Service Field Office, Regarding the Kairos Hermes Test Reactor Construction Permit Application. (Accession No. ML23036A004)
January 31, 2023	E-mail from Jennifer Davis, NRC Staff Summarizing the Request from a Consulting Tribe for Government to Government Consultations (Accession No. ML23031A036)
February 2, 2023	Email from Niki Nicholas, National Park Service, to the NRC, Regarding the Kairos Hermes Test Reactor Construction Permit Application. (Accession No. ML23036A000)
March 21, 2023	NRC Memorandum: Summary of November 16, 2022 Public Meeting to Discuss the Draft Environmental Impact Statement for the Kairos Hermes Test Reactor Construction Permit Application. (Package Accession No. ML23031A160)
March 31, 2023	Letter to NRC from Peter Hastings, Kairos Power, Submitting Revision 1 of the Environmental Report for the Kairos Power Fluoride Salt-Cooled, High Temperature Non-Power Reactor (Hermes). (Package Accession No. ML23089A386)
June 23, 2023	Letter to NRC from Peter Hastings, Kairos Power, Supplemental Information for Environmental Report (ML23178A096)

APPENDIX D

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

Table D-1 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 site preparation, construction, and operation of two or more small modular reactors at the Kairos Hermes nuclear site.

Table D-1 was adapted from Table 1.4-1 of the Environmental Report submitted to the U.S. Nuclear Regulatory Commission by the applicant (Kairos 2023-TN8172).

Table D-1 Authorizations Required for Preconstruction, Construction, and Operation Activities

Agency	Authority	Requirement	Activity Covered
U.S. Nuclear Regulatory Commission	Atomic Energy Act 10 CFR 50.50	Construction Permit	Construction of the facilities
	10 CFR 50.57	Operating License	Operation of the facilities
	10 CFR Part 40	Source Material License	Possession, use, and transfer of special nuclear material
	10 CFR Part 30	By-Product Material License	Production, possession, and transfer of radioactive by-product material
	10 CFR Part 70	Special Nuclear Material License	Receipt, possession, use, and transfer of special nuclear material
	National Environmental Policy Act (NEPA) 10 CFR Part 51	Environmental Assessment or Environmental Impact Statement in accordance with NEPA	Site approval for construction and operation of a radiation facilities
Federal Aviation Administration	Federal Aviation Act 14 CFR Part 77	Construction Notice	Construction of structures that may impact air navigation (height greater than 200 feet [ft]), construction of structures above a 1 to 100 slope from nearest runway
U.S. Environmental Protection Agency	Resource Conservation and Recovery Act 40 CFR Part 261 and 262	Acknowledgement of Notification of Hazardous Waste Activity	Generation of hazardous waste
	Clean Water Act 40 CFR Part 112 Appendix F	Spill Prevention, Control, and Countermeasure Plans for Construction and Operation	Storage of oil during construction and operation
U.S. Fish and Wildlife Service	Endangered Species Act	Section 7 Consultation	Protection of endangered and threatened species and critical habitats designated under the Federal Endangered Species Act
U.S. Department of Transportation	Hazardous Material Transportation Act	Certificate of Registration	Transportation of hazardous materials
Tennessee Department of Environment and Conservation (TDEC)	Federal Clean Air Act	Air Pollution Control Construction Permit	Construction of an air pollution emission source that is not specifically exempted

Table D-1 Authorizations Required for Preconstruction, Construction, and Operation Activities (Continued)

Agency	Authority	Requirement	Activity Covered
		Air Pollution Control Operation Permit	Operation of an air pollution emission source that is not specifically exempted
	Federal Clean Water Act	Construction Storm Water Discharge Permit	Discharge of stormwater runoff from the construction site
		Industrial Storm Water Discharge Permit	Discharge of stormwater runoff from the site during facilities operation
Tennessee Department of Safety and Professional Services		Building Plan Review	Compliance with state building codes; required before local building permit can be issued for a commercial building
Tennessee Department of Transportation (TDOT)		Permit for Connection to State Trunk Highway	Construction of driveway connection to Highway 58
		Right-of-Entry Permit	Construction by the City of Oak Ridge of Utility Extensions across Highway 58
City of Oak Ridge		Site Plan Approval	Administrative approval of site layout, plans for parking, landscaping, lighting, etc.
		Storm Water Plan approval (may be included in Site Plan Approval)	Administrative approval of grading and drainage plans
		Erosion Control Permit (may be included in Site Plan Approval)	Administrative approval of erosion control plans
		Building Permit	Construction of buildings
		Plumbing Plan Approval	Installation of plumbing systems
		Heating, Ventilation, and Air Conditioning Plan approval	Installation of heating, ventilation, and air conditioning systems
		Occupancy Permit	Occupancy of completed buildings
		Conditional use Permit	Construction of multiple buildings on the same site
		Sanitary Sewer and Water Supply Facility Approvals	Administrative approval of construction, installation, and operation of connections to the municipal sewer and water supply systems

Table D-1 Authorizations Required for Preconstruction, Construction, and Operation Activities (Continued)

Agency	Authority	Requirement	Activity Covered
Tennessee State Historic Preservation Office Tribal Historic Preservation Officer	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, and identification of potentially affected resources, i.e., a site survey	Protection of archaeological and historical resources

APPENDIX E

GREENHOUSE GAS EMISSIONS

The U.S. Nuclear Regulatory Commission (NRC) staff estimated the greenhouse gas (GHG) emissions of various activities associated with the building, operating, and decommissioning of nuclear power plants (NPPs). The GHG emission estimates include direct emissions from nuclear facilities and indirect emissions from workforce and fuel transportation, decommissioning, and the uranium fuel cycle. The estimates are based on a single installation of 1,000 megawatt electric (MWe) output with an 80 percent capacity factor henceforth referred to as the reference 1,000 MWe reactor. The estimates may be roughly linearly scaled from the reference 1,000 MWe reactor for other reactor outputs.[7] This appendix discusses the calculation of GHG emission estimates for the reference 1,000 MWe reactor.

The estimated emissions from equipment used to build a NPP listed in Table E-1 are based on hours of equipment use estimated for a single NPP at a site requiring a moderate amount of terrain modification (UniStar 2007-TN1564). Construction equipment carbon monoxide (CO) emission estimates were derived from the hours of equipment use, and carbon dioxide (CO_2) emissions were then estimated from the CO emissions using a scaling factor of 172 tons (T) of CO_2 per ton of CO (Chapman et al. 2012-TN2644). The scaling factor is based on the ratio of CO_2 to CO emission factors for diesel fuel industrial engines as reported in Table 3.3-1 of AP-42 Compilation of Air Pollutant Emission Factors (EPA 2012-TN2647). A CO_2 to total GHG equivalency factor of 0.991 is used to account for the emissions from other GHGs, such as methane (CH_4) and nitrous oxide (N_2O) (Chapman et al. 2012-TN2644). The equivalency factor is based on non-road/construction equipment in accordance with relevant guidance (NRC 2014-TN3768; Chapman et al. 2012-TN2644). Equipment emissions estimates for decommissioning are assumed to be one-half of those for construction equipment. Data on equipment emissions for decommissioning are not available; the one-half factor is based on the assumption that decommissioning would involve less earthmoving and hauling of material, as well as fewer labor hours, compared to those involved in building activities (Chapman et al. 2012-TN2644).

Table E-2 lists the NRC staff's estimates of the CO_2 equivalent[8] (CO_2eq) emissions associated with workforce transportation. Construction workforce estimates for the reference 1,000 MWe reactor are conservatively based on estimates in various combined license applications (Chapman et al. 2012-TN2644), and the operational and decommissioning workforce estimates are based on Supplement 1 to NUREG–0586 (NRC 2002-TN665). Table E-2 lists the assumptions used to estimate total miles (mi) traveled by each workforce and the factors used to convert total miles to metric tons of CO_2eq. The workers are assumed to travel in gasoline-powered passenger vehicles (cars, trucks, vans, and sport utility vehicles) that get an average of 21.6 miles per gallon (mi/gal) (9.1 kilometers per liter [km/L]) of gasoline (FHWA 2012-TN2645). Conversion from gallons of gasoline burned to CO_2eq is based on U.S. Environmental Protection Agency (EPA) emission factors (EPA 2012-TN2643).

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[7] The term "model LWR" has also been used to describe a 1,000 MWe light water reactor for the purpose of evaluating the environmental considerations of the supporting fuel cycle to the annual reactor operations (WASH-1248, AEC 1974-TN23). It is assumed there are no significant differences between the 1,000 MWe reactor evaluated in WASH-1248 and the 1,000 MWe reference reactor evaluated in this appendix.

[8] A measure to compare the emissions from various GHGs on the basis of their global warming potential, defined as the ratio of heat trapped by one unit mass of the GHG to that of one unit mass of CO_2 over a specific time period.

Table E-1 Greenhouse Gases Emissions from Equipment Used in Building and Decommissioning (Metric Tons of Carbon Dioxide Equivalent [(MT CO_2eq])

Equipment	Building Total[(a)]	Decommissioning Total[(b)]
Earthwork and dewatering	12,000	6,000
Batch plant operations	3,400	1,700
Concrete	5,400	2,700
Lifting and rigging	5,600	2,800
Shop fabrication	1,000	500
Warehouse operations	1,400	700
Equipment maintenance	10,000	5,000
Total[(c)]	39,000	19,000

(a) Based on hours of equipment usage over a 7-year period.
(b) Based on equipment usage over a 10-year period.
(c) Results are rounded to the nearest 1,000 MT CO_2eq.

Table E-2 Workforce Greenhouse Gases Footprint Estimates

	Construction Workforce	Operational Workforce	Decommissioning Workforce	SAFSTOR Workforce
Commuting trips (round trips per day)	1,000	550	200	40
Commute distance (miles per round-trip)	40	40	40	40
Commuting days (days per year)	365	365	250	365
Duration (years)	7	40	10	40
Total distance traveled (mi)[(a)]	102,000,000	321,000,000	20,000,000	23,000,000
Average vehicle fuel efficiency[(b)] (mi/gal)	21.6	21.6	21.6	21.6
Total fuel burned[(a)] (gal)	4,700,000	14,900,000	900,000	1,100,000
CO_2 emitted per gallon[(c)] (MT CO_2)	0.00892	0.00892	0.00892	0.00892
Total CO_2 emitted[(a)] (MT CO_2)	42,000	133,000	8,000	10,000
CO_2 equivalency factor[(c)] (MT CO_2/MT CO_2eq)	0.977	0.977	0.977	0.977
Total GHG emitted[(a)] (MT CO_2eq)	43,000	136,000	8,000	10,000

Key: SAFSTOR = SAFe STORage; mi = miles; mi/gal= miles per gallon; gal=gallon; MT = metric tons; CO_2eq = carbon dioxide equivalent.
(a) Results are rounded.
(b) Source: FHWA 2012-TN2645.
(c) Source: EPA 2012-TN2643.

Title 10 of the *Code of Federal Regulations* 51.51(a) (10 CFR 51.51[a]; TN250) states that every environmental report [9] prepared for an early site permit or combined license stage of a light-water-cooled nuclear power reactor shall use Table S–3, Table of Uranium Fuel Cycle Environmental Data, as set forth in 10 CFR 51.51(b) (TN250) as the basis for evaluating the contribution of the environmental effects of uranium fuel-cycle activities to the environmental costs of licensing the nuclear power reactor. Section 51.51(a) (TN250) further states that Table S–3 shall be included in the ER and may be supplemented by a discussion of the environmental significance of the data set forth in the table as weighted in the project-specific analysis for the proposed facility.

Table S–3 of 10 CFR 51.51(b) (TN250) does not directly apply to non-light-water reactors (LWRs), nor does it provide an estimate of GHG emissions associated with the uranium fuel cycle; it only addresses pollutants that were of concern when the table was promulgated in the 1970s. However, Table S–3 states that 323,000 megawatt-hour (MWh) is the assumed annual electric energy use for the Table S–3 reference 1,000 MWe NPP and that this 323,000 MWh of annual electric energy is assumed to be generated by a 45 MWe coal-fired power plant burning 118,000 MT of coal. These assumptions are based upon 1970s uranium enrichment technology, which has changed substantially since then. The older, energy-intensive gaseous-diffusion plants have been replaced with more efficient centrifuge-based systems. The current operating gas centrifuge uranium enrichment facility in the United States is URENCO-USA (Louisiana Energy Services), which is located in Eunice, New Mexico. The URENCO-USA facility does not rely solely upon coal as an energy source (Napier 2020-TN6443). If a 1,000 MWe plant is assumed to operate at 35 percent thermal efficiency and use uranium fuel enriched to 5 percent in uranium-235 (U-235) with an average burnup of 40,000 megawatt-day per metric ton (MWd/MT) for 40 years, then it will require about 1,043 T of enriched uranium for fuel. To produce 1 T of 5 percent enriched uranium with 0.25 percent U-235 in the depleted uranium stream requires extraction of 10.3 T of natural uranium and 7,923 separative work units (Napier 2020-TN6443). The 1,043 T of uranium enriched to 5 percent U-235 required over the 40-year life of the 1,000 MWe plant would then require 8,264,000 separative work units. Because a centrifuge enrichment facility requires about 50 kWh per separative work units (WNA 2020-TN6661), a total of 413,200 MWh is needed to produce 40 years' worth of uranium enriched to 5 percent U-235 for fuel for the lifetime operation of the 1,000 MWe plant. For the existing U.S. centrifuge enrichment plant, the regional average CO_2 emission factor is 1,248 pounds per megawatt-hour (lb/MWh),[10] and the total CO_2 emission is about 243,000 MT.

Table S–3 also assumes that approximately 135,000,000 standard cubic feet (scf) of natural gas is required per year to generate process heat for certain portions of the uranium fuel cycle. The NRC staff estimates that burning 135,000,000 scf of natural gas per year results in approximately 7,440 MT of CO_2eq being emitted into the atmosphere per year because of the process heat requirements of the uranium fuel cycle.[11] For a 40-year operational life, this is 298,000 MT of CO_2eq. This amount is in addition to the CO_2eq emissions from the enrichment process.

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[9] The NRC requires most applicants, including all reactor applicants, to submit an Environmental Report as part of the application. 10 CFR 51.45 and 10 CFR 51.50 [TN250]).

[10] The EPA provides estimates of emissions from electricity production for different regions in the United States at https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid for CO_2 in units of lb/kWh. The value for southeastern New Mexico has been applied here.

[11] The conversion is 0.0551 (MT CO_2/thousand scf) **(**https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references**).**

The NRC staff estimated GHG emissions related to plant operations from the typical usage of various onsite diesel generators (UniStar 2007-TN1564). CO emission estimates were derived assuming an average of 600 hours of emergency diesel generator operation per year (four generators, each operating 150 hours per year [hr/yr]) and 200 hours of station blackout diesel generator operation per year (two generators, each operating 100 hr/yr) (Chapman et al. 2012-TN2644). A scaling factor of 172 was then applied to convert the CO emissions to CO_2 emissions, and a CO_2 to total GHG equivalency factor of 0.991 was used to account for the emissions from other GHGs such as CH_4 and N_2O (Chapman et al. 2012-TN2644).

The number of shipments and shipping distances for transport of fresh nuclear fuel and spent nuclear fuel and radioactive wastes are presented in Table S-5 of Supplement 1 to WASH-1238 [NRC 1975-TN216], for a 1,100 MWe LWR with an 80 percent capacity factor. WASH-1248 (AEC 1974-TN23) assumes that truck casks weigh 50,000 pounds (lb) (23 MT) and rail casks weigh 100 T (91 MT). For this analysis, emission rates of CO_2 for trucks are taken to be 64.7 gram per ton-mile (g/T-mi) (44.2 gram per metric ton-kilometer [g/MT-km]) and for rail are taken to be 32.2 g/T-mi (22 g/MT-km) (Cefic and ECTA 2011-TN6966). For the calculation, it is also assumed that return trips with empty casks double the total miles traveled by truck or rail. Table E-3 presents estimated annual CO_2eq emissions from shipments associated with the reference 1,000 MWe reactor.

Table E-3 Annual Number of Shipments for the Reference 1,000 MWe Reactor

Material	Annual Number of Shipments for the Reference 1,000 MWe Reactor	Typical Distance (mi)[a]	Annual CO_2eq Emissions[b]
Unirradiated fuel (truck)	6	1,000	19
Spent fuel (truck)	60	1,000	194
Spent fuel (rail)	10	1,000	64
Radioactive waste (truck)	46	500	74

Key: MWe = megawatt electric; mi = mile; CO_2eq = carbon dioxide equivalent.

[a] Source: NRC (1975-TN216), Table S-5.

[b] Results are rounded to the nearest 1,000 MT CO_2e.

The total GHG emissions for fuel and waste transportation are approximately 352 MT per reference reactor-year from Table E-3. Over a 40-year operating life for the reference 1,000 MWe reactor, the total is approximately 14,000 MT of CO_2eq emitted.

Given the various sources of GHG emissions discussed above, the NRC staff estimated the total lifetime GHG footprint for the reference 1,000 MWe reactor to be about 990,000 MT CO_2eq, with a 7-year building phase, 40 years of operation, and 10 years of active decommissioning.[12] These components of the GHG emissions footprint are summarized in Table E-4. The uranium fuel cycle component of the footprint is the largest portion of the overall

[12] Under the NRC's regulations, a reactor licensee has up to 60 years to complete the decommissioning of a reactor facility commencing with the licensee's certification that it has permanently ceased reactor operations (10 CFR 50.82(a)(3); TN249). The 60-year decommissioning period may be exceeded subject to NRC approval, if necessary, to protect "public health and safety." Id. The estimated 10-year decommissioning period is a subset of the 60-year decommissioning period, during which significant demolition and earthmoving activities may occur (e.g., deployment and operation of equipment at the decommissioning site and shipments by truck or rail to remove irradiated soil, rubble, and debris from the site), as discussed in Supplement 1 to NUREG–0586 (NRC 2002-TN665).

estimated GHG emissions and is directly related to the assumed power generated by the plant. The GHG emission estimates for the uranium fuel cycle are based on newer enrichment technology, assuming that the energy required for enrichment is provided by modern regional electric systems.

Table E-4 Nuclear Power Plant Life-cycle Greenhouse Gas Footprint

Source	Activity Duration (in years)[a]	Total Emissions (MT CO_2eq)
Construction equipment	7	39,000
Construction workforce	7	43,000
Plant operations	40	181,000
Operations workforce	40	136,000
Uranium fuel cycle	40	540,000
Fuel and waste transportation	40	14,000
Decommissioning equipment	10	19,000
Decommissioning workforce	10	8,000
SAFSTOR workforce	40	10,000
TOTAL[b]		990,000

Key: CO_2eq = carbon dioxide equivalent; SAFSTOR = SAFe STORage.

[a] Nuclear power plant life-cycle for estimating GHG is assumed to be 97 years which includes building, operating, and decommissioning.

[b] Results are rounded to the nearest 1,000 MT CO_2eq.

The Intergovernmental Panel on Climate Change (IPCC) released a special report about renewable energy sources and climate change mitigation in 2012 (IPCC 2012-TN2648). Annex II of the IPCC report includes an assessment of previously published works on life cycle of GHG emissions from various electric generation technologies, including nuclear energy. The IPCC report included only reference material that passes certain screening criteria for quality and relevance in its assessment. The IPCC screening yielded 125 estimates of nuclear energy life cycle GHG emissions from 32 separate references. The IPCC-screened estimates of the life cycle GHG emissions associated with nuclear energy, as shown in Table A.II.4 of the IPCC report, ranged from 1 to 220 gram (g) of carbon equivalent per kilowatt hour (CO_2eq/kWh), with 25th percentile, 50th percentile, and 75th percentile values of 8 g CO_2eq/kWh, 16 g CO_2eq/kWh, and 45 g CO_2eq/kWh, respectively. The range of the IPCC estimates is due, in part, to assumptions regarding the type of enrichment technology employed, how the electricity used for enrichment is generated, the grade of mined uranium ore, the degree of processing and enrichment required, and the assumed operating lifetime of a NPP. The NRC staff's GHG life cycle estimate of approximately 990,000 MT CO_2eq for the reference 1,000 MWe reactor is equal to about 3.5 g CO_2eq/kWh, which places the NRC staff's estimate at the lower end of the IPCC estimates in Table A.II.4 of the IPCC report. This placement is primarily because the IPCC estimates were for LWRs that used enrichment technologies that were based on the use of coal-fired generation as the electricity source.

The GHG emissions presented in Section 3.0 of this draft EIS use the values presented in this appendix but are scaled based on project-specific information. The GHG emissions for building, operation (including the fuel waste and transportation of fuel and waste), and decommissioning are discussed in Section 3.2.

E.1 References

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

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." TN250.

AEC (U.S. Atomic Energy Commission). 1974. *Environmental Survey of the Uranium Fuel Cycle*. WASH–1248, Washington, D.C. ADAMS Accession No. ML14092A628. TN23.

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EPA (U.S. Environmental Protection Agency). 2012. "Stationary Internal Combustion Sources." Chapter 3 in *Technology Transfer Network Clearinghouse for Inventories & Emissions Factors: AP-42.* Fifth Edition, Research Triangle Park, North Carolina. ADAMS Accession No. ML12292A637. TN2647.

FHWA (Federal Highway Administration). 2012. "Highway Statistics 2010 (Table VM-1)." Office of Highway Policy Information, Washington, D.C. ADAMS Accession No. ML12292A645. TN2645.

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NRC (U.S. Nuclear Regulatory Commission). 2002. *Final Generic Environmental Impact Statement of Decommissioning of Nuclear Facilities: Regarding the Decommissioning of Nuclear Power Reactors*. NUREG–0586, Supplement 1, Volumes 1 and 2, Washington, D.C. ADAMS Accession Nos. ML023470327, ML023500228. TN665.

NRC (U.S. Nuclear Regulatory Commission). 2014. *Attachment 1: Staff Guidance for Greenhouse Gas and Climate Change Impacts for New Reactor Environmental Impact Statements, COL/ESP-ISG-026*. Washington, D.C. ADAMS Accession No. ML14100A157. TN3768.

UniStar (UniStar Nuclear Energy, LLC). 2007. *Technical Report in Support of Application of UniStar Nuclear Energy, LLC and UniStar Nuclear Operating Services, LLC for Certificate of Public Convenience and Necessity Before the Maryland Public Service Commission for Authorization to Construct Unit 3 at Calvert Cliffs Nuclear Power Plant and Associated Transmission Lines*. Public Service Commission of Maryland, Baltimore, Maryland. ADAMS Accession No. ML090680053. TN1564.

WNA (World Nuclear Association). 2020. "Uranium Enrichment." London, United Kingdom. Webpage accessed October 16, 2020, at https://www.world-nuclear.org/information-library/nuclear-fuel-cycle/conversion-enrichment-and-fabrication/uranium-enrichment.aspx. TN6661.

APPENDIX F

VIEWSHED PHOTOGRAPHS AT NEARBY HISTORIC AND CULTURAL RESOURCES

Kairos Power

KP-NRC-2204-008

April 27, 2022

Docket No. 50-7513

US Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: Kairos Power LLC
Transmittal of Supplemental Information for NRC Information Need HCUL-10 for the Hermes Environmental Review

References:
1. Letter, Kairos Power LLC to Document Control Desk "Submittal of the Environmental Report for the Kairos Power Fluoride Salt-Cooled, High Temperature Non-Power Reactor (Hermes)," October 31, 2021 (ML21306A131)
2. Email, Nuclear Regulatory Commission, Tamsen Dozier to Kairos Power LLC, "Kairos Power, LLC Hermes Environmental Report Audit Plan," February 2, 2022 (ML22052A008)

By letter dated October 31, 2021 (Reference 1), Kairos Power LLC submitted its Environmental Report (ER) in support of the construction permit application (CPA) for the Hermes test reactor. As part of the Nuclear Regulatory Commission (NRC) review of the information contained in the ER, NRC announced (Reference 2) and conducted an audit of the Hermes ER.

During the audit, the NRC requested that Kairos Power provide supplemental information related to audit information need HCUL-10 (Reference 2). The enclosure to this letter submits photographs taken in the Hermes site vicinity, specifically requested by NRC staff during the audit. Kairos Power requests NRC staff review of this information in support of continued review of the Hermes non-power test reactor CPA.

If you have any questions or need any additional information, please contact Marty Bryan at bryan@kairospower.com or at (865) 369-1136, or Darrell Gardner at gardner@kairospower.com or (704) 769-1226.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on April 27, 2022.

Peter Hastings, PE
Vice President, Regulatory Affairs and Quality

Enclosure: Supplemental Information for HCUL-10 for Hermes Environmental Review

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Enclosure 1
Supplemental Information for HCUL-10 for Hermes Environmental Review

(Non-Proprietary)

Kairos Power

NRC Question Number: HCUL-10

In ER Section 4.6.1, it states that the nearest listed National Register of Historic Places property is the K-25 Gaseous Diffusion Plant which is part of the Manhattan Project National Park. The ER states that "...given the intervening structures between the site and the K-25 Plant as well as the low profile of the proposed structures on the site, no visual or other indirect impacts occur." Please describe or discuss any architectural surveys conducted for the proposed project to assess indirect (i.e., visual) effects to other historic and cultural resources (i.e., historic properties) within the viewshed/indirect effects APE?

Kairos Power Response:

During the audit, the NRC requested, and Kairos Power agreed to submit to the docket, supplemental information related to this Audit Information Need Historic and Cultural Resources (HCUL)-10. Specifically, photographs are provided to assess the indirect (i.e., visual) effects to selected historic and cultural resources (i.e., historic properties) within the proposed site viewshed. The following eight photographs were recently taken from the historic and cultural properties in the site vicinity, in the direction of the proposed Hermes facility.

Al photographs were taken on March 24, 2022.

Impact on Licensing Document:

This information does not result in changes to the Hermes Environmental Report.

Photo 1 - Gallaher Cemetery (Front)

Photo 1, taken at the Gallaher Cemetery entrance and facing toward the Hermes site

Photo 2 - Gallaher Cemetery (Back)

Photo 2, taken at the back of the Gallaher Cemetery, facing toward the Hermes site

Photo 3 - African Burial Ground

Photo 3, taken from the African Burial Ground, facing toward the Hermes site

Photo 4 – Wheat Community African Burial Ground (Marker)

Photo 4, taken at the site of the Wheat Community African Burial Ground Marker, facing toward the Hermes site

Photo 5 - Wheat Community Historic Marker

Photo 5, taken at the Wheat Community Historic Marker, facing toward the Hermes site

Photo 6 - George Jones Memorial Baptist Church

Photo 6, taken near the George Jones Memorial Baptist Church entrance, facing toward the Hermes site

Photo 7 - Ellis Cemetery

Photo 7, taken from the Ellis Cemetery fenceline, facing toward the Hermes site

Photo 8 - K-25 Proposed Viewing Platform Site

Photo 8, taken from the proposed site of the K-25 Viewing Platform, facing toward the Hermes site

APPENDIX G

DRAFT ENVIRONMENTAL IMPACT STATEMENT COMMENTS AND RESPONSES

As part of the U.S. Nuclear Regulatory Commission (NRC) review of Kairos Power, LLC's (Kairos's) application for a Construction Permit for the Hermes test reactor in Oak Ridge, Tennessee, the NRC staff solicited comments from the public on the draft environmental impact statement (EIS). The draft EIS was issued, and a 60-day comment period began on October 7, 2022, when the U.S. Environmental Protection Agency (EPA) issued a *Federal Register* Notice of Availability on the draft EIS (87 FR 61014-TN8174) to allow members of the public to comment on the results of the environmental review. The public comment period closed on December 6, 2022.

As part of the process to solicit public comments on the draft EIS, the review team:

- placed a copy of the draft EIS at the Oak Ridge Public Library in Oak Ridge, Tennessee;
- made the draft EIS available in the NRC's Public Document Room in Rockville, Maryland;
- placed a copy of the draft EIS on the NRC website at http://www.nrc.gov/reading-rm/doc-collections/nuregs;
- provided a copy of the draft EIS to the Kairos Hermes environmental review mailing list and any member of the public who requested one;
- sent copies of the draft EIS to certain Federal, State, Tribal, and local agencies;
- published a request for comment on the draft EIS in the *Federal Register* on October 7, 2022 (887 FR 61014-TN8174);
- filed the draft EIS with the EPA; and
- held an in-person public meeting on Wednesday, November 16, 2022, in Oak Ridge, Tennessee with option for virtual attendance.

Approximately 100 people attended the public meeting held at Oak Ridge, Tennessee, and numerous participants provided oral comments. A certified court reporter recorded these oral comments and prepared a written transcript. The transcript of the public meeting is located in NRC's Agencywide Documents Access and Management System (ADAMS) at Accession Number ML22329A011. In addition to the comments received at the public meeting, the NRC received comment letters, e-mail messages, and posts to the regulations.gov site.

The comment letters, regulations.gov posts, e-mail messages, and transcripts of the public meeting are available in NRC's ADAMS. ADAMS is accessible at http://www.nrc.gov/reading-rm.html. Persons who do not have access to ADAMS or encounter problems in accessing the documents located in ADAMS should contact the NRC's Public Document Room reference staff at 1-800-397-4209 or 301-415-4737. The ADAMS accession numbers for the letters, regulations.gov posts, e-mail messages, and transcripts are provided in Table G-1. The remainder of this appendix is organized as follows:

- Section G.1: "Disposition of Comments" provides a list of commenter names and a unique identifier that is used throughout this appendix.

- Section G.2: “Comments and Responses” provides individual comments and the corresponding response by subject category.
- Section G.3: “References” provides the list of references used in this appendix.

G.1 Disposition of Comments

Each set of comments from a given commenter was given a unique correspondence identifier, allowing each set of comments from a commenter to be traced back to the transcript, letter, or e-mail in which the comments were submitted. After the comment period ended, the NRC staff considered and dispositioned all comments received. To identify each individual comment, the NRC staff reviewed the transcripts of the public meetings and each piece of correspondence received related to the draft EIS. As part of the review, the NRC staff identified statements that were related to the proposed action and recorded the statements as comments. Each comment was assigned to a specific subject area, and similar comments were grouped together. Finally, responses were prepared for each comment or group of comments.

Some commenters addressed topics and issues that are not part of the environmental review for this proposed action. Many comments, however, did address the scope of the environmental review, analyses, and issues contained in the draft EIS.

Table G-1 provides a list of commenters identified by name, affiliation (if given), comment number, and the source of the comment.

Table G-1 Individuals Providing Comments During the Comment Period

Commenter	Affiliation (if stated)	Comment Source and Document ID	Correspondence ID
[Author, Missing]		Meeting Transcript (ML22329A011)	8
Anonymous, Anonymous		Email (ML23031A036)	23
Anonymous, Anonymous	Nuclear Matters	reg.gov (ML22336A189)	16
Arndt, Steven	American Nuclear Society	Email (ML22340A045)	11
Baxter, Farouk		Email (ML22284A094)	1
Boatner, Tracy	East Tennessee Economic Council	Meeting Transcript (ML22329A011)	8-8
Campbell, Brian		reg.gov (ML22279A924)	3
Colclasure, Doug		Email (ML22341A025)	7
Creswell, Wade	Roane County Executive	Letter (ML22303A003)	5
Davidson, Bryan	Tennessee Department of Environmental and Conservation	Email (ML22341A022)	14
DeLong, Carmen		Meeting Transcript (ML22329A011)	8-6
Frady, Teresa	CROET Heritage Center	Email (ML22348A214)	18
Franovich, Rani	Breakthrough Institute	Email (ML22347A048)	17
Franovich, Rani	Breakthrough Institute	Meeting Transcript (ML22329A011)	8-1

Table G-1 Individuals Providing Comments During the Comment Period (Continued)

Commenter	Affiliation (if stated)	Comment Source and Document ID	Correspondence ID
Harm, Elizabeth	Energy Technology Environmental Business Association	Meeting Transcript (ML22329A011)	8-10
Hastings, Peter	Kairos Power	Email (ML22340A043)	10
Hastings, Peter	Kairos Power	Meeting Transcript (ML22329A011)	8-3
Hayes, Alyssa		Meeting Transcript (ML22329A011)	8-7
Hopf, Jim	Citizens Climate Lobby	Meeting Transcript (ML22329A011)	8-12
Houghtalen, Natalie	ClearPath	reg.gov (ML22341A162)	22
Hult, Philip	Generation Atomic	Meeting Transcript (ML22329A011)	8-5
Ibarra, Jr., Victor	Nuclear Innovation Alliance	reg.gov (ML22341A160)	20
Kajumba, Ntale	Environmental Protection Agency	Email (ML22340A580)	12
Lowe, Alan	AMSE Foundation	Email (ML22318A311)	6
McIntyre, Jr., Patrick	Tennessee Historical Commission	Email (ML22285A203)	2
Meyer, Eric	Generation Atomic	reg.gov (ML22341A161)	21
Michaels, Christine	Oak Ridge Chamber of Commerce	Meeting Transcript (ML22329A011)	8-11
Mills, Grant		Meeting Transcript (ML22329A011)	8-13
O'Neill, Martin	Nuclear Energy Institute	Email (ML22340A583)	13
Pickering, Ryan		Meeting Transcript (ML22329A011)	8-2
Piercy, Craig	American Nuclear Society	Email (ML22340A045)	11
Russell, Michael		Meeting Transcript (ML22329A011)	8-9
Schroder, Madison	Generation Atomic	reg.gov (ML22341A161)	21
Shaw, John	Roane County Environmental Review Board	Letter (ML22303A003)	5
Skelton, Jim	Tennessee Chamber of Commerce and Industry	Meeting Transcript (ML22329A011)	8-4
Torres, Gilberto		reg.gov (ML22336A190)	15
Walker, Kalene		Email (ML22303A002)	4
Watson, Mark	City of Oak Ridge, TN	Email (ML22348A215)	19
Wieland, Chris		Email (ML22340A042)	9

Table G-2 provides an alphabetical index of the comment categories and lists the commenters and the specific comment identification number(s) that were included in each category.

Table G-2 Comment Categories

Comment Category	Commenter (Comment ID)
Accidents—Severe	• Creswell, Wade (5-1-7) • Hastings, Peter (10-5) • Ibarra, Jr., Victor (20-3) • Shaw, John (5-1-7)
Alternatives—No-Action	• Arndt, Steven (11-5) • Franovich, Rani (17-1-9) (17-1-14) (17-1-15) (17-1-16) (17-1-17) (8-1-3) (8-1-7) • Meyer, Eric (21-2) • Piercy, Craig (11-5) • Schroder, Madison (21-2)
Benefit-Cost Balance	• Franovich, Rani (17-1-6) (17-1-10) (17-1-11) (17-1-13) (8-1-2) (8-1-5) • Hastings, Peter (10-6) • Hopf, Jim (8-12-4)
Cumulative Impacts	• Creswell, Wade (5-1-14) • Ibarra, Jr., Victor (20-4) • Shaw, John (5-1-14)
Ecology—Terrestrial	• Creswell, Wade (5-1-18) (5-2-1) (5-2-2) • Frady, Teresa (18-3) • Shaw, John (5-1-18) (5-2-1) (5-2-2)
Geology	• Davidson, Bryan (14-6)
Health—Nonradiological	• Baxter, Farouk (1-2) • Creswell, Wade (5-1-6) • Davidson, Bryan (14-3) • Shaw, John (5-1-6)
Health—Radiological	• Walker, Kalene (4-1)
Historic and Cultural Resources	• Anonymous, Anonymous (23-1) • McIntyre, Jr., Patrick (2-2)
Hydrology—Groundwater	• Creswell, Wade (5-1-4) (5-1-15) (5-1-16) (5-1-17) • Davidson, Bryan (14-8) (14-9) (14-10) (14-11) (14-12) • Shaw, John (5-1-4) (5-1-15) (5-1-16) (5-1-17)
Hydrology—Surface Water	• Davidson, Bryan (14-1) (14-7) • Hayes, Alyssa (8-7-3)
Land Use-Site and Vicinity	• Arndt, Steven (11-4) • Colclasure, Doug (7-1) (7-2) (7-6) • Hastings, Peter (10-2) (8-3-4) • Hayes, Alyssa (8-7-2) • Hopf, Jim (8-12-5) • Piercy, Craig (11-4) • Watson, Mark (19-3)
Meteorology and Air Quality	• Creswell, Wade (5-1-11) (5-1-10) • Davidson, Bryan (14-2) (14-4) • Shaw, John (5-1-11) (5-1-10)
Noise	• Creswell, Wade (5-1-13) • Shaw, John (5-1-13)

Table G-2 Comment Categories (Continued)

Comment Category	Commenter (Comment ID)
Process—NEPA	• Creswell, Wade (5-1-2) (5-1-3) • Franovich, Rani (17-1-2) (17-1-3) (17-1-4) (17-1-5) (17-1-7) (17-1-18) • Kajumba, Ntale (12-2) • Shaw, John (5-1-2) (5-1-3)
Site Layout and Design	• Baxter, Farouk (1-1) • Hastings, Peter (10-1) (10-3) • Kajumba, Ntale (12-1)
Socioeconomics	• Creswell, Wade (5-2-3) • Franovich, Rani (17-1-12) • Houghtalen, Natalie (22-4) • Michaels, Christine (8-11-2) • Shaw, John (5-2-3) • Watson, Mark (19-2)
Uranium Fuel Cycle	• Creswell, Wade (5-2-6) • Hastings, Peter (10-4) • Shaw, John (5-2-6) • Watson, Mark (19-4) • Wieland, Chris (9-3)
Water Resources	• Creswell, Wade (5-2-4) • Shaw, John (5-2-4)
Support—Nuclear Power	• Anonymous, Anonymous (16-2) • Arndt, Steven (11-1) • Frady, Teresa (18-2) • Franovich, Rani (17-1-1) (17-2-3) • Hastings, Peter (8-3-3) • Hayes, Alyssa (8-7-1) • Hopf, Jim (8-12-3) • Houghtalen, Natalie (22-2) • Piercy, Craig (11-1) • Torres, Gilberto (15-1) • Wieland, Chris (9-1) • Arndt, Steven (11-2) • Colclasure, Doug (7-4) • Frady, Teresa (18-1) • Franovich, Rani (17-2-2) (8-1-6) • Hopf, Jim (8-12-2) • Houghtalen, Natalie (22-1) • Ibarra, Jr., Victor (20-2) • McIntyre, Jr., Patrick (2-1) • Meyer, Eric (21-1) • Michaels, Christine (8-11-1) (8-11-3) • O'Neill, Martin (13-2) • Pickering, Ryan (8-2-1) • Piercy, Craig (11-2) • Schroder, Madison (21-1) • Wieland, Chris (9-2)

Table G-2 Comment Categories (Continued)

Comment Category	Commenter (Comment ID)
Support—Licensing Action	• Arndt, Steven (11-3) • Boatner, Tracy (8-8-1) • Campbell, Brian (3-1) (3-3) • Frady, Teresa (18-4) • Harm, Elizabeth (8-10-1) • Hastings, Peter (8-3-2) • Hayes, Alyssa (8-7-4) • Hult, Philip (8-5-1) • Ibarra, Jr., Victor (20-1) (20-5) • Lowe, Alan (6-1) • Meyer, Eric (21-3) • Mills, Grant (8-13-2) • O'Neill, Martin (13-1) • Piercy, Craig (11-3) • Russell, Michael (8-9-2) • Schroder, Madison (21-3) • Anonymous, Anonymous (16-1) • Skelton, Jim (8-4-1) • Watson, Mark (19-1) (19-6)
Support—Licensing Process	• Arndt, Steven (11-6) • Franovich, Rani (17-1-8) (17-2-1) (8-1-1) (8-1-4) • Harm, Elizabeth (8-10-2) • Hastings, Peter (8-3-1) (8-3-5) • Hopf, Jim (8-12-1) • Houghtalen, Natalie (22-3) • Mills, Grant (8-13-1) • O'Neill, Martin (13-3) • Pickering, Ryan (8-2-2) • Piercy, Craig (11-6) • Russell, Michael (8-9-1)
Editorial Comments	• Creswell, Wade (5-1-1) (5-1-5) (5-1-8) (5-1-12) (5-1-19) (5-2-8) • Davidson, Bryan (14-5) • Shaw, John (5-1-1) (5-1-5) (5-1-8) (5-1-12) (5-1-19) (5-2-8)
Outside Scope—Emergency Preparedness	• DeLong, Carmen (8-6-2) • Watson, Mark (19-5)
Outside Scope—Miscellaneous	• Campbell, Brian (3-2) • Colclasure, Doug (7-3) (7-5) (7-7) • Creswell, Wade (5-1-9) (5-2-5) (5-2-9) • Davidson, Bryan (14-13) • Shaw, John (5-1-9) (5-2-5) (5-2-9)
Outside Scope—NRC Oversight	• DeLong, Carmen (8-6-1)
Outside Scope—Safety	• Creswell, Wade (5-2-7) • Shaw, John (5-2-7)

G.2 Comments and Responses

Table G-3 is a list of the comment categories included in this appendix in the order in which they appear. This section presents the comments and responses organized by topic category. When

the comments resulted in a change in the text of the draft EIS, the corresponding response refers the reader to the appropriate section of the EIS where the change was made. Throughout the EIS, with the exception of this new Appendix G, revisions to the text from the draft EIS are indicated by vertical lines (change bars) in the margin beside the text.

Table G-3 Comment Categories in Order of Presentation

G.2.1 Comments Concerning Accidents—Severe

Comment: Comment ID: 07

Document Location: Page xviii, Table ES-1, Accidents

Comment Description: States “NRC staff is conducting an independent review of the consequences of accidents and will document in its Safety Evaluation (SE) (NRC 2023-TN8414). The last sentence for this resource area states “the nearest resident dose from accidents is also below the radiation dose limits for individual members of the public.” Since the SER is still under development, then how can the last statement under this category be made so definitively? (**5-1-7** [Creswell, Wade] [Shaw, John])

Response: *The U.S. Nuclear Regulatory Commission (NRC) staff performed an audit of the information provided by Kairos Power, LLC (Kairos), in the Kairos Hermes Test Reactor Environmental Report that included a review of postulated accidents (NRC 2022-TN7954). The staff’s environmental review concerning postulated accidents is incorporated in the safety*

review. The safety review provided the final determination that the Hermes test reactor would provide reasonable assurance of adequate protection of public health and safety. As part of developing the final environmental impact statement (EIS), the postulated accidents discussion was reviewed and coordinated with the safety review to ensure that appropriate adjustments are made to Section 3.11 of the EIS. No changes were made to the EIS based on this comment.

Comment: Comment Number: 5

Draft Environmental Impact Statement Text and Location: Page 3-79, Line 36: Additionally, as an indicator of the low risks from postulated accidents, the MHA dose at the LPZ is also below the annual radiation dose limits for individual members of the public of 100 mrem TEDE under 10 CFR 20.1301(a).

Comment: The MHA dose at the LPZ is below the annual dose limit values specified in 10 CFR 20.1301(a). However, these limits are for annual effluent releases and are not applicable to MHA doses associated with postulated events in this or other applications. We believe the NRC staff's purpose in making this comparison is to demonstrate the fact that even postulated accident doses are below normal-operation limits, but we suggest some clarification. (**10-5** [Hastings, Peter])

Response: *The statement in question is providing clarification to the significance of the accident finding to place this risk in perspective with radiation levels that adequately protect public health and safety. Changes were made to Section 3.11 of the EIS based on this comment to further clarify that postulated accident doses are below normal operating limits.*

Comment: The Draft EIS prepared by the NRC found that Kairos Power's Hermes Test Reactor would have very limited impacts to the environment. Specifically, the NRC staff concluded that the design would result in "SMALL" environmental impacts across all studied resources areas. The Draft EIS also highlighted the protective characteristics of TRISO fuel pebbles including the ability to mitigate significant radioactive effluent release in an accident scenario. (**20-3** [Ibarra, Jr., Victor])

Response: *This comment restates the conclusions and basis of the staff's findings for postulated accidents. No changes were made to the EIS based on this comment.*

G.2.2 Comments Concerning Alternatives—No-Action

Comment: I strongly encourage the NRC to more fully and holistically examine and characterize the substantial adverse impacts of taking no federal action, not just for the Hermes test reactor but for all major federal actions involving any reactor, any nuclear power generation, from either the currently operating fleet or future generations of nuclear technologies. (**8-1-7** [Franovich, Rani])

Response: *As noted in Section 1.2 of the draft EIS, the purpose and need of the proposed Kairos Hermes test reactor project is to demonstrate key elements of the Kairos Power Fluoride Salt-Cooled, High Temperature Reactor technology for possible future commercial deployment. Section 4.1 of the draft EIS notes that under the No Action Alternative, the applicant would not have an opportunity to test the new technology, and that missing this opportunity could slow or impede the safe and efficient development of the technology. Section 4.3 of the draft EIS contains a cost-benefit analysis for the proposed Hermes project that presents several possible benefits of the proposed Hermes project that would be foregone should the applicant be denied a construction permit (CP) and could not build the project. Section 4.4 of the draft EIS notes that the no action alternative would not meet the*

purpose and need for the action. The NRC staff maintains that the information noted in the referenced sections of the draft EIS adequately characterizes the environmental impacts of the no action alternative. The staff notes that further exploration of the no action alternative could be speculative and therefore beyond the scope of a proper National Environmental Policy Act (NEPA) analysis. No changes were made to the EIS in response to this comment.

Comment: However, there is room for improvement of the EIS. It starts with the recognition that NRC's issuance of an operating license or construction permit is a necessary major federal action to demonstrate an option that mitigates global warming, health effects of fossil alternatives, and threats to the nation's energy security. However, public health and safety are undermined when the federal government takes no action, takes no action, takes too long, or charges the applicant excessive review fees that disincentivize rapid deployment of safe new nuclear technologies.

I and other stakeholders commented during the NRC scoping meeting on March 23rd, 2022 that the environmental impact of constructing and operating the Hermes test reactor should be considered and weighed against the more significant environmental impacts and health effects associated with alternative energy technologies that might supplant nuclear energy generation, primarily fossil sources that emit carbon dioxide. However, it appears that the NRC staff did not apply this comment in its review of the no action alternative presented in Section 1 in Table 4-1.

Section 4.1, quote, no action alternative, end quote, includes the following excerpt, and I'm quoting: None of the environmental effects described in Section 3.0 of this draft EIS would occur under the no action alternative, but, because Section 3.0 characterizes all potential environmental impacts of the proposed action as small, any environmental benefits from selecting the no action alternatives or the no action alternative instead of the proposed action would be minimal. I beg to differ.

The NRC staff's characterization of the no action alternative as environmentally beneficial fails to consider the lost benefits of the Hermes project discussed in Section 5.3.2 of the draft EIS. There are no environmental benefits to the no action alternative. Rather, this alternative is detrimental to society's interest and realizing the benefits of clean, safe, base load capacity from nuclear generation.

As a former member of the NRC staff for 30 years and a branch chief over both safety and environmental reviews for power reactor license renewal, I am very familiar with the NRC staff's characterization, it's a longstanding characterization, of the no action alternative as somehow environmentally benign. Careful examination of this superficial assertion reveals a flawed paradigm. It fails to consider the pressing concerns about the public's general welfare. For example, as long as energy demand outpaces supply and fossil alternatives are available, failure to license, construct, or operate a safe, emission-free nuclear power reactor is absolutely detrimental to society.

The no action alternative perpetuates global climate change, degrades environmental quality, harms human health, and undermines national energy security. This substantial impact to the local, national, and global community needs to be duly considered in all environmental reviews undertaken by the NRC and reflected in their environmental impact statements, including the final EIS for the Hermes test reactor. (**8-1-3** [Franovich, Rani])

Comment: <u>No Action Alternative</u>

<u>ANS agrees with the NRC statement that the failure to construct and operate Hermes "...could slow or impede safe and efficient development of the [KP-FHR] technology."</u>

(Section 4.1, p. 4-2). However, ANS does not agree that this is the full extent of the adverse impact of the no action alternative.

Timely deployment of the advanced reactor designs will be necessary if the United States is to meet its aggressive decarbonization targets. In addition to clean electricity generation, high temperature reactors like the KP-FHR will be essential for large scale replacement of greenhouse gas-emitting fossil fuels in many industrial applications. Failure to issue a timely construction permit for Hermes would have a chilling effect on the deployment of all advanced nuclear energy systems, thereby jeopardizing the nation's ability to limit the extent of harmful climate impacts. (**11-5** [Arndt, Steven] [Piercy, Craig])

Comment: Additionally, failure to license and deploy new and advanced reactors has significant negative consequences to the environment, climate change and human health. These detrimental impacts of the "no action" alternative should be generically characterized in the GEIS for advanced reactors. (**17-1-9** [Franovich, Rani])

Comment: As a former member of the NRC staff for 30 years, and branch chief over both safety and environmental reviews for power reactor license renewal, I am very familiar with the NRC staff's long-standing characterization of the "no action" alternative as somehow environmentally benign. However, careful examination of this simplistic assertion reveals a flawed paradigm. It fails to consider pressing concerns about the public's general welfare.

Improvement toward modernization starts with the recognition that NRC's issuance of an operating license or construction permit is a necessary Federal action to mitigate climate change, reduce adverse health effects of alternatives that emit air pollutants, and reduce threats to the Nation's energy security. From this holistic perspective, public health and safety are undermined when the Federal government takes no action, takes too long, or charges the applicant excessive review fees that disincentivize deployment of safe new nuclear generation. (**17-1-14** [Franovich, Rani])

Comment: The Breakthrough Institute and other stakeholders commented during the NRC scoping meeting on March 23, 2022, that the environmental impact of constructing and operating the Hermes test reactor should be considered and weighed against the more significant environmental impacts and health effects associated with alternative energy technologies that might supplant nuclear energy generation, primarily fossil sources that emit carbon dioxide and other pollutants. Although the NRC staff acknowledged the long-term benefits of nuclear energy that outweigh any short-term environmental impacts of this project, it appears that the staff did not apply this comment in its review of the "no action" alternative, discussed in Section 4 and presented in Table 4-1. (**17-1-15** [Franovich, Rani])

Comment: The NRC staff's characterization of the "no action" alternative as environmentally beneficial is inaccurate; it fails to consider the lost benefits of the Hermes project discussed in Section 5.3.2 of the draft EIS. There are no environmental benefits to the "no action" alternative. Rather, this alternative is detrimental to Society's interest in realizing the benefits of safe, clean, baseload capacity from nuclear generation. The Hermes EIS should be revised to reflect this. (**17-1-16** [Franovich, Rani])

Comment: Final Interim Staff Guidance Augmenting NUREG-1537, Part 1, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Format and Content," dated October 17, 2012, includes the following statement in Section 19.5.1, "No-Action Alternative."

> *For applications to construct and operate a new non-power reactor, the no-action alternative usually considers the environmental impacts if the construction permit or operating license is denied. In such case,* ***the environmental impacts would generally be the same as the status quo*** [emphasis added].[7]
>
> [7] ADAMS Accession Number ML12156A069, p. 121

This characterization omits any discussion of the harms of "status quo" energy sources. As long as energy demand outpaces supply, and fossil alternatives are available, failure to license, construct or operate a safe, emission-free nuclear power reactor is absolutely detrimental to Society. The "no action" alternative perpetuates global climate change, degrades environmental quality, harms human health, and undermines National energy security. This substantial impact to the local, National and global community needs to be duly considered in all environmental reviews undertaken by the NRC staff and reflected in their EISs—including the GEIS for advanced reactors and the Final EIS for the Hermes test reactor. Guidance associated with NUREG-1537 should be updated to reflect the environmental harms and negative human health effects of the "no action" alternative. The NRC staff should make conforming changes to any other guidance governing NRC's review of environmental impacts caused by its decision-making (or failure to take a Federal action). (**17-1-17** [Franovich, Rani])

Comment: Regarding discussions of the Kairos Hermes Test Reactor's environmental impact, we believe that it is important to consider the impact on the environment if the project does not continue. Nuclear energy provides carbon-free base load energy with very little land use, making it one of, if not the most, environmentally friendly sources of energy available. Failure to develop nuclear energy projects such as the Kairos reactor will encourage the continued use of fossil fuels and damage to the planet. Any analysis of the environmental impact of this reactor should take into account the effect of its non-build as well. (**21-2** [Meyer, Eric] [Schroder, Madison])

Response: *The NRC staff appreciates the information and insight provided in these comments. Section 4.3 of the draft EIS contains a cost-benefit analysis of the proposed Kairos Hermes test reactor project that notes many of the benefits alluded to in these comments. These possible benefits would not be realized under the No Action Alternative. However, the NRC staff maintains that deeper exploration of the possible environmental effects of the No Action Alternative could be speculative and therefore outside the scope of a NEPA analysis. While there is a possibility that there could be an increase in the use of fossil fuels in the future should the Hermes project not be licensed (or decrease in the use of fossil fuels in future), these long-term possibilities are speculative. The technology proposed for demonstration by the Hermes project is not the only advanced nuclear reactor technology under consideration at this time, and there are other possible ways that use of fossil fuels could decrease in the future (e.g., increased renewable energy generation). Such a broad perspective for evaluating the ramifications of differing energy generation technologies is beyond the scope of possible environmental consequences of a specific project such as Hermes. Hence, no changes were made to the EIS in response to these comments.*

G.2.3 Comments Concerning Benefit-Cost Balance

Comment: I was pleased to see the NRC staff's characterization of the environmental impacts in Section 5.3.2, which describes the relationship between local short-term uses of the environment and maintenance and enhancement of long-term productivity. An excerpt from this section reads as follows: quote, while the uses of and impacts on environmental resources

would be minimal over the short term, the long-term benefits from implementation of the Hermes project could be substantial. Operation of the Hermes facilities could help demonstrate the commercial viability of the Kairos power fluoride salt-cooled high-temperature technology and may generate data helpful in future commercial deployment of the technology. Successful future deployment of the technology could help the United States develop another economically-viable source of energy and help the nation meet its climate change objectives.

And I want to emphasize this next quote. These are all the same quote. Use of the technology may help the United States meet its 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 large commitments of land and have a greater potential for aesthetic impact on landscapes and seascapes and physical injury to terrestrial or aquatic wildlife, end quote. That entire few passages came from the staff's EIS, draft EIS.

This is a relevant and appropriate consideration, and it is consistent with the Energy Reorganization Act of 1974, which acknowledges the benefits of nuclear energy to, quote, meet the needs of present and future generations; to increase the productivity of the national economy and strengthen its position in regard to international trade; to make the nation self sufficient in energy; to advance the goals of restoring, protecting, and enhancing environmental quality; and to assure public health and safety, end quote. (**8-1-2** [Franovich, Rani])

Comment: their thoughtful consideration of the substantial long-term benefits from implementation of the Hermes project. (**8-1-5** [Franovich, Rani])

Comment: By producing high-temperature heat, the Kairos reactor will also be able to serve industrial process heat applications that would otherwise be difficult to decarbonize. (**8-12-4** [Hopf, Jim])

Comment: Next generation light-water and nonlight-water reactors pose far fewer and much smaller negative impacts to the environment than non-nuclear energy and industrial complexes. In fact, as the NRC staff has noted in the instant Draft EIS, the long-term benefits of these reactors to Society far outweigh any short-term negative impacts (see Section IV of this comment). (**17-1-6** [Franovich, Rani])

Comment: We were pleased to see NRC staff's characterization of the environmental impacts in Section 5.3.2, "Relationship Between Local Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity." An excerpt from this section reads as follows:

> *While the uses of, and impacts on, environmental resources would be minimal over the short term, the long-term benefits from implementation of the Hermes project could be substantial.*[4]
>
> [4] ADAMS Accession Number ML22259A126, p. 5-9

We agree with this astute assessment and commend the NRC staff for acknowledging the following salient facts:

(1) Operation of the Hermes test facility could help demonstrate the commercial viability of the technology and generate useful data for commercial deployment.

(2) Successful demonstration could lead to large-scale deployment of another economically viable source of energy vital to meeting National climate change objectives.

(3) Use of the technology may help the U.S. meet its climate change goals with less reliance on more land-intensive energy generation (e.g., large solar or wind) that has a more negative aesthetic impact to landscapes and seascapes and greater potential to harm wildlife.

This is a relevant and appropriate consideration as the NRC evaluates the construction permit application for the Hermes test reactor. It also is consistent with the Energy Reorganization Act of 1974, which acknowledges the benefits of nuclear energy to "meet the needs of present and future generations, to increase the productivity of the national economy and strengthen its position in regard to international trade, to make the Nation self-sufficient in energy, to advance the goals of restoring, protecting, and enhancing environmental quality, and to assure public health and safety."[5] The NRC staff deserves much credit for its work on Section 5.3.2 of the Draft EIS.

[5] ADAMS Accession Number ML13274A489, Sec. 2. "Declaration of Purpose" (**17-1-13** [Franovich, Rani])

Response: *These comments agree with the staff's characterization of technological benefits that may occur based upon successful demonstration of the Kairos Hermes Test Reactor project. The staff acknowledges the potential for such benefits to arise in the future, as discussed in the draft EIS. However, these comments do not present new information affecting the staff's analysis of the proposed action. Hence, no changes to the draft EIS were made as a result of these comments.*

Comment: In Section 4.3 "Cost-Benefit of the Alternatives," the NRC staff described the economic benefits of the Hermes project at the alternative Eagle Rock site. However, we did not find a similar assessment of costs and benefits of the proposed action at the preferred site in Oak Ridge, TN.

Consistent with 10 CFR 51.45(c)[1], the applicant described the benefits of the proposed action in Section 6.2.1 of its environmental report (ER).

[1] 10 CFR 51.45(c) states "...the analysis in the environmental report should also include consideration of the economic, technical, and other benefits and costs of the proposed action and its alternatives." (**17-1-10** [Franovich, Rani])

Comment: Yet the Draft EIS for the Hermes test reactor does not explicitly consider the proposed action's economic costs and benefits. Rather, it does so obliquely in Section 4.3.1, "Cost- Benefit of the Alternatives." In this section the NRC staff described the economic stimuli from project-related incomes during the construction, operation, and decommissioning of the proposed test reactor—including the hundreds of workers needed to construct and operate the plant. This means skilled jobs for plant workers. The NRC staff further noted that most of the skills needed for these jobs are "available locally" at the alternative site.

However, the same should be true at the preferred site in Oak Ridge, TN, or the surrounding communities. Because these benefits are discussed only in the context of an alternative site, they are not explicitly considered for the proposed action. The NRC staff should remedy this oversight in the Final EIS. (**17-1-11** [Franovich, Rani])

Response: *These comments agree with the conclusions of the NRC staff's analysis of benefits and costs, but indicate the interpretation that the analysis was only carried out for the Eagle Rock alternative site near Idaho Falls, Idaho, and not for the proposed site on the Oak Ridge Reservation (ORR), Tennessee. The staff conducted detailed analysis of potential benefits and costs as described in Section 4.3.1. The staff specifically indicated that the analysis results apply equally, whether the ORR site or the Eagle Rock site were considered. The comments did not provide any new or different information for the staff's consideration. Hence, no changes to the EIS were made as a result of these comments.*

Comment: Comment Number: 6

Draft Environmental Impact Statement Text and Location: Page 4-9, Line 23: The applicant did not provide cost (internal, external, fuel, waste disposal) information for the construction, operation, or decommissioning of the proposed project.

Comment: Financial information was provided as proprietary information in enclosure 4 with the PSAR submission dated September 29, 2021. (**10-6** [Hastings, Peter])

Response: *The staff agrees with the comment and has considered the information discussed in the comment as part of its review. Section 4.3 of the EIS has been revised accordingly.*

G.2.4 Comments Concerning Climate Change

None

G.2.5 Comments Concerning Cumulative Impacts

Comment: Comment ID: 15

Document Location: Page 3-23, Line 25

Comment Description: The current water treatment plant is identified as "currently at capacity and beyond its useful life." A new drinking water treatment plant is planned and scheduled to be operational by 2025 (roughly two years after construction starts). How firm is this replacement schedule? Can the estimated water treatment need for not only the Hermes reactor project but also all the other new projects planned for the Horizon Center and Heritage Center be handled by the increased capacity planned? (**5-1-14** [Creswell, Wade] [Shaw, John])

Response: *As explained in Section 3.3 of the draft EIS, based on information available at this time, the NRC staff expects that the water treatment capabilities of the City of Oak Ridge, Tennessee, would be adequate to handle the increased demands of the Kairos Hermes Test Reactor project over its full life cycle as well as those of other reasonably foreseeable projects. The only licensing decision to be made at this time is issuance of a CP authorizing construction of the proposed Hermes facilities. When Kairos applies for an operating license (OL) in the future requesting NRC to authorize operation of the new facilities, the NRC staff will evaluate any new and significant information available at that time regarding the City's capabilities of handling the water treatment demands of the Hermes facilities and other reasonably foreseeable demands. No changes were made to the EIS in response to this comment.*

Comment: Further, the Draft EIS determined that Hermes Test Reactor would result in minimal to no expected cumulative impacts related to land use, air quality, or water resources in Oak Ridge, Tennessee, despite conservative assumptions. (**20-4** [Ibarra, Jr., Victor])

Response: *The NRC staff acknowledges this comment regarding cumulative impacts, which reflects the conclusions presented in the draft EIS. No changes were made to the EIS in response to this comment.*

G.2.6 Comments Concerning Ecology—Terrestrial

Comment: Comment ID: 19

Document Location: Page 3-27, Line 40

Comment Description: One Federal candidate species was noted in the discussion on Federally listed endangered species. However, no further identification of this Federal candidate species is mentioned. Information for this Federal endangered species candidate should be included. (5-1-18 [Creswell, Wade] [Shaw, John])

Response: *Information about the indicated Federal candidate species, the monarch butterfly, has been added to Section 3.4. The mowed grasses and concrete foundations present in areas of the site subject to disturbance during building and operation activities of the Kairos Hermes Test Reactor facilities do not provide quality habitat for the monarch butterfly. However, because Federal agencies such as the NRC are not required to consult on Federal candidate species under Section 7 of the Endangered Species Act, the monarch butterfly was not addressed in the biological evaluation contained in Table 3-5 of the EIS.*

Comment: Comment ID: 22

Document Location: Page 3-29, Line 10

Comment Description: Mention is made of cooling towers not being part of the Hermes project. However, mention has been made of 100-foot stacks. Were these considered for potential impacts on wildlife during construction (Section 3.4.2), as well as during operation (Section 3.4.3)? (**5-2-2** [Creswell, Wade] [Shaw, John])

Response: *The NRC staff considered the potential for bird collisions with tall structures during building and operation of the proposed facilities when preparing the evaluations presented in Sections 3.4.2 (Environmental Consequences of Construction) and 3.4.3 (Environmental Consequences of Operation). The literature review cited in those sections supports the staff's conclusions and considered possible collisions with a number of tall structures commonly associated with nuclear sites, not just cooling towers. No additional information needs to be added to the draft EIS to address this comment. Hence, no additional information was added to the EIS.*

Comment: Comment ID: 21

Document Location: Page 3-28, Lines 37–38

Comment Description: Disturbed soils and further establishment of invasive species is address in a generalized statement. Was the invasive species *Solenopsis invicta*, Red Imported Fire Ant,

considered due to their prevalence in the area and preference for freshly disturbed soils for colony establishment? (**5-2-1** [Creswell, Wade] [Shaw, John])

Response: *The NRC staff did not specifically address the red imported fire ant in the draft EIS. However, the staff expects that the applicant would promptly revegetate the exposed soils as part of their best management practices for erosion control. The anticipated soil disturbance to build the proposed facilities would therefore not likely provide a substantive opportunity greater than a plowed crop field for the establishment of invasive species favoring disturbed soils. The staff added information in Section 3.4.2 of the EIS addressing the red imported fire ant, but the newly added information does not change the staff's conclusions.*

Comment: I don't think Kairos could have chosen a better location for their test reactor given the history of Oak Ridge and the K-25 site and the conclusion by the NRC staff that the potential direct, indirect, and cumulative ecological impacts of the proposed action would be small. (**18-3** [Frady, Teresa])

Response: *The NRC staff acknowledges this comment, but the comment does not provide new information affecting the NRC staff's analysis of the proposed action. Hence, no changes were made to the EIS in response to this comment.*

G.2.7 Comments Concerning Geology

Comment: Remediation—Oak Ridge

TDEC notes that the Draft EIS does not include a discussion of the ongoing Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) activities occurring within or around the Project Site area. The Draft EIS states several times that "DOE has remediated the land environmentally and released it for industrial use." TDEC encourages NRC to clarify this statement in the final EIS by detailing that soils have been designated for industrial use to 10 feet below ground surface (ft bgs). Groundwater and media below 10 feet have not been mentioned in the Draft EIS and are currently being addressed within ongoing CERCLA activities.

The Draft EIS notes that significant excavation below 10ft bgs is planned for this site to support the Kairos Hermes test reactor. Excavation at this depth will require an Excavation/Penetration Permit (EPP) from the United States Department of Energy (DOE) for this site. TDEC encourages NRC to include a discussion of this permitting requirement, as well as a soil management plan which may be addressed through the EPP program, in the final EIS. Groundwater and other environmental media below 10ft bgs will not be addressed until current and future CERCLA actions are completed. Based on unknown conditions below 10ft bgs, TDEC recommends baseline sampling to determine if there are CERCLA contaminants that may be mobilized by site preparations. (**14-6** [Davidson, Bryan])

Response: *The area of the Heritage Center Industrial Park (Heritage Center), including that of the proposed Kairos Hermes Test Reactor site, has produced nuclear fuel for weapons and reactors for approximately four decades. Because of these operations, the area has a legacy of radiologically and chemically contaminated structures, soil, sediment, and groundwater that required remedial action to reduce the risk to human health and the environment. Since the early 1990s, the U.S. Department of Energy (DOE) Oak Ridge Office of Environmental Management (OREM) has directed the environmental cleanup of this contaminated land through the Comprehensive Environmental Response, Compensation and Liability Act of 1980*

(CERCLA) process. The cleanup activities have included the demolition of contaminated facilities and structures, including the DOE Buildings K-31/K-33 formerly on the Hermes site, remediation of contaminated soils, disposal of associated waste, and treatment of contaminated groundwater.

Due to these past industrial activities, the quit claim deed (Condition 10) includes a prohibition for extraction or use of the groundwater, in any way, unless such use is approved in advance by the grantor, the U.S. Environmental Protection Agency (EPA) and the Tennessee Department of Environment and Conservation (TDEC). Additional provisions are included to prevent inadvertent exposure to contaminated groundwater and/or any contamination that could possibly remain in the excavated soils. Details on the site conditions, including annual DOE environmental sampling and monitoring plans are publicly available at the DOE Information Center, as cited in the EIS references, including DOE/OR/01-2749&D1/A2/R1, "Addendum 2 to the Supplemental Sampling and Analysis Plan for the East Tennessee Technology Park Sitewide Residual Contamination Remedial Investigation K-31/K-33 Area Oak Ridge, Tennessee." The NRC staff added a discussion of the ongoing CERCLA activities by DOE in the Heritage Center to Section 3.1.1 of the EIS.

The NRC staff has also added a note in Section 3.3.2.2 that the applicant would obtain any necessary DOE approvals for the excavation.

G.2.8 Comments Concerning Health—Nonradiological

Comment: Comment ID: 06

Document Location: Page xvii, Table ES-1, Human Health

Comment Description: States *"DOE has already razed the buildings and remediated the site for unrestricted industrial use."* This statement is incorrect. See Comment 04 for specifics. (**5-1-6** [Creswell, Wade] [Shaw, John])

Response: *The "Summary of Impact" summary text for human health in Table ES-1 has been edited to indicate that DOE has remediated the site for industrial reuse subject to conditions.*

Comment: There is a need to address normal, off-site, and standby power sources and their individual environmental impacts. For all three sources, if oil containing transformers are being utilized, the environmental impact of oil spills, fires, explosions, and run-off fire suppression systems must be addressed.

The need for any specific new or upgraded off-site power supplies and their environmental impact, including increased emf exposure must be addressed.

Spills, fires, and explosions from on-site standby fuel oil supplies, and the on-site source itself, need to be included. (**1-2** [Baxter, Farouk])

Response*: Section 3.7.1 of the draft EIS addresses non-radiological health hazards, including those attributable to oil use and storage. Section 3.7.1.3 of the draft EIS notes that the Kairos Hermes Test Reactor project would not involve building or operating high-voltage transmission lines or switchyards, and that there would therefore be little potential for health hazards caused by electromagnetic fields. The draft EIS notes that the applicant would comply with applicable Occupational Safety and Health Administration (OSHA) regulations and other regulations*

*related to oil spills and onsite oil storage. The applicant has indicated that it has not yet prepared a spill prevention control and countermeasures (SPCC) plan (*Kairos 2023-TN8172*); however, a SPCC plan is not required at the CP stage of licensing. The staff expects that the applicant would prepare such a plan if required by other agencies. This information has been added to Section 3.7.1 of the EIS.*

Comment: The initial project will not involve the demolition or renovation of facilities, but the Draft EIS projects that the facilities built as part of this project will be demolished at the end of the test period. Be advised that there are federal regulations enforced by the EPA and TDEC regarding asbestos renovation and demolition activity.[3] These regulations apply to any facilities proposed to be demolished. When any structures are proposed to be demolished, an asbestos demolition notification must be provided in advance, and proper pre-demolition surveys should be conducted to identify any regulated asbestos containing material (ACM) present. Prior to any demolition, all facilities must to be examined for ACM, and all potential ACM in the buildings proposed for demolition must be handled and disposed of according to the applicable federal, state, and local regulations.

[3] See TAPCR 1200-03-11-.02; https://www.epa.gov/asbestos/asbestos-laws-and-regulations. (**14-3** [Davidson, Bryan])

Response: *The NRC acknowledges this comment and expects that the applicant would comply with all applicable Federal, State, and local regulatory requirements when decommissioning the Kairos Hermes Test Reactor project. No changes were made to the EIS in response to this comment.*

G.2.9 Comments Concerning Health—Radiological

Comment: Of particular interest / concern is the plan for disposition of the Flouride salt waste (and TRISO fuel pellets).

I have been unable to find information on the current location and disposition of waste from the five SFR fast breeder reactors referenced in slides 12-15.
https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML22262A252

Could you please send information on the current location and disposition of the sodium waste from these reactors as well as the Oakridge SMRE.

Certainly, viable plans for the long lived radioactive waste must be thoroughly evaluated in NRC review and EIS for the proposed test reactor. (4-1 [Walker, Kalene])

Response: *The disposition of lithium tetrafluoroberyllate (Li_2BeF_4, Flibe) and spent TRI-structural ISOtropic (TRISO) fuel is discussed in Section 3.9 of the EIS and states that the Flibe will be treated as low-level radioactive waste and the spent TRISO fuel will be safely stored in accordance with NRC regulations. No changes were made to the EIS based on this comment.*

G.2.10 Comments Concerning Historic and Cultural Resources

Comment: On December 6, 2022, the NRC received comments from a consulting Tribe on the Kairos DEIS which requested that a cultural resources survey be conducted for the proposed project. In its letter, the Tribe also informed NRC of its interest in acting as a consulting party

and requested that the NRC include its office regarding the development of the Archaeological Monitoring and Discovery Plan for the Kairos site. (**23-1** [Anonymous, Anonymous])

Response: *NRC staff met with the consulting Tribe on June 1, 2023, and June 5, 2023, to discuss supplemental information provided by Kairos in April of 2023. The Tribe confirmed that consultation should remain at a government-to-government level. The consulting Tribe requested additional information regarding the extent and depth of construction fill across the site and that a reconnaissance field investigation be performed by a geoarchaeologist qualified by Secretary of Interior (SOI). The consulting Tribe agreed with NRC staff that the draft Archaeological Resources Monitoring and Unanticipated Discovery Plan (monitoring plan) should be updated by the SOI-qualified archaeologist and include a mitigation plan, work controls, and monitoring procedures. Additionally, the consulting Tribe stated that their office wants to receive the weekly monitoring reports once construction commences.*

On June 6, 2023, the NRC met with Kairos to discuss the April 2023 supplemental information and provide preliminary comments from the NRC and the consulting Tribe. As a result of NRC's meetings with the consulting Tribe, Kairos agreed to work with a geoarchaeologist, qualified by the SOI, to review pertinent information related to the proposed project and develop a methodology for the reconnaissance field investigation, and update the draft monitoring plan, as appropriate. Kairos will make available the methodology for the field investigation to the NRC and consulting Tribe for review and comment. At the time of publishing this final EIS, the consulting parties have agreed upon a path forward to support NHPA Section 106 consultation closure. NHPA Section 106 consultation closure will be documented in the NRC's Record of Decision. Section 3.5 of the EIS has been revised in response to this comment.

Comment: Based on the additional information provided, and in accordance with our previous correspondence dated March 11, 2022 we find that the project will have not adversely affect historic properties.

This office has no objection to the implementation of this project as currently planned. If project plans are changed or previously unevaluated archaeological resources are discovered during project construction, please contact this office to determine what further action, if any, will be necessary to comply with Section 106 of the National Historic Preservation Act. (**2-1** [McIntyre, Jr., Patrick])

Response: *The NRC acknowledges the comments from the Tennessee Historical Commission (THC). Section 3.5 of the EIS has been updated to reflect the THC's concurrence with the NRC's finding of no adverse effects to historic properties.*

G.2.11 Comments Concerning Hydrology—Groundwater

Comment: Comment ID: 16

Document Location: Page 3-120, Line 2

Comment Description: Deepest excavation depth is identified as 30 feet below 765-foot grade level. This excavation depth will reach bedrock (limestone) thus ensure resulting in contact with existing groundwater during construction. See Comment 04 for safety issues with regard to groundwater contact restrictions for this TMZ designated site. (5-1-15 [Creswell, Wade] [Shaw, John])

Response: *Due to past industrial activities at the Kairos Hermes Test Reactor site, the quit claim deed (Condition 10) includes a prohibition for extraction or use of the groundwater, in any way, unless such use is approved in advance by the DOE (the grantor), the EPA, and the TDEC. Additional provisions are included in the deed to prevent inadvertent exposure to contaminated groundwater and/or any contamination that could possibly be present in the excavated soils. The analyses in the EIS assume that the applicant would comply with the provisions of the deed. No changes were made to the EIS in response to this comment.*

Comment: TDEC encourages the NRC to consider including a statement under the Hydrogeology and water resources row in Table ES-1 of the Executive Summary (Page xvi) detailing how dewatering activities may impact groundwater flow in the area. It is unclear from the Draft EIS how the proposed stormwater pond will be constructed. If the stormwater pond will allow for infiltration of stormwater into the subsurface, will this impact existing CERCLA groundwater activities? For example, the footprint of the proposed stormwater pond and potential subsurface infiltration of water falls within an area of CERCLA groundwater action (existing monitoring well UNW-083) that may impact the proposed monitored natural attenuation (MNA) remedy for groundwater in this general area. The Final EIS should evaluate whether monitoring well UNW-083 must be abandoned to allow for pond construction. (**14-8** [Davidson, Bryan])

Response: *The applicant would be required to comply with the quit claim deed established by the DOE for future users of the land now composing the Kairos site, including requirements that land use not interfere with DOE environmental monitoring and remediation activities. No changes were made to the EIS in response to this comment.*

Comment: TDEC encourages the NRC to edit Section 3.3.2.1 Affected Environment (Page 3-22; Paragraph starting at Line 34) in the Final EIS to acknowledge that, although current water quality is expected to be poor, CERCLA actions are underway to remediate and restore groundwater within the Project Site area to beneficial reuse. Any actions taken at this site will be required to comply with state and federal water regulations. As such, this section would benefit from a discussion about the ongoing CERCLA groundwater activities and include the list of contaminants that are present in groundwater at concentrations greater than federal and state numerical standards if relevant.(14-9 [Davidson, Bryan])

Response: *The NRC staff added a discussion of ongoing CERCLA activities by the DOE in the Heritage Center Industrial Park to Section 3.1.1 of the draft EIS. Specific sampling and analysis plans, including annual environmental sampling plans, are publicly available and published by the DOE Information Center as cited in the EIS references, including DOE/OR/01-2749&D1/A2/R1, "Addendum 2 to the Supplemental Sampling and Analysis Plan for the East Tennessee Technology Park Sitewide Residual Contamination Remedial Investigation K-31/K-33 Area Oak Ridge, Tennessee." The DOE annual reports cited in the draft EIS provide lists of contaminants and concentrations known to occur in the area.*

Comment: Comment ID: 04

Document Location: Page xiii, Lines 39–40

Comment Description: Draft EIS states *"DOE has remediated the land environmentally and released it for industrial reuse*" This statement is incomplete as it fails to identify that release is conditional based on requirements stipulated in DOE/OR/01-2893&D1/R1, *Remedial Investigation/Feasibility Study Report for the K-31/K-33 Area at the East Tennessee Technology*

Park, Oak Ridge, Tennessee dated November 2021. In this document the entire K31/K-33 Area is defined as a target management zone (TMZ). Included in this TMZ are multiple target treatment zones (TTZs). The timeframe to address this groundwater contamination is identified as over 25 years under Alternative 2 (natural attenuation). While Kairos does not plan to use groundwater, and the Quitclaim Deed in fact prohibits such action, the Remedial Study indicates need to prevent:

- Exposure of construction workers to contaminated groundwater during excavation within the TMZ until land use controls and monitored contaminant levels are reduced below protective levels.
- Exposure to groundwater to protect human receptors (through dermal, ingestion, and inhalation pathways) until contaminant concentrations are reduced to maximum contaminant levels. (**5-1-4** [Creswell, Wade] [Shaw, John])

Comment: Comment ID: 17

Document Location: Page 3-24, Line 11

Comment Description: Since potential for dewatering activities is almost guaranteed, is planned wastewater treatment path configured/licensed to handle previously identified groundwater contaminants? (**5-1-16** [Creswell, Wade] [Shaw, John])

Comment: Comment ID: 18

Document Location: Page 3-25, Lines 31–32

Comment Description: States *"minor impacts could be associated with discharges of the extracted groundwater to Poplar Creek*." DOE/OR/012893&D1/R1, *Remedial Investigation/Feasibility Study Report for the K-31/K-33 Area at the East Tennessee Technology Park, Oak Ridge, Tennessee* dated November 2021 stipulates that any groundwater extracted must be treated with filtration and io-exchange prior to discharge. Contaminants recovered through this physiochemical treatment is stipulated to require management at an appropriate treatment, storage, and disposal facility. (**5-1-17** [Creswell, Wade] [Shaw, John])

Comment: In Section 3.3.2.2 Environmental Consequences of Construction (Page 3-24; Line 7), the excavation depths for the ancillary buildings are estimated to be approximately 10 ft bgs. Based on the reported encountered depth to water of 6 to 8 ft bgs (Kairos 2021-TN7880), is it anticipated that dewatering will be necessary during construction of these ancillary buildings, and will dewatering continue during operations? If so, the Final EIS should discuss management of potentially contaminated groundwater and coordination with the EPP program. (**14-10** [Davidson, Bryan])

Comment: In Section 3.3.2.2 Environmental Consequences of Construction (Page 3-24; Line 14), an estimated 2.2 million gallons of water may be extracted as a consequence of dewatering of the reactor excavation pit. TDEC encourages the Final EIS to elaborate on plans for dewatering and under what permit authority this groundwater will be discharged, as the construction stormwater permit is limited to stormwater controls. (**14-11** [Davidson, Bryan])

Comment: As outlined in Section 3.3.2.2 Environmental Consequences of Construction (Page 3-24; Line 17), temporary dewatering of the reactor excavation pit could potentially create a gradient towards the excavation impacting planned CERCLA activities. Evaluation of the

impacts to CERCLA groundwater operations should be considered through the EPP program. (**14-12** [Davidson, Bryan])

Response: *Section 3.3.2.2 of the draft EIS states that there would be regulatory oversight of the dispositioning of the extracted water by the DOE, EPA, and TDEC. This oversight would ensure that the extracted water would be treated by properly configured and licensed facilities. To better address this issue, the NRC staff added a sentence to Section 3.3.2.2 of the EIS explaining that the applicant plans to manage the extracted groundwater in accordance with the requirements of the three agencies indicated above and obtain any necessary approvals. Section 3.3.2.2 addresses all dewatering during construction of the entire Hermes project, regardless of which specific building requires the excavation. Section 3.3.2.3 states in the second sentence of the first paragraph that the applicant expects that there would not be dewatering during operations.*

G.2.12 Comments Concerning Hydrology—Surface Water

Comment: The facility also will not be releasing any byproducts whatsoever into the local water supply. So these decisions truly minimize any environmental or health risks. (**8-7-3** [Hayes, Alyssa])

Comment: The Draft EIS identifies existing infrastructure on the site in Figure 1-1 on page 1-2 and notes "...stormwater collected in the stormwater pond would be discharged to an existing outfall" on page 2-16 of the supporting document Kairos 2021-TN7880. The Final EIS should include a detailed discussion of stormwater management plans at the site to confirm alignment with DOE CERCLA activities. These stormwater management plans can be addressed through the EPP program. Two of the identified outfalls (outfalls 694 and 690, respectively) have been recorded discharging mercury and PCBs that exceed human health ambient water quality criteria (AWQC). Outfall 694 was plugged and abandoned in Federal FY22.[4] The K-897-A oil/water separator was evaluated as a source of PCBs. TDEC has been informed the entirety of the outfall 690 collection system will be grouted in place.[5] The footprint of the proposed stormwater pond falls on top of the outfall 690 stormwater collection network. Considering this infrastructure will be grouted in-place, TDEC requests that the Final EIS address how this may affect the construction of a stormwater pond in this area. TDEC also encourages the NRC to clarify in the Final EIS whether previous storm drain system sampling results been taken into consideration with the blending of future construction and operational discharges covered by the NPDES permits.

[4] United Cleanup Oak Ridge, LLC prepared for the US Department of Energy. 2022 Remediation Effectiveness Report for the U.S. Department of Energy Oak Ridge Site Oak Ridge, Tennessee (DOE/OR/01-2916&D2). August 2022. Pg. E-20.

[5] Ibid. Pg. E-23 and E-25. (**14-7** [Davidson, Bryan])

Response: *The quit claim deed requires the applicant to adhere to applicable Federal, State, and local laws prior to any development of the property, which includes a storm water pond. In addition, the quit claim deed requires future owners of the site to not impede the DOE's remediation responsibilities under CERCLA. The draft EIS notes in several sections, including Sections 3.3.1.2 and 3.3.2.2, that the applicant would develop a Storm Water Pollution Prevention Plan requiring approval from the TDEC that addresses stormwater management and discharges and soil erosion. The stormwater activities would, like other elements of the Hermes project, be coordinated with DOE to avoid interference with CERCLA activities. As stated in the*

draft EIS sections above, the NRC staff expects that the applicant would coordinate with subject matter experts at the TDEC and DOE to ensure that the plan and best management practices are compatible with the site history and present conditions, including the conditions outlined in these comments. Because of the applicant's need to adhere to State law under the authority of TDEC for stormwater permitting and the authority of TDEC to set sampling requirements for a permit, no changes were made to the EIS in response to this comment.

Comment: Water Resources

The proposed project will require an individual stormwater construction permit (CGP), including a project-specific Surface Water Pollution Prevention Plan (SWPPP).[1] A Tennessee Multi-Sector Permit will also be required.[2] It is unclear from the Draft EIS if any discharges into the Oak Ridge municipal sewer system would require pre-treatment; Kairos should consult with the Oak Ridge pre-treatment coordinator as well as the TDEC Division of Water Resources pre-treatment coordinator before making any discharges into the Oak Ridge municipal sewer system.

[1] https://www.tn.gov/environment/permit-permits/water-permits1/npdes-permits1/npdes-stormwater-permitting-program/npdes-stormwater-construction-permit.html

[2] https://www.tn.gov/environment/permit-permits/water-permits1/npdes-permits1/npdes-stormwater-permitting-program/npdes-industrial-stormwater-general-permit/npdes-stormwater-multi-sector-general-permit-for-industrial-activities-tnr050000.html (**14-1** [Davidson, Bryan])

Response: *As noted by the applicant in the environmental report (Table 1.4-1: Permits and Approvals Required for Construction and Operation), TDEC permits and approvals for the project include a Construction General Permit and Industrial Storm Water Discharge Permit and permits and approvals from the City of Oak Ridge for a Sanitary Sewer and Water Supply Facility and a Storm Water Plan. The draft EIS notes in several sections, including Sections 3.3.1.2 and 3.3.2.2, that the applicant would develop a Storm Water Pollution Prevention Plan addressing stormwater management and discharges and soil erosion. This plan would have to be approved by TDEC. As indicated in the above noted draft EIS sections, the NRC staff expects that the applicant would coordinate with experts at TDEC and DOE to ensure that the plan and best management practices outlined in the plan are compatible with the site history and present conditions, including the conditions outlined in these comments. No changes were made to the EIS in response to these comments.*

G.2.13 Comments Concerning Land Use—Site and Vicinity

Comment: This additional input is elaboration on one point mentioned in my earlier public input attached below. Regarding proximity of the project to a proposed general aviation (GA) airport, I believe it is important and justified that the NRC reach out to the Federal Aviation Administration GA planners and voice concern-objection even, to the plans for a GA airport so close. As I noted in earlier input physical safety from what would be low flying and concentrated numbers of aircraft, is one concerning issue but the health risks of tetraethyllead is another and much more insidious. The proposed airport would be situated such that the Kairos-Hermes workforce would be in the shadow of the proposed airport primary aircraft takeoff location. Here is some perspective on human health risks form piston engine aircraft, see below four Wikepedia "links" that offer a understanding of lead as a motor-fuel additive and consequential health hazard. A picture of science and history of lead in our economy and health risks associated with piston engine aircraft. (**7-1** [Colclasure, Doug])

Comment: So the problem for the people who are near and downwind of the proposed airport is that during the most power-& fuel-hungry portion of a flight, i.e. takeoff, this powerful neurotoxin will be spewed into the immediate environment at an orders of magnitude greater rate than at any other phase of flight (i.e., cruise, and landing which is essentially just a glide). Worse, this emission is occurring at and near ground level. (**7-2** [Colclasure, Doug])

Comment: As this point there is a proposal to construct a small general aviation airport in close proximity to the location of the Hermes nuclear facility. The safety implications were not foreseen by those proposing an Oak Ridge airport back in 2009, see attached. During the depressed economic prospects of 2009, it was believed that a small GA airport would lead to economic benefits to industries looking to locate adjacent to an airport. To this day, 13 + years later, there are no independent assessments supporting that contention. Simply put -no compelling merits to justify an airport. For starters the 1300 acre Heritage Center industrial park is all but sold and occupied, only 151 acres in small isolated parcels, remaining. In fact quite the contrary. (**7-6** [Colclasure, Doug])

Response: *The staff appreciates the additional information concerning the possible human health effects of operating the proposed general aviation airport. While building and operating the airport is not within the scope of the licensing action by the NRC, the draft EIS addresses the potential environmental impacts from the proposed airport with respect to how they contribute cumulatively to those of the proposed Kairos Hermes Test Reactor facility. Section 3.1.5 of the draft EIS addresses the contribution of the airport to the cumulative land use impact analysis for the Hermes facilities. These comments do not provide new and significant information affecting the NRC staff's analysis of the proposed action. Hence, no changes were made to the EIS in response to these comments.*

Comment: The Hermes research reactor will validate technical concepts and provide assurance to us, the members of the public, ahead of any commercial endeavors. Additionally, this reactor cannot be sited in a better place. The proposed location in the East Tennessee Technological Park is in a brownfield released for industrial use. It's not able to support residential use, it's not released for agricultural use. This is the best thing that we could be putting on that land. (**8-7-2** [Hayes, Alyssa])

Comment: Also, more specifically, you know, an industrial site that's already industrial and where past nuclear activities have been performed is an ideal and very appropriate location for an advanced reactor demonstration project. (**8-12-5** [Hopf, Jim])

Comment: Environmental Impacts

The discussion in Chapter 3 makes it clear that the Heritage Center Industrial Park of the East Tennessee Technology Park is a suitable location for the planned Hermes test reactor. (**11-4** [Arndt, Steven] [Piercy, Craig])

Response: *The staff acknowledges these comments, which reinforce that the site is an appropriate location for a project of this type. The comments do not present new information affecting the staff's analysis of the proposed action. Hence, no changes were made to the EIS in response to these comments.*

Comment: So returning to this specific proceeding, we selected Oak Ridge as the site for Hermes based on a combination of regional workforce capabilities; proximity to highly-capable local collaborators, such as Oak Ridge National Laboratory, Tennessee Valley Authority, and

others; and the infrastructure and characterization data available for the selected site. We appreciate the support we've received from the local community since announcing our plans to deploy Hermes at the East Tennessee Technology Park. (**8-3-4** [Hastings, Peter])

Response: *The staff acknowledges this statement from the applicant regarding their reasons for selection of the proposed project site. The comment does not present new information affecting the staff's analysis of the proposed action. No changes were made to the EIS in response to this comment.*

Comment: Comment Number: 2

Draft Environmental Impact Statement Text and Location**:** Page 3-6, Line 27: The applicant has indicated that the Atlas facility would occupy no more than 30 ac of land on the site, located outside of the approximately 30 ac of land occupied by the Hermes facilities...

Comment: The Atlas facility location, within the Kairos property, has not been chosen yet. No land use conflict is expected. We suggest the language in the DEIS be altered to delete "located outside of the approximately 30 ac of land occupied by the Hermes facilities" (**10-2** [Hastings, Peter])

Response: *The UNRC staff has deleted the indicated language from the text of Section 3.1.5.*

Comment: The information provided in the draft environmental impact statement appears to reinforce that potential environmental impacts associated with construction of the proposed project will be minimal. (19-3 [Watson, Mark])

Response: *The NRC staff acknowledges this comment. The comment does not provide any new or different information for the staff's consideration. Hence, no changes were made to the EIS in response to this comment.*

G.2.14 Comments Concerning Meteorology and Air Quality

Comment: Comment ID: 12

Document Location: Page 3-16, Lines 8–9

Comment Description: The Kingston Fossil Plant is scheduled for closure starting in 2025, should it be used as air quality impact example since Hermes reactor operations is not scheduled to start till 2026? (**5-1-11** [Creswell, Wade] [Shaw, John])

Response: *The cumulative impacts of reasonably foreseeable actions related to air quality are discussed in Section 3.2.1.1.8. The continued operation of industrial parks and energy facilities such as those that are part of the Tennessee Valley Authority (TVA) fleet will affect air quality during the construction and operation of the Kairos Hermes Test Reactor facilities. The TVA is considering retirement of the Kingston Fossil Plant starting in 2025 with nine units to retire as early as 2026 and no later than 2031 and the remaining six units as early as 2027 and no later than 2035 (TVA 2023-TN8188, 86 FR 31780-TN8187). However, even if retirement is initiated, emissions from the operation of some of the Kingston units and retirement activities will continue until the plant is completely closed and any remediation conducted by TVA post-closure is complete. Since continued operation and remediation will occur during the planned 4-year operation of the Kairos plant facilities, the NRC staff agrees that the Kingston Fossil Plant*

is a valid example of a plant that will continue to contribute to regional air impacts. However, including a discussion of the Kingston Fossil Plant in the final EIS does not alter the cumulative analysis provided in Section 3.2.1.1.8 of the EIS.

The TVA has a goal of phasing out their fossil fuel generation and to have net-zero greenhouse gas emissions by 2050. These reductions would likely have the effect of improving regional air quality as fossil plants are closed over the next 25 years. However, TVA's phase-out activities would not significantly change baseline regional air quality during the construction and operation of the Kairos plant facilities or change the NRC staff's conclusion that air quality impacts are SMALL. No changes were made to the EIS as a result of these comments.

Comment: Air Pollution Control

TDEC appreciates Kairos' proposed measures to mitigate air quality impacts from fugitive dust and their commitment to minimize the impacts of the project on air quality. TDEC also recommends that all construction equipment employed on site be well maintained and equipped with the latest emissions control equipment, and that unnecessary vehicle idling be discouraged. (14-2 [Davidson, Bryan])

Comment: Table 3-3 of the Draft EIS provides estimates of air emissions during facility operation. This table projects annual emissions of nitrogen oxides (NOx) of 20.65 tons per year (TPY). Be advised that construction and operating permits may be required, and any fuel-burning sources with potential NOx emissions of five TPY or more will be required to utilize low-NOx burners. (**14-4** [Davidson, Bryan])

Response: *NRC staff analysis in the EIS demonstrates that air emissions from the proposed Kairos Hermes Test Reactor facilities are well below all thresholds considered in the analysis and would not be a major source of air emissions. The TDEC may impose additional requirements on Kairos for construction equipment employed onsite to be well maintained and equipped with emissions control equipment and ascertain that unnecessary vehicle idling be discouraged through its permitting process. In addition, the NRC understands that TDEC, through its construction and operating permits, may require fuel-burning sources with potential nitrogen oxide (NOx) emissions of 5 tons per year (TPY) or more to use low-NOx burners. The NRC staff expects that Kairos will comply with any requirements imposed by TDEC. No changes were made to the EIS as a result of these comments.*

Comment: Comment ID: 11

Document Location: Page 3-15, Lines 21–22

Comment Description: The values used for greenhouse gas emissions were adjusted by a factor of 3 *"to account for the efficiency of the reactor."* What was the reference basis for this efficiency adjustment? (**5-1-10** [Creswell, Wade] [Shaw, John])

Response: *The comment has been noted. Section 3.2.1.1.6 "GHG Emissions" of the EIS has been modified to describe the methodology for estimating greenhouse gas emissions from Kairos Hermes Test Reactor life-cycle activities and the resulting estimated emissions.*

G.2.15 Comments Concerning Noise

Comment: Comment ID: 14

Document Location: Page 3-17, Line 18

Comment Description: Projected noise levels at nearest residential level are projected to increase 3 dBA over baseline noise levels measured by applicant. Will noise levels be monitored at the nearest residential area identified in the EIS during construction? If actual noise levels increase and are found to be considerably above the projected levels during construction, will the applicant address this issue at that time? (**5-1-13** [Creswell, Wade] [Shaw, John])

Response: *The applicant has not proposed to monitor noise levels during construction or other life-cycle phases of the project. As noted in Section 3.2.2.2 of the draft EIS, the NRC staff expects that any noise increases during construction would be temporary and typical of construction sites in industrial parks, and would therefore not be objectionable. If residents experience objectionable noise levels during construction or other life-cycle phases of the Kairos Hermes Test Reactor project, they may pursue action under the City of Oak Ridge municipal regulations concerning noise. Hence, no changes were made to the EIS in response to this comment.*

G.2.16 Comments Concerning Process—NEPA

Comment: Comment ID: 02

Document Location: Page xiii, Line 19

Comment Description: The identified virtual public outreach and EIS scoping meeting conducted on March 23, 2022 has not been made available to the general public. From the NRC Hermes—Kairos Application webpage (Hermes - Kairos Application | NRC.gov) in the Public Involvement section, the link provided for access to the Public Outreach Meeting document (dated 03/23/2022) does not work. When clicked, persons receive the following error message: *"The resource you are looking for has been removed, had its name changed, or is temporarily unavailable*." The link takes you to the following internet address, where you receive this message: https://www.nrc.gov/docs/ML2206/ML22068A212.html. The inability of the public to access this document, as well as the full unencumbered versions of most documents associated with the Hermes Project, has left the public in the dark as to the proposed project's specifics and at a great disadvantage in evaluating the project's configuration, operational, and safety aspects. (**5-1-2** [Creswell, Wade] [Shaw, John])

Comment: Comment ID: 03

Document Location: Page xiii, Line 29

Comment Description: As stated in Comment #2, inability to access Public Outreach Meeting documentation has left the public unable to identify previous public comments and evaluate how they may have been addressed by this draft EIS. (**5-1-3** [Creswell, Wade] [Shaw, John])

Response: *The commenter is correct that the Kairos Hermes Test Reactor project web page was not updated when the public outreach and scoping meeting notice was revised just prior to the scoping meeting. However, the scoping summary report (issued and distributed in August 2022) included information on how to access all comments submitted during the scoping period as well as the transcript of the public outreach and scoping meeting and the meeting summary. The draft EIS referenced the scoping summary report in Chapter 1 and included a*

chronology (draft EIS Appendix C), which provided the Agencywide Document Access and Management Systems (ADAMS) location of the meeting summary and the scoping summary report.

The project web page was updated to include a link to both the revised meeting notice and the meeting summary report, but no changes were made to the EIS as a result of this comment.

Comment: (2) Community Involvement: According to the DEIS, the NRC conducted a virtual joint public outreach and scoping meeting on March 23, 2022. However, the DEIS does not include any details about the meeting, and it does not discuss any additional outreach to the surrounding communities.

Recommendation: The EPA recommends that the NRC discuss in the Final EIS how the NRC meaningfully involved the local communities throughout the NEPA process to help identify potential benefits and burdens associated with construction, licensing and permitting decisions. We recommend the discussion include any adaptive and innovative approaches to both public outreach and community involvement regarding project issues that were implemented during the project planning phase. (**12-2** [Kajumba, Ntale])

Response: *The NRC has engaged communities and stakeholders throughout this process, including a virtual public outreach and scoping meeting held in March 2022.*

The decision to conduct the NRC's joint public outreach and scoping meeting as a virtual meeting was based on the high COVID-19 transmission rate for the Oak Ridge area at that time. However, the staff were proactive in ensuring community awareness of the meeting and the scoping comment period by purchasing multiple-day advertisements in both local and regional newspapers. These advertisements included information about the scoping comment period, where to submit comments, and provided the URL to the NRC's web page dedicated to sharing the regularly updated information about the NRC's review of the CP application for the Kairos Hermes Test Reactor. Earlier in the month, the NRC's Office of Public Affairs had issued a press release jointly with the Federal Register Notice announcing the beginning of the scoping period, which presented information about how interested members of the public could remain apprised of the date and access information about the public outreach and scoping meeting.

The NRC distributed a scoping summary report in August 2022, and the draft EIS referenced the report in Chapter 1 and Appendix C, Chronology of Key Correspondence. Additionally, correspondence between the NRC and Federal, State, Tribal, regional, and local agencies that has taken place and are included in draft EIS Appendix C.

The final EIS has been updated to include additional information about the joint outreach and scoping meeting, including reference to the meeting summary in the text of Chapter 1, rather than only in the Appendix C Chronological Listing of Key Correspondence for the review.

For the meeting to present the draft EIS and receive comments, a joint virtual and in-person public meeting was held in Oak Ridge on November 16, 2022. This meeting was the first time the NRC hosted a joint virtual and in-person meeting for a licensing review. The meeting on the draft EIS had been coordinated months in advance with community leaders and was similarly advertised in local and regional newspapers. A non-public meeting was also held with community leaders and local regulatory agencies to ensure that their comments on the draft EIS were appropriately informed. The final EIS includes a description of its outreach efforts to ensure community involvement during the comment period for the draft EIS.

Comment: Congress and the public are calling upon the NRC to modernize its regulatory frameworks and to enable the safe civilian use of nuclear energy. (**17-1-2** [Franovich, Rani])

Response: *The NRC is committed to improving the efficiency of its required regulatory processes while assuring compliance with Congressional mandates. This comment does not present new information affecting the staff's analysis of the proposed action, so no changes were made to the EIS.*

Comment: When Congress passed the Nuclear Energy Innovation and Modernization Act of 2019 (NEIMA), it mandated that the NRC modernize and streamline nuclear licensing and other regulatory procedures commensurate with a new generation of smaller, safer reactor technologies that rely on a variety of fuels and fuel cycles. To modernize its regulatory practices, satisfy NEIMA, and effectively serve the public's interests, the NRC staff must conduct timely and efficient environmental reviews (**17-1-3** [Franovich, Rani])

Response: *The NRC is committed to improving the efficiency of its required regulatory processes while assuring compliance with Congressional mandates. For example, the draft EIS represents a substantial reduction in page count and schedule length compared to past NRC new reactor EISs. The NRC's streamlined review still ensured that all NRC's obligations under NEPA and related laws, regulations, and processes were fully met. This comment does not present new information affecting the staff's analysis of the proposed action, so no changes were made to the EIS.*

Comment: We commend the NRC staff for publishing the Hermes draft EIS for comment six weeks ahead of schedule. This level of customer service should be encouraged and rewarded by NRC's leadership. However, we note the NRC staff prepared an EIS when an environmental assessment (EA) would have sufficed for the instant Federal action: issuance of a construction permit for a non-power test reactor. It is not clear how this constitutes a major Federal action, for which an EIS is required by the National Environmental Policy Act (NEPA). (17-1-4 [Franovich, Rani])

Comment: As a general matter, the NRC should incentivize innovation and reward improved safety outcomes by eliminating or reducing unnecessary costs and schedule delays for an applicant. For example, the NRC staff should prepare an EA in lieu of an EIS to the maximum extent possible for non-major Federal actions involving the construction, operation, and decommissioning of test reactors and larger scale commercial reactors. (**17-1-5** [Franovich, Rani])

Comment: As such, EAs offer a less resource-intensive, time-consuming and costly alternative means to satisfy NEPA. Preparation of EAs should be the NRC's preferred approach, consistent with the NRC's Efficiency Principle of Good Regulation. (**17-1-7** [Franovich, Rani])

Response: *As noted in the Executive Summary of the draft EIS, the NRC's environmental protection regulations that implement NEPA in Title 10 of the Code of Federal Regulations (CFR) Part 51 describe several types of actions that require an EIS. Issuing a CP for a nuclear testing facility is identified in 10 CFR 51.20 as one type of action that requires an EIS, so the NRC staff prepared an EIS rather than an environmental assessment (EA) for the proposed action. These comments do not present new information affecting the staff's analysis of this proposed action, so no changes were made to the EIS.*

Comment: As mentioned earlier, the Breakthrough Institute receives no funding from the nuclear industry and represents the public's interests. In light of the urgent public concerns described herein, the Breakthrough Institute strongly encourages the NRC to (1) prepare EAs in lieu of EISs to the maximum extent possible for non-major Federal actions involving the construction, operation, and decommissioning of test reactors and their larger scale commercial reactors; (2) make maximum use of the GEIS for advanced reactors when a licensing decision clearly constitutes a major Federal action; (3) more fully and directly examine and characterize the economic benefits of the proposed action; and (4) acknowledge and holistically consider the substantial adverse environmental and human health impacts of taking no Federal action. Thoughtful consideration of these impacts should be reflected not only in the Final EIS for the Hermes test reactor, but for all generic and site-specific reviews of Federal actions involving any nuclear power generation from either the currently operating fleet or emergent commercial designs and technologies. (**17-1-18** [Franovich, Rani])

Response: *As noted in the Executive Summary of the draft EIS, the NRC's environmental protection regulations that implement NEPA in 10 CFR Part 51 describe several types of actions that require an EIS. Issuing a CP for a nuclear testing facility is identified in 10 CFR 51.20 as one type of action that requires an EIS, so the NRC staff prepared an EIS rather than an EA for the proposed action. In addition, the Advanced Nuclear Reactor Generic (GEIS) is still under development by the NRC. These comments do not present new information affecting the staff's analysis of this proposed action, so no changes were made to the EIS.*

G.2.17 Comments Concerning Site Layout and Design

Comment: There is no mention of any electrical power requirements for this project, and the accompanying environmental impact if any of these power sources. (**1-1** [Baxter, Farouk])

Response: *As noted in Section 2.2.4 of the application, the applicant, Kairos plans to connect an electrical distribution line to nearby electric transformers serving the existing Heritage Center Industrial Park to provide electricity to the new Hermes facilities (*Kairos 2023-TN8172*). The staff expects that building and operating this distribution line, which would be located within an existing industrial park, would have no potential for noticeable environmental impacts. A discussion of electrical power impacts has been added to Section 2.4 "Equipment and Material Usage" of the EIS.*

Comment: Comment Number: 1

Draft Environmental Impact Statement Text and Location: Page 2-3, Line 19: ...the offsite discharges would include 16 gpm from the bathrooms and 1 gpm from the decay heat removal system (DHRS).

Comment: The 1 gpm from the decay heat removal system is evaporated. If evaporation is included in this discharge summary, the staff may also want to consider the 34 gpm of evaporation from the chilled water system, per ER Figure 2.4-1. (**10-1** [Hastings, Peter])

Response: *This statement quantifies the operational demand for offsite water and the offsite discharges. Since the evaporation losses are not discharges, the 34 gpm of evaporation from the chilled water system has been noted in Section 2.5 of this EIS, and the mention of the 1 gpm of evaporative losses from the decay heat removal system has been deleted from Section 2.5.*

Comment: Comment Number: 3

Draft Environmental Impact Statement Text and Location: Page 3-13, Line 22: ...Intermittent use of propane fired heaters for the intermediate coolant located in the primary heat rejection system during maintenance activities...

Comment: This information was deleted from the ER in an enclosure to a letter dated February 18, 2022. (ML22049B556) (**10-3** [Hastings, Peter])

Response: *The mention of the propane-fired heaters has been removed from Section 3.2.1.1.5 of the EIS.*

Comment: (1) Water Resources: Sections 2.5, 2.6 and 2.8 of the Draft Environmental Impact Statement (DEIS) appear to include inconsistent information regarding the use of municipal water sources. Section 2.5 *Water Consumption and Treatment* (Page 2-3) states that the water demand during construction, operation and decommission would be met with municipal water sources or truck-delivered, and that wastewater would be disposed of in municipal sewers. The section specifies (with reference to Figure 2.4-1, which is part of the 2021 Environmental Report and is not available in the DEIS) 50 gallons per minute (GPM) of municipal water. This section also states that the operation would not involve *any* intake or discharge pipelines. Section 2.6 *Cooling and Heat Removal* (Page 2-3) states that there would be no cooling water system. Section 2.8 *Storage, Treatment and Transportation of Radioactive and Non-Radioactive Materials* (Page 2-4) states that Tri-structural Iso-tropic (TRISO) fuel pebbles would be stored onsite in a water-cooled storage pool.

Recommendation: The Final EIS should provide more clarity on Sections 2.5, 2.6 and 2.8 of the report that appear to be inconsistent with each other. If the proposed project will use municipal water facilities, then the report should identify those facilities and the water sources. The NRC should clarify how the Hermes facility would meet this requirement without the necessary infrastructure to convey both water and wastewater. The Final EIS should also address what the 50 GPM would be used for in more detail, since Section 2.8 states that there would be no cooling water system while also stating that TRISO fuel pebbles would be stored onsite in a water-cooled storage pool. Finally, Figure 2.4-1 from the 2021 Environmental Report should also be provided in the body of the Final EIS report or in the Appendix. (**12-1** [Kajumba, Ntale])

Response: *As noted in Section 3.3.2 of the draft EIS, water demands for the Kairos Hermes Test Reactor project would be met by municipal or commercial suppliers and all wastewater treatment demands would be met by the City of Oak Ridge, Tennessee. There would be no intakes from surface water sources or groundwater wells, and there would be no discharges to surface waters (other than stormwater, using best management practices). The NRC staff determines that identifying the specific municipal or commercial suppliers and a detailed breakdown on use of the water is not necessary to adequately consider possible environmental impacts at the CP stage. The highest potential water demand would be during the operation life-cycle phase of the project. Prior to initiation of operations, Kairos would have to submit a subsequent application to the NRC for an OL. The NRC staff expects that Kairos would have a more mature operational design at that time that would include greater detail regarding water usage and treatment during operations. The NRC staff would at that time review the more mature design data for new and significant information regarding water usage and wastewater treatment impacts and present that information in a Supplemental EIS evaluating the OL. No changes were made to the EIS in response to this comment.*

G.2.18 Comments Concerning Socioeconomics

Comment: It also extends the world class research reputation of Oak Ridge and draws additional highly-qualified technicians and energy experts to our area. The creation of construction jobs, as well as permanent high-quality jobs is most welcome.

Kairos also gives us further economic development potential for attracting companion industries. (**8-11-2** [Michaels, Christine])

Comment: The NRC staff characterized any increase in tax revenues from the proposed project as minimal because (1) fewer than 500 workers would be needed to build the plant, and fewer than 100 to operate it; and (2) the project will be of short duration—12 years from groundbreaking to cessation of operations. Though minimal, this benefit of the proposed action should be explicitly acknowledged in the NRC's Final EIS for the Hermes test reactor.

It is important that economic benefits are factored into NRC's environmental reviews. Though marginal for this project, these economic benefits will be much greater for mass production and rapid deployment on a commercial scale, and they should be explicitly acknowledged in the Hermes EIS. Moreover, these benefits should be generically evaluated and characterized in the GEIS for advanced reactors. (**17-1-12** [Franovich, Rani])

Comment: and applauds the opportunity to create new jobs and advance new, innovative technology in our town. (**19-2** [Watson, Mark])

Comment: The positive impacts of advanced nuclear reactors extend further than the fenceline. Kairos is also committed to investing in the community. An agreement was signed with the Tennessee Valley Authority (TVA) to provide engineering, operations, and licensing services for Hermes. At Oak Ridge, in the East Tennessee area, Kairos has committed to investing $100 million to create high-paying jobs that support the construction, operation, and decommissioning of the Hermes reactor. The Hermes project has a number of other skilled partners including Oak Ridge National Laboratory, Idaho National Laboratory, EPRI, and Materion Corporation. (**22-4** [Houghtalen, Natalie])

Response: *These comments call attention to economic development benefits and longer-term, extended, benefits expected beyond this specific permitting action. Such benefits include future economic development, which might occur based upon successful demonstration of the Kairos Hermes Test Reactor project, potential future business partnerships, and other benefits that might result in other locations. The NRC staff acknowledges the potential for such benefits to arise in the future. However, these comments do not present new information affecting the staff's analysis of this proposed action at the ORR in Tennessee. No changes to the EIS were made as a result of these comments.*

Comment: Comment ID: 23

Document Location: Page 3-45, Lines 40–41

Comment Description: States *"largest city in Morgan County is Harriman*." Since only a very small portion of Harriman extends into Morgan County, it should not be considered as a whole to make the statement as the largest city in Morgan County. If the same rational was applied to Oak Ridge, it would be considered the largest city in Roane County. We are not aware of hearing this reference ever previously being made. (**5-2-3** [Creswell, Wade] [Shaw, John])

Response: *This comment identifies factual errors or provides updated information. Section 3.6.1.1 of the EIS has been updated to incorporate the new or corrected information.*

G.2.19 Comments Concerning the Uranium Fuel Cycle

Comment: I do, however, have reservations regarding the storage of spent reactor fuel, even the safer pelletized Triso fuel planned for testing in the Hermes reactor. Congress has failed to identify and develop a long-term secure national nuclear waste repository, and nuclear reactor facilities are therefore left to store their nuclear wastes either at the reactor facility itself or at an interim storage facility. That being the case, I would ask that Kairos commit to moving spent fuel to an interim storage facility outside Oak Ridge and its surrounding area upon closure. Oak Ridge has had a long and fraught relationship with radioactive wastes, and as a result, suffers from a reputation as a contaminated city. For this reason, I believe that Kairos should make a clear, legally binding commitment in the CPEIS that spent fuel will be removed at closure and stored offsite until such time as a national facility can be brought on line. (**9-3** [Wieland, Chris])

Comment: With that said, the City does not support the indefinite storage of spent fuel canisters on the site after the cessation of operation (Section 2.8) and encourages clarity regarding storage issues. Since no federal spent fuel repository or regional spent fuel storage facility has been identified, the potential for the site to become a *de facto* storage facility is incompatible with the community's mixed-use vision of the Heritage Center site and proximity to Oak Ridge residential neighborhoods. (**19-4** [Watson, Mark])

Response: *The NRC regulations in 10 CFR Parts 50 and 72 require that a licensee safely manage any spent nuclear fuel under a licensee's control. Impacts from spent nuclear fuel storage onsite are addressed in the NRC Continued Storage Final Environmental Impact Statement (NUREG-2157). The request that Kairos enter into a binding commitment to store spent nuclear fuel in an area other than Oak Ridge is outside the scope of the staff's environmental review and is not considered in the EIS. No changes were made to the EIS based on this comment.*

Comment: Comment Number: 4

Draft Environmental Impact Statement Text and Location: Page 3-71, Line 18: A primary heat rejection system capture system for tritium separation from dry air in the cover gas;

Comment: This information was deleted from the PSAR and the ER in enclosures to a letter dated February 18, 2022 (ML22049B556). (**10-4** [Hastings, Peter])

Response: *The NRC staff agrees with the comment and the appropriate change was made to Section 3.9.2.3 of the EIS.*

Comment: Comment ID: 26

Document Location: Page 3-72, Lines 2–3

Comment Description: Spent fuel storage is identified to involve a "cooling pool supplemented with dry storage using air cooling." What backup system is provided for this arrangement? (**5-2-6** [Creswell, Wade] [Shaw, John])

Response: *The issues raised in the comment are outside the scope of the environmental review and are not addressed in the EIS. The NRC has developed a safety evaluation (SE) (NRC 2023-TN8414) that analyzes all aspects of the Kairos Hermes Test Reactor and its operational safety. No changes were made to the EIS in response to this comment.*

G.2.20 Comments Concerning Water Resources

Comment: Comment ID: 24

Document Location: Page 3-59, Lines 32–34

Comment Description: States *"expected exposure pathways to members of the public would principally be from radiological gaseous effluent release because a small volume of radioactive liquid effluent releases would be discharged to the sewer lines*." Does the planned wastewater treatment plant, Rarity Ridge Wastewater Treatment Plant, have the necessary equipment/licensure to handle this planned radiological gaseous effluent discharge? (**5-2-4** [Creswell, Wade] [Shaw, John])

Response: *As explained in Section 3.3 of the draft EIS, the staff determined, based on information available at this time, that the water treatment capabilities of the City of Oak Ridge, Tennessee, would be adequate to handle the increased demands of the Kairos Hermes Test Reactor project, including liquid effluent releases within regulatory limits. No changes were made to the EIS in response to this comment.*

G.2.21 General Comments in Support of Nuclear Power

Comment: The timing of this meeting is, by sheer happenstance, coincident with meetings that are taking place at the UN Climate Conference where the IPCC, along with several other domestic and international bodies, have recognized the critical importance of nuclear energy in combating climate change. If you'll indulge me for a minute, I've got a quote that I think is really on point here, and this comes from a Scientific American article in 2013. It's a little long; forgive me. The question is not just one of nuclear energy but of our responsibility toward our fellow human beings and future generations. What would our grandchildren say if they knew we had such an awesome source of life-giving energy at our disposal and failed to make sensible use of it? The liberation of entire populations from the shackles of poverty and ignorance has been one of the triumphs of the human experiment, and it's largely been possible because of the twin pillars of harmonious systems of governance and technological breakthroughs of which energy must rank at the very top. If we deprive similar populations of the biggest chance they have to relive this transformation, we will have failed in our basic obligations to each other. That's a really powerful and important quote, and it underlies everything that we're doing. (**8-3-3** [Hastings, Peter])

Comment: Alyssa Hayes, University of Tennessee. So according to the recent 2022 Global Carbon Budget paper, the world has about less than ten years to decarbonize enough to prevent us from reaching the 1.5 degrees Celsius limit, and populations are growing and energy demand is growing. So we should be using every tool, every carbon-free resource that we can in order to prevent that from happening. Nuclear energy is critical to the global decarbonization effort, so I am ecstatic to see Kairos and others beginning to renew American contributions to these vital technological developments. (**8-7-1** [Hayes, Alyssa])

Comment: Deployment of advanced nuclear reactors will replace fossil fuel-powered for heat generation that is vastly more harmful in terms of both climate and public health impacts. Firm, clean sources like nuclear will be needed in the future to back up intermittent sources and ensure grid reliability. (**8-12-3** [Hopf, Jim])

Comment: I am generally in favor of nuclear energy as one means for mitigating climate change. (**9-1** [Wieland, Chris])

Comment: On behalf of the 10,000 nuclear technology professionals that make up the American Nuclear Society (ANS), I am pleased to provide comments on the Nuclear Regulatory Commission's (NRC's) draft environmental impact statement (EIS) for the Kairos Hermes test reactor. ANS members are involved in many applications of nuclear technology for the betterment of humanity, including the clean generation of reliable energy using nuclear power plants. (**11-1** [Arndt, Steven] [Piercy, Craig])

Comment: I am truly encouraged and excited to see America, through the NRC, taking this direction in nuclear energy. We Nukes can only hope that the testing of fluoride salt-cooled, high-temperature reactor technology will be followed soon by the testing (maybe at ACU, Abilene, TX?) of LFTR technology and Thorium. This is the hope for America. (**15-1** [Torres, Gilberto])

Comment: The secure deployment of advanced reactors is crucial to meeting our nation's carbon reduction goals and strengthening national energy security, as well as solidifying the U.S.'s global leadership on advanced nuclear technology. In addition, the advancement of new reactor technologies provides a career pathway for the next generation of nuclear industry professionals. Nuclear Matters encourages the NRC to fully recognize these positive environmental and economic impacts, plus the long safety record of the commercial nuclear power sector, in the final EIS.

Nuclear Matters appreciates the opportunity to provide comments on the draft EIS. Our advocates are enthusiastic about and supportive of the next generation of nuclear technology, including advanced reactor designs. New reactor technologies offer a clean source of carbon-free energy that can be deployed safely and affordably and will play a key role in securing America's clean energy future. (**16-2** [Anonymous, Anonymous])

Comment: We advocate for appropriate regulation in licensing and oversight of advanced nuclear reactors to enable the timely deployment of safe, innovative, and economically viable emerging nuclear technologies. We believe new and advanced reactors represent critical pathways to climate mitigation and deep decarbonization. (**17-1-1** [Franovich, Rani])

Comment: The rapid scaling of innovative clean technologies, like advanced nuclear energy, is essential for a reliable and robust clean-energy system. Advanced nuclear reactors have a variety of attributes that allow them to tackle power sector decarbonization at utility-and microgrid-scale as well as provide clean energy for industrial and district heating. (**22-2** [Houghtalen, Natalie])

Response: *The NRC staff acknowledges these comments in support of nuclear power. No changes were made to the EIS in response to these comments.*

Comment: Rapid deployment of these power reactors will advance the Nation's clean energy goals, enhance environmental quality, and supply reliable electricity to the transmission

grid. These pressing public interests must be considered in any environmental review informing NRC's regulatory decision-making. (**17-2-3** [Franovich, Rani])

Comment: I believe this project is important not only to this region, considering the projected capital investment and creation of high quality jobs, but also to the nation, as we look to the future and the development of safe and affordable carbon-free energy sources. (**18-2** [Frady, Teresa])

Comment: This Kairos SMR R & D program is all about clean energy, reducing the carbon footprint, mitigating climate change-global warming, i.e., supporting the greater public good by every measure. Kairos held a public engagement Zoom meeting on Nov 3, 2022. It is encouraging to hear first-hand how focused and confident they are in making cleaner energy a reality for our nation. There is hope. (**7-4** [Colclasure, Doug])

Comment: The Hermes reactor is a vital step toward proving the safety and security of commercial deployment of larger-scale reactors of its design. These power reactors will advance the nation's clean energy goals, enhance environmental quality, and supply reliable electricity to the transmission grid. (**8-1-6** [Franovich, Rani])

Comment: I'm Christine Michaels, President of the Oak Ridge Chamber of Commerce and also an Oak Ridge resident. And our organization supports NRC's preliminary recommendation to issue the construction permit. We appreciate the NRC's thoughtful consideration of the site and its prior industrial use and your determination of a small impact.

We encourage the NRC to look favorably on what we believe is a key part of the country's nuclear future. The Hermes reactor offers the potential for meeting our energy needs while also meeting carbon reduction goals. (**8-11-1** [Michaels, Christine])

Comment: In December 2020, the U.S. Department of Energy (DOE) announced Kairos Power as a "Risk Reduction" award winner under the Advanced Reactor Demonstration Program (ARDP). According to the DOE, ARDP is designed to help domestic private industry demonstrate advanced nuclear reactors in the United States. This collaborative effort between the U.S. DOE Office of Nuclear Energy (DOE-NE) and private industry can help the United States meet national and global climate and energy policy objectives by taking leadership in advanced technology sources that are clean, firm, and can operate safely.

Under ARDP, Kairos will demonstrate the Hermes Reduced-Scale Test Reactor. The Hermes reactor will provide Kairos Power and the NRC the opportunity to test technologies, design features, and safety functions related to the KP-FHR. Hermes will have cross-cutting benefits including demonstrating the feasibility of using and managing TRISO fuel in pebble form and the management of molten fluoride-lithium-beryllium (FLiBe) salt cooled systems. Successful deployment and operation of a molten salt cooled, pebble bed reactor could demonstrate how advanced nuclear technologies can help decarbonize communities and industries that lack clean, firm, and sustainable power sources. (**20-2** [Ibarra, Jr., Victor])

Response: *The NRC staff acknowledges these comments in support of nuclear power. Section 4.3 of the draft EIS includes a cost-benefit evaluation of the proposed Kairos Hermes Test Reactor project that discusses some of the potential benefits of the project to the public. The NRC does not set United States policy on energy or climate change. No changes were made to the EIS in response to these comments.*

Comment: It is clear that the net environmental impact of this project will be overwhelmingly positive (**8-12-2** [Hopf, Jim])

Comment: The former DOE K–25 (K-31/K-33) site is quite acceptable from an environmental standpoint, and I have no reservations regarding direct impacts to the physical or biological environments in that area. (**9-2** [Wieland, Chris])

Comment: Constructing and operating the Hermes test reactor is a significant step in the development and licensing of the Kairos Power Fluoride Salt-Cooled, High Temperature Reactor (KP-FHR). Once deployed, the KP-FHR will provide an important capability for generation of clean, reliable energy using advanced reactor technology. (**11-2** [Arndt, Steven] [Piercy, Craig])

Comment: The Hermes reactor is a vital step toward proving the safety and security of commercial deployment of larger-scale reactors of its design. (**17-2-2** [Franovich, Rani])

Comment: I am writing in support of the NRC's approval of the draft EIS for the Hermes test reactor. As the designated park manager of the Heritage Center Industrial Park (aka East Tennessee Technology Park and K-25), CROET is fully supportive of the Hermes project. (**18-1** [Frady, Teresa])

Comment: This letter expresses Generation Atomics' formal support for the construction of the Kairos Hermes Test Reactor. The construction of this reactor represents major progress in the development of advanced nuclear technologies in the United States. Designed to demonstrate its capability to deliver low-cost nuclear heat, moving forward with this project is a step in the right direction for the future of US energy infrastructure. (**21-1** [Meyer, Eric] [Schroder, Madison])

Response*: The NRC staff acknowledges these comments in support of the proposed Kairos Hermes Test Reactor project. These comments do not provide any new or different information for the staff's consideration. No changes were made to the EIS in response to these comments.*

Comment: I agree with the NRC staff's recommendation to approve the environmental impact statement. And, you know, my understanding is this test reactor is not going to produce actual electricity, but it is going to produce intellectual learnings and also regional leadership for the local community and, overall, is going to help America's understanding of what this technology can do. And given that the health and environmental benefits of the community are considered in full, we should also consider the economic benefits, given, you know, especially given the energy crunch today. (**8-2-1** [Pickering, Ryan])

Comment: Chief among those benefits are demonstrating the viability of the Kairos Power Fluoride Salt-Cooled High Temperature (KP-FHR) technology and generating technical data necessary to the future licensing and commercial deployment of the technology. In this regard, the Hermes project also will facilitate the mass production of many of the commercial-scale reactor's standardized components, thereby reducing construction and maintenance costs and making the full-sized KP-FHR cost-competitive with other generation technologies. Successful future deployment of the KP-FHR technology, in turn, will enhance the nation's ability to provide an affordable advanced generation source that complements renewable energy sources by reliably producing dispatchable, zero-emission electricity from a comparatively smaller geographic footprint—all in furtherance of critical climate and energy security objectives. Additionally, the Hermes test reactor project will yield local and regional socioeconomic benefits

that will be amplified by the eventual commercial deployment of the KP-FHR on a wider geographic scale. (**13-2** [O'Neill, Martin])

Comment: ClearPath appreciates the opportunity to express support for the Kairos Hermes test reactor and emphasize the benefits of this project to the community and of nuclear energy to the climate. (**22-1** [Houghtalen, Natalie])

Response: *The NRC staff acknowledges these comments in support of the proposed Kairos Hermes Test Reactor project. Section 4.3 of the draft EIS includes a cost-benefit consideration concluding that the project would accrue benefits over its life cycle that would likely outweigh its economic, environmental, and social costs. No changes were made to the EIS in response to these comments.*

Comment: We encourage you to make a favorable decision and an expedited one to issue the construction permit. (**8-11-3** [Michaels, Christine])

Response: *The NRC staff will make an appropriate licensing decision regarding the CP application once it has completed its review of the application in accordance with the regulations in 10 CFR Part 50 and its environmental review requirements in accordance with 10 CFR Part 51. No changes were made to the EIS in response to this comment.*

G.2.22 General Comments in Support of the Licensing Action

Comment: I am hoping the NRC can Rapidly approve the draft EIS. I believe the Kairos Power's application for a construction permit to build the Hermes low-power demonstration reactor at the East Tennessee Technology Park in Oak Ridge, Tenn. fulfills the NRC's mission "to promote the common defense and security and to protect the environment." (**3-1** [Campbell, Brian])

Comment: The NRC needs to follow it's mission statement and move forward on Kairos Power's first part of its application for Hermes. Please approve Scope EIS and enable Kairos Power's completion of Hermes on time in 2026. (**3-3** [Campbell, Brian])

Comment: I write this in support of the work being planned in Oak Ridge by Kairos Power. Their plans for the Hermes reactor are impressive and will represent a major advance for nuclear power, an advance greatly needed to combat carbon emissions and climate change. Molten salt reactors had their origin in Oak Ridge so it is wonderful that Kairos is coming here with the Hermes reactor and that they have worked closely with Oak Ridge National Laboratory. I am impressed especially with the inherent safety features the Kairos design provides. Kairos has put a tremendous focus on transparency -their interactions with Oak Ridge have been extremely open and positive, showing their very deliberate, thoughtful process. I am excited also about the jobs their work in Oak Ridge will bring to our community, a community that was built on the nuclear enterprise and continues today to be at its forefront. (**6-1** [Lowe, Alan])

Comment: We plan to build and operate the Hermes low-power demonstration reactor in Oak Ridge to demonstrate our capacity to deliver clean, safe, and affordable nuclear heat. Construction and operation of the Hermes test reactor is a step toward the commercialization of this life-saving technology, and that's what the mission of this unit is all about. And it's in furtherance of our company mission, which is to enable the world's transition to clean energy with the ultimate goal of dramatically improving people's quality of life while protecting the environment. (**8-3-2** [Hastings, Peter])

Comment: I'm Jim Skelton, Director of Member Services and Programs for the Tennessee Chamber of Commerce and Industry. The Tennessee Chamber serves as the primary voice of business and manufacturing interests in Tennessee on major employment and economic issues facing public policy decision-makers. We are also the state affiliate for the U.S. Chamber of Commerce, the National Association of Manufacturers, and the American Chemistry Council.

Please accept these remarks on behalf of the Tennessee Chamber in support of Kairos Power and its construction permit application for its demonstration reactor to be built in Oak Ridge, Tennessee. This exciting project also includes two other significant partners in our state, the U.S. Department of Energy's Oak Ridge National Laboratory and the Tennessee Valley Authority.

Oak Ridge enjoys a global reputation as the, quote, unquote, city of firsts for its many groundbreaking contributions to energy, national defense, medical science, super computers, and so many fields. And we're excited that Kairos is committed to locating this next generation demonstration nuclear facility here in Tennessee. (**8-4-1** [Skelton, Jim])

Comment: My name is Philip Hult, and I am a volunteer with Generation Atomic, a nonprofit nuclear advocacy group. And I just want to thank the NRC for their fine work of both the presenters today, who have done a great job of really concisely explaining the process that we're going through and where we're at, and then also to the hard work of those who have worked to prepare and review the environmental impact statement and give us this draft. I'm very pleased with the outcome and the results. I think it represents a well-considered position. And with that said, I recommend that the NRC move forward and hope to see the EIS approved. (**8-5-1** [Hult, Philip])

Comment: So keeping this brief, I'm a resident of an environmental justice community in North Knoxville, Tennessee. And as a young woman of color, I support the construction of the Kairos Hermes reactor. Thank you so much. (**8-7-4** [Hayes, Alyssa])

Comment: I am Tracy Boatner, and I'm the President of the East Tennessee Economic Council here in Oak Ridge. And I wanted to thank the NRC and to let everyone know that, after reviewing the draft EIS, the East Tennessee Economic Council agrees with the NRC's assessment and fully supports the recommendation to site the Hermes reactor here in Oak Ridge, Tennessee. And we believe that there's no better place to site this Hermes project. The innovative, clean nuclear energy technology was born here, and we just look forward to supporting Kairos Power and the Hermes project here in Oak Ridge. (**8-8-1** [Boatner, Tracy])

Comment: And so I did want to, as far as supporting the application and the environmental impact statement draft to agree with the conclusions and the recommendations thus far. (**8-9-2** [Russell, Michael])

Comment: My name is Elizabeth Harm, and I am the Executive Director of ETEBA, the Energy Technology Environmental Business Association. We are a nonprofit trade association with over 200 members across the country, and I am proud to be here tonight representing this organization.

We are enthusiastic about Kairos's plans to bring the Hermes low-power demonstration reactor to the heritage site. Kairos's plan will build on Oak Ridge's long nuclear legacy and industry that ETEBA is proud to support. We believe that Kairos will leverage proven technologies to enable our country's transition to clean energy right here in East Tennessee. (**8-10-1** [Harm, Elizabeth])

Comment: Given the results of this statement and the vast potential of advanced nuclear reactors, I, too, believe that this project should proceed and in the same efficient and deliberate manner that it has been thus far. Thank you all for your time. (**8-13-2** [Mills, Grant])

Comment: ANS agrees with the draft NRC findings that the environmental impacts from construction, operation, and decommissioning of the Hermes test reactor and associated facilities would be small (Section 5.1, Table 5-1). Also, ANS concurs with the preliminary NRC staff recommendation that "...unless safety issues mandate otherwise, ...the NRC issue the CP [construction permit] to Kairos for the Hermes facility." (Section 5.4, p. 5-11). (**11-3** [Arndt, Steven] [Piercy, Craig])

Comment: We continue to support the NRC's efforts to efficiently meet its obligations under the National Environmental Policy Act (NEPA) to consider any potentially significant environmental impacts of proposed licensing actions and to inform the public about the agency's environmental decision making. We also are pleased that the NRC's DEIS reflects appropriate consideration of comments submitted by NEI during the environmental scoping process for the Kairos Hermes CP application.[3]

[3] See Letter from Kati R. Austgen, NEI, to NRC, "Subject: NEI Comments Regarding the Scope of the Environmental Review for the Kairos Power Hermes Non-Power Test Reactor Construction Permit Application [Docket ID: NRC- 2021-0193]" (Apr. 19, 2022) (ADAMS Accession No. ML22110A068).

We concur fully with the NRC staff's preliminary recommendation (pending completion of its safety review and final EIS) that the CP be issued to Kairos Power. That recommendation rests soundly on the NRC staff's detailed technical review of the Hermes application, during which the staff weighed the environmental, economic, technical, and other benefits of the proposed action against its environmental and other costs. The DEIS makes clear that the construction and operation of the proposed Hermes test reactor, which has received strong local and national support, will have only minor environmental impacts while conferring potentially substantial long-term benefits. (**13-1** [O'Neill, Martin])

Comment: Nuclear Matters applauds the NRC's tentative recommendation to approve the construction permit in the draft EIS and recognizes the significant efforts of the NRC to streamline environmental reviews for first-of-a kind advanced nuclear projects. The draft EIS is testament to the NRC's efforts, which ensure that the letter and spirit of the laws protecting the environment are met in the most efficient manner possible, to the benefit of the environment and the public. (**16-1** [Anonymous, Anonymous])

Comment: As stated in previous communications, the Oak Ridge community supports the proposed project (**19-1** [Watson, Mark])

Comment: The City of Oak Ridge supports the issuance of a construction permit for Kairos Hermes Test Reactor with the proviso of our comments regarding storage and public safety requirements. (**19-6** [Watson, Mark])

Comment: The NIA agrees with the NRC staff's recommendation that "unless safety issues mandate otherwise," the NRC issue the CP application to Kairos Power to construct and demonstrate a prototype, molten salt cooled, TRISO fueled, nonpower reactor at the East Tennessee Technology Park site in Oak Ridge, Tennessee. (**20-1** [Ibarra, Jr., Victor])

Comment: Recent events both domestically and abroad have demonstrated the need for further investment into energy technologies that provide reliable, safe energy at a reasonable cost to consumers-and this project is just that. Moving forward with the Kairos Hermes Test Reactor lays the groundwork not just for the later commercial development of this technology, but also for the future licensing of other advanced nuclear as well. It is for these reasons that we support the licensing and construction of this reactor. (**21-3** [Meyer, Eric] [Schroder, Madison])

Response: *The NRC staff acknowledges these comments in support of the proposed Kairos Hermes Test Reactor project and CP licensing action. These comments do not present new information affecting the staff's analysis of the proposed action. No changes were made to the EIS in response to these comments.*

Comment: I believe it would be in the best interest of all concerned for the NRC to approve the draft EIS as in a timely manner so that the licensing process, and the project, can continue to move toward completion. (**18-4** [Frady, Teresa])

Comment: Having reviewed the Draft EIS, NIA agrees that the careful analysis conducted by NRC supports these high-level conclusions. The NRC's findings provide important substantive insights into the environmental impacts of the Hermes reactor. The NRC review also provides process insights that will benefit environmental reviews of subsequent advanced reactors. The NRC's commitment to scoping and performing environmental reviews commensurate with the potential impacts of the licensed activity is critical to ensuring effective and efficient regulation of advanced reactors.

NIA appreciates Kairos Power's and the NRC's diligence in preparing and performing a full EIS for the Construction Permit for the Kairos Hermes Test Reactor. The NIA awaits the Final Environmental Impact Statement from the Nuclear Regulatory Commission. (**20-5** [Ibarra, Jr., Victor])

Response: *The NRC staff worked to complete the EIS and other elements of the environmental review in as timely a manner as possible while still meeting the requirements of applicable environmental statutes and regulations. No changes were made to the EIS in response to these comments.*

G.2.23 General Comments in Support of the Licensing Process

Comment: We would like to thank the NRC for their hard work on this EIS, for the opportunity for interested stakeholders to share public comments, and what they've outlined here tonight, which we believe will benefit East Tennessee while continuing the mission of developing important science and national security work for the United States, an Oak Ridge tradition. (**8-10-2** [Harm, Elizabeth])

Comment: Overall, ANS commends the NRC for the quality and scope of the draft EIS for the Kairos Hermes test reactor. (**11-6** [Arndt, Steven] [Piercy, Craig])

Response: *The NRC staff acknowledges these comments in support of the NRC's licensing process. No changes were made to the EIS in response to these comments.*

Comment: I also commend the NRC staff's timely release of the draft EIS for comment (**8-1-4** [Franovich, Rani])

Comment: I appreciate the NRC, their early completion of publishing the draft. So, you know, I think that's something to be commended in these times. And, you know, we all need to work quickly and efficiently to bring good, clean energy to the grid, and so I appreciate everyone's work and I support moving forward. (**8-2-2** [Pickering, Ryan])

Comment: we want to commend the NRC staff on an efficient and thorough review. We appreciate their efforts. We've worked very hard with the NRC staff to try to move the review along, both on the environmental side and on the safety side as quickly and as efficiently as possible. We'll continue to work with the staff to address any issues that might arise as a result of public comments on the EIS, to the extent that that support is requested and needed.

We're also working with the rest of the industry and with NRC as collaboratively as possible to help identify efficiencies in the review process, both on the applicant side and on the regulator side, so that our positive experience in terms of the timely and efficient review and that we've received so far becomes the norm and not the exception for future applications going forward. (**8-3-1** [Hastings, Peter])

Comment: In addition to substantial engagement with the NRC staff, both in advance of the application submittal and since, we've also held a number of local community events to try to keep our neighbors apprised of our status. (**8-3-5** [Hastings, Peter])

Comment: And I did want to commend the staff for the excellent job in putting together the draft EIS, and I also want to commend Kairos for their excellent community engagement. This has been a series of activities where they have involved community folks. (*8-9-1* [Russell, Michael])

Comment: My name is Jim Hopf. I'm a member Citizens Climate Lobby, a grassroots organization that's mainly concerned with climate change. I would just like to express my appreciation for the support and the efforts to move this project forward and the timely completion of this draft EIS. (**8-12-1** [Hopf, Jim])

Comment: Thank you very much. My name is Grant Mills, and I'm a nuclear engineering student at the University of California Berkeley. I'd like to thank the NRC team and Kairos for their efforts in producing this environmental impact statement and in their efforts to share it with the public. (**8-13-1** [Mills, Grant])

Comment: Consistent with NEI's scoping comments, the NRC's DEIS recognizes that the determination of the need to build a test reactor is within the applicant's discretion. As the DEIS explains, "[t]he purpose and need of this proposed Federal action is to allow Kairos Power to build and operate a non-power test reactor to demonstrate key elements of the [KP-FHR] technology for possible future commercial deployment."[4] The DEIS also notes that the need for the project is tied directly to the DOE's objectives the under Advanced Reactor Demonstration Program (ARDP), which seeks to enable private companies like Kairos Power demonstrate safe and affordable advanced reactor technologies that can be licensed and deployed over the next 10 to 14 years.[5] Importantly, the NRC's informed articulation of the purpose and need for the proposed action lays the groundwork for the appropriately focused analysis of reasonable alternatives in Section 4.0 of the DEIS.

[4] DEIS at xiv.
[5] DEIS at 1-3.

Finally, we also support the NRC's approach to leverage existing evaluations and various regulatory tools to optimize the environmental review process. Notably, the NRC issued the DEIS less than a year after Kairos tendered its application and two months ahead of the staff's proposed schedule. This reflects the NRC staff's efforts to implement certain process improvements, including more effective pre-application engagement, an enhanced environmental audit process, and increased use of requests for confirmatory information in lieu of formal requests for additional information. Even with the appendices, the DEIS is less than 200 pages long, consistent with the NRC staff's stated intention to produce thorough but concise environmental review documents. To achieve this greater economy, the NRC staff consolidated the affected environment and environmental impacts discussions into a single section (Section 3.0) of the DEIS, presented a single combined discussion of preconstruction and construction impacts for each resource, and made increased use of incorporation by reference. Among other documents, the NRC made frequent use of its 2019 final EIS for Tennessee Valley Authority's application for an early site permit for a small modular reactor project (the Clinch River Nuclear project) on a site located near the proposed Hermes site.[6] Given the anticipated substantial increase in the volume of advanced reactor license applications over the next decade (e.g., for light-water small modular reactors, non-LWRs, microreactors), efficient environmental reviews will be even more imperative.[7]

[6] NUREG-2226, Environmental Impact Statement for an Early Site Permit (ESP) at the Clinch River Nuclear Site—Final Report (Apr. 2019) (ADAMS Package Accession ML19087A266).
[7] See Letter from Marcus R. Nichol, NEI, to Robert M. Taylor, NRC, "Subject: NEI Input on Regulatory Priorities for New and Advanced Reactors" (June 7, 2022) (ADAMS Accession No. ML22158A363).

In summary, NEI is pleased with the quality, timeliness, and efficiency of the NRC's DEIS for the Hermes application, as well as the NRC's consideration of our scoping comments. We also commend Kairos Power for submitting a high-quality application and working with the NRC staff to meet its related information needs, both of which are essential to timely and efficient NRC reviews. These improvements in the EIS process provide a foundation for achieving even greater efficiencies and timeliness for future advanced reactor environmental reviews. (**13-3** [O'Neill, Martin])

Comment: We also commend the NRC staff's timely release of the draft EIS for comment and their thoughtful consideration of the substantial long-term benefits from implementation of the Hermes project. (**17-2-1** [Franovich, Rani])

Response: *The NRC staff acknowledges these comments in support of NRC's licensing process. The NRC staff continues to seek ways to enhance the timeliness of its environmental review process while still meeting the objectives of NEPA and other environmental statutes by providing effective, open, and transparent analyses of potential environmental consequences of its licensing decisions. No changes were made to the EIS in response to these comments.*

Comment: I encourage the NRC staff to make maximum use of the generic environmental impact statement, or the GEIS, for advanced reactors. Generically evaluating and characterizing the much smaller environmental impacts of next-generation nuclear power plants significantly reduces review schedules and costs for the applicant.

I commend the NRC staff for publishing the Hermes draft EIS six weeks ahead of schedule. It's my understanding that the project manager actually sacrificed some personal plans to get it done, and I appreciate her efforts and dedication. (**8-1-1** [Franovich, Rani])

Comment: When a licensing decision clearly constitutes a major Federal action, we encourage the NRC staff to make maximum use of the Generic EIS (GEIS) for advanced reactors. Generically evaluating and characterizing the economic benefits and much smaller environmental impacts of these sleek, environmentally harmonious new designs significantly reduces review schedules and costs. (**17-1-8** [Franovich, Rani])

Response: *The NRC staff is unable to reference the Advanced Nuclear Reactor (ANR) GEIS at this time because the GEIS has yet to be published. The NRC staff acknowledges the remainder of the comment. Even before the ANR GEIS is available for use, the NRC staff continues to seek ways to enhance the timeliness of the environmental review process while still meeting the objectives of NEPA and other environmental review statutes by providing effective, open, and transparent analyses of potential environmental consequences of its licensing decisions. No changes were made to the EIS in response to this comment.*

Comment: The Nuclear Regulatory Commission (NRC) has a critical role to play in the deployment of new facilities. The Hermes review is important because elements can likely be used for full-scale, Kairos reactor deployments. Furthermore, as the Hermes test reactor will be one of the first advanced reactor designs to undergo a license review by the NRC, the insights can be applied to the multiple advanced reactor designs the NRC anticipates receiving in the near future. The review of a new reactor technology is an exciting opportunity, and the NRC staff's review will have broader impacts on future nuclear energy deployments. (**22-3** [Houghtalen, Natalie])

Response: *The NRC staff agrees that the insights gained from the environmental review of this application could prove valuable in improving the efficiency and effectiveness of environmental reviews for future licensing applications for advanced reactor technologies. No changes were made to the EIS in response to this comment.*

G.2.24 General Editorial Comments

Comment: Comment ID: 01

Document Location: Page iii, Lines 34–35 and other locations in document

Comment Description: States *"NRC staff's recommendation in this draft EIS is tentative. Before identifying a final recommendation in the final EIS, the NRC staff will also consider comments received on the draft EIS from Federal, State, local, and Tribal officials, and members of the public."*; however, on Lines #24–25 on same page already states *"NRC staff recommends, unless safety issues mandate otherwise that the NRC issue CP to Kairos*." Statements in locations identified seemed to be contradictory. ALL recommendation statements should be identified as tentative within the draft EIS. Anything stated as a full recommendation should be reserved only for the final EIS. (**5-1-1** [Creswell, Wade] [Shaw, John])

Comment: Comment ID: 05

Document Location: Page xv, Lines 29–39 and other locations in document

Comment Description: NRC staff again *"recommends issuance of the construction permit to Kairos"* in one sentence but conflict this statement by saying that the *"recommendation in this draft EIS is tentative"* a few sentences later. ALL recommendation statements should be

identified as tentative within the draft EIS. Anything stated as a full recommendation should be reserved only for the final EIS. (**5-1-5** [Creswell, Wade] [Shaw, John])

Response: *All recommendations in the draft EIS are tentative. The NRC staff can alter recommendations noted in the draft EIS based on its review of comments received and any new and significant information available to the NRC staff prior to completion of the EIS. In the case of this EIS, the NRC staff did not change any of its recommendations following consideration of public comments. No changes were made to the EIS in response to these comments.*

Comment: Comment ID: 09

Document Location: Page 1-3, Line 1 and Line 4

Comment Description: Line 1 states *"If Kairos were to apply for an OL"* (operating license) but Line 4 states *"Kairos proposes to build and operate the Hermes project*." Which is it? (**5-1-8** [Creswell, Wade] [Shaw, John])

Response: *Kairos is applying for a CP, which would authorize only construction of the proposed test reactor. Kairos will have to apply for and receive from the NRC an OL before it can operate the reactor. As explained in Section 1.1 of the EIS, a complete environmental review for a CP covers the potential impacts from the construction, operation, and decommissioning the Hermes facility, even though the permit the applicant is currently seeking from the NRC will only authorize the construction phase of the Hermes project. No changes were made to the EIS in response to this comment.*

Comment: Comment ID: 13

Document Location: Page 3-16, Line 36

Comment Description: The Michael Dunn Center has relocated. If you maintain this reference, the distance to its new facility should be adjusted. (**5-1-12** [Creswell, Wade] [Shaw, John])

Response: *The website for the Michael Dunn Center shows its location as 1324 Lawnville Road, Kingston, TN. This address is situated roughly 4.6 miles southwest of the proposed site of the Kairos Hermes Test Reactor. The staff does not plan to change the distance noted. No changes were made to the EIS in response to this comment.*

Comment: Comment ID: 20

Document Location: Page 3-28, Lines 14–17

Comment Description: The EIS states *"The 135 ac of land potentially subject to temporary or permanent disturbance for building, operating, and decommissioning the Hermes facilities contains trees and thus lacks any potential roost or maternity trees."* However, the previous Line 12-14 states *"However, the absence of trees or vegetation other than ruderal vegetation in the area where the Hermes facilities would be sited suggests that even transient presence in the affected area is unlikely."* This would seem to indicate that the statement in Lines 14–17 needs to be reworded to state "The 135 ac of land potentially subject to temporary or permanent

disturbance for building, operating, and decommissioning the Hermes facilities contains **only immature** trees and thus lacks any potential roost or maternity trees." (**5-1-19** [Creswell, Wade] [Shaw, John])

Comment: Comment ID: 28

Document Location: Page 4-3, Line 31

Comment Description: EDITORIAL: There is a missing parenthesis. Sentence portion should read "(Kairos 2022-TN7902)." (**5-2-8** [Creswell, Wade] [Shaw, John])

Response: *The final EIS will include these wording changes.*

Comment: Note that the header of the second column is mislabeled as "Emissions During Construction (TPY)." (**14-5** [Davidson, Bryan])

Response: The header of the second column in Table 3-3 will be changed to "Emissions (TPY)."

G.2.25 Comments Concerning Issues Outside Scope—Emergency Preparedness

Comment: The question I have is really as an Oak Ridger. Oak Ridgers are smart people, and they're pro-nuclear power. But recently I was working at Diablo Canyon Nuclear Power Plant, and I volunteered on the emergency preparedness team. And it's quite an involved evolution. You do have to do drills a couple of times a year at least, and it's quite an involved evolution and it's taxing on municipalities to have dedicated staff and resources, police and whatnot.

Understanding that this is a 35-megawatt system and, therefore, the source term is considerably smaller than a 2,000-megawatt system, NRC is still concerned with consequences. So I'm pretty sure it is going to be a requirement, 10 CFR 50.54(q) maybe -- am I right -- to have an emergency preparedness program. And although the EPZ is going to be a lot smaller, that's still going to be a requirement.

So my question as an Oak Ridger who is concerned about all things Oak Ridge and Oak Ridge budgets is have we, are we already planning on making sure -- PG&E would pay for municipalities to be prepared with their emergency preparedness program. They would pay. They paid for buildings, resources. They paid for those budgets that the cities would need in order to coordinate with the plant's emergency preparedness program.

So are we already working with Oak Ridge to make sure Oak Ridge has the budget and the resources to be able to provide a healthy emergency preparedness program? (**8-6-2** [DeLong, Carmen])

Comment: Likewise, the City looks forward to providing input regarding any "safety zone" requirements, as well as providing efficient public safety response capability to the site during construction and operation. (**19-5** [Watson, Mark])

Response: *These comments deal with emergency preparedness and/or emergency response actions and, as such, are outside the scope of the environmental review that is the subject of this EIS. An evaluation of emergency preparedness issues was included as part of the staff's review of Preliminary Safety Analysis Report Appendix 12A, Emergency Planning, and it was documented in its SE (NRC 2023-TN8414). No changes were made to the EIS as a result of these comments.*

G.2.26 Comments Concerning Issues Outside Scope—Miscellaneous

Comment: 2022-02-The first of two units at China's much-watched high-temperature gascooled modular pebble bed (HTR-PM) demonstration project was successfully connected to the grid on Dec. 20, 2021. The achievement marks a major milestone for fourth-generation advanced nuclear technology. https://www.powermag.com/china-starts-up-first-fourth-generation-nuclear-reactor/.

The USA has been lax in researching and building advanced Nuclear Technologies and SEEM to be surrendering Nuclear Technology leadership to competitors. (**3-2** [Campbell, Brian])

Comment: TDEC notes that the OF200 Mercury Treatment Facility is not operational and is not planned to be operational until 2025 (Referenced Document Kairos 2021-TN-7880, Section 3.4.3.1.1, Page 3-69). (**14-13** [Davidson, Bryan])

Response: *The NRC staff acknowledges this comment and notes that it is out of scope for preparation of an EIS for the subject action. No changes were made to the EIS in response to this comment.*

Comment: Comment ID: 25

Document Location: Page 3-71, Lines 30–31

Comment Description: Its stated Kairos has no current plans to sell the tritium captured. Since it says *"no current plans*," would this be considered in the future? (**5-2-5** [Creswell, Wade] [Shaw, John])

Response: *The EIS addresses only what Kairos has stated it plans to do as part of its CP application. Should Kairos propose activity in the future that requires an additional NRC license, the NRC staff would consider the environmental impacts of the additional activity at that time. No changes were made to the EIS in response to this comment.*

Comment: Comment ID: 29

Document Location: Page 4-9, Line 27

Comment Description: What portion of estimated overall funding for the Hermes Reactor construction, operation, and decommissioning is provided by the $303 million awarded by the DOE Advanced Reactor Demonstration Program? (**5-2-9** [Creswell, Wade] [Shaw, John])

Response: *The question raised in this comment is out of the scope of preparing an EIS for this project. No changes were made to the EIS in response to this comment.*

Comment: Before the Clean Water/Air Acts kicked in, this stuff was everywhere. But now that we (the human race) have done such a good job at removing heavy metallic neurotoxins from our economy, an operation like small-scale general aviation, has a relatively more toxic effect compared to past.

This proposed airport is a local recreational luxury by choice not economically essential, while Kairos's Hermes SMR initiative is a national clean energy economic priority. The contrast could not be more stark-clean energy R&D and next to it a proposal that began 13 years ago (see

attached) to develop an airport, a major contributor of greenhouse gas emissions. When an airport was suggested during the depressed economy of 2009 there were little to no prospects at Heritage Center. That fact has changed dramatically with Hermes and other opportunities of far greater merit -even national priorities. No firm commitment to an airport after 13 years is indication of the lack of merit. Especially with a modern GA airport within 23 minutes travel time --RKW. (**7-3** [Colclasure, Doug])

Comment: A proposed General Aviation airport with piston engine aircraft operating on leaded avgas https://en.wikipedia.org/wiki/Avgas, spewing carbon and lead emissions in great concentrations at low altitude operating at maximum power at takeoff directly overhead of the very people devoted to clean energy **-is embarrassingly contrary** to what our future in Oak Ridge (think Hermes, ORNL materials-high speed computing-climate mitigation R & D programs), in Tennessee, and our country is desperately pursuing. (**7-5** [Colclasure, Doug])

Comment: Just in the last 5 years the following business entities have chose to locate and do business in Oak Ridge. And not one has tied their decision to the prospect of a general aviation airport, Kairos, X-Energy, TVA-Hitachi-GE, Ultra Safe Nuclear Corp, General Fusion, Carbon Rivers, etc. Some say TYS congestion suggests the need for a "reliever airport." This is highly questionable. TYS has two runways over 9,500' in length. From 2014 through 2021 TYS had one runway completely closed for a total reconstruction ($110 million). And during that 7 years the GA traffic at TYS increased at least 33% -Cirrus. The FAA reported no traffic congestion issues. Keep in mind TYS is the 92nd largest Commercial & GA airport in the US. Spread over 2500 acres. Ample room for growth -re: Cirrus for example. And not once has consideration been given to how convenient RKW is to west Knox County and Oak Ridge.

To be building a small General Aviation airport for use by a few dozen recreational pilots to store and fly light sport aircraft, many with FAA experimental designation, has nuclear safety & other implications that make such a project ill-advised on many levels.

You may be unaware that as recently as this past spring the runway preliminary design alignment-characteristics were changed again for at least the 6th time in the 13 years. There is just no location safe for aviation, in this narrow ridge and valley topographic province. Having a concentration of low flying LSA's passing directly above the reactor, preparing to land would be a recipe for concern.

The latest proposed plan is to construct the runway across the front of Heritage Center. Effectively constructing a wall, 50' high at the west end, for over a mile in length across the entire front of Heritage Center parallel to TN Rt 58, with tunnel access to the site. The vast majority of vehicle traffic doing business in Heritage Center would be funneled through this tunnel. This would include primary access to and from Hermes, emergency services, the Oak Ridge fire department, tourists visiting the MPNHP K-25 History Center, Energy Solutions semi-trucktrailer access to their rail facility for off site transfer of hazardous materials, etc. Please make your voices heard that an airport under such dubious merits is an unacceptable risk to the nuclear reactors and related nuclear facilities within & in the vicinity of Heritage Center industrial park. Keep in mid it is not just Hermes at risk, the list is quite lengthy:

* Kairos 10 MW Thermal SMR "Hermes" --requiring NRC permit now being addressed

* And Kairos plans for Atlas -SMR fuel mfg --requiring another NRC permit --handling HALEU

* X-Energy's plans to mfg TRISO-X -requiring NRC permit -handling HALEU

* TVA-Hitachi-GE plans for a three SMR demonstration project at the former CRBR site-requiring NRC permits

* As well the HFIR at ORNL

* And SNM (special nuclear materials} at CNS-Y12

All of these are within 9 miles or less from a proposed airport and in the shadow of often little more than sightseeing flights flown at low altitude by recreational pilots.

It would be one thing if an airport existed with established economic benefits compared to a yet to be constructed airport proposed 13 years ago under far different economic prospects and now offering little more than a recreational luxury. There is just no defense to place so many nuclear facilities at risk from an unnecessary GA airport, that will require 230 acres of rare flat land, tax exempt, creating at most 6 jobs with starting pay of $17 per hour. Rewards vs risks are just not there. In a word a proposed GA airport in this instance in this location is “unjustified” on many levels—economically and nuclear safety risks are but two.

Public safety is a part of the environment being assessed, re: the EA. The NRC has every defensible reason (safety, incompatibility, no clear economic justification, etc) to look at this permit request through a much broader lens and clearly oppose this proposed general aviation airport in such close proximity to Hermes and surrounding nuclear facilities. Think of it like this – “Would the NRC license a nuclear facility in the same Industrial Park this close to an existing GA airport?” , “Would you even be faced with that prospect ?”

It is likely the NRC is not aware of the fact that the proposed location of the airport does not meet the FAA “Entry Criteria” requirement.

See page 19 of the FAA Order:

https://www.faa.gov/documentLibrary/media/Order/planning_5090_3c.pdf

RKW is only 23 minutes travel time from Heritage Center. And only 15 air miles. It is a modem ($ millions in upgrades and new facilities in past 15 years) general aviation airport with unlimited room for expansion.

https://airnav.com/airport/RKW

Just 1 mile off I-40 at exit 340. Here is a link to some of the pics of Rockwood Airport -One of the most modern airports in East Tennessee.

https://www.dropbox.com/sh/n2abiyzbicsutpe/AADyUOu6h7zy7lm2FfBxvkVa?dl=0

(**7-7** [Colclasure, Doug])

Response: *The proposed general aviation airport at the Heritage Center Industrial Park is not part of the action addressed in this EIS. The need for the airport is not within the scope of the EIS. The proposed airport is, however, discussed in the consideration of cumulative environmental impacts in Chapter 3 of the EIS. No changes were made to the EIS in response to this comment.*

Comment: Comment ID: 10

Document Location: Page 2-2, Lines 1–3

Comment Description: The TRISO pellet design is described as able to *"prevent the release of radioactive fission products*." Since nothing is 100% in all circumstance, this statement should be reworded to state **reduces the potential for the release of radioactive fission products**. (**5-1-9** [Creswell, Wade] [Shaw, John])

Response: *The accuracy of this statement concerns a safety issue that is outside the scope of this environmental review. No changes were made to the EIS in response to this comment.*

G.2.27 Comments Concerning Issues Outside Scope—NRC Oversight

Comment: I've had the pleasure of working with the NRC on many, many projects, and I just want my Oak Ridge residents to know that they are an outstanding regulator. Every time I've had to talk with anyone at the NRC about anything, and usually it's Chapter 15 postulated accidents, they're just exceptionally knowledgeable, very well organized. They have excellent processes, and they're ahead of industry on knowledge transfer. You know, we're being hit pretty hard in commercial nuke by the silver tsunami, a lot of people retiring that are taking that knowledge with them. But the NRC has been ahead of industry on implementing knowledge transfer programs. Some 15–20 years ago you guys started doing that; I can't remember. I'm getting old. (**8-6-1** [DeLong, Carmen])

Response: *The NRC staff acknowledges this comment. No changes were made to the EIS in response to this comment.*

G.2.28 Comments Concerning Issues Outside Scope—Safety

Comment: Comment ID: 27

Document Location: Page 3-72, Lines 21–23

Comment Description: Radioactive gases are identified as released through "high-efficiency particulate air filters" before discharge. Radioactive gases are not removed by high-efficiency particulate air filters alone, but also require addition of carbon filters to be effective. Will carbon filters also be utilized to properly capture radioactive gas releases? If so, this needs to be added to the description/requirements. (**5-2-7** [Creswell, Wade] [Shaw, John])

Response: *The issues raised in the comment are outside the scope of the environmental review and will not be addressed in the EIS. The NRC has developed a SE (NRC 2023-TN8414) that analyzes aspects of the Kairos Hermes Test Reactor and its operational safety. The NRC will only issue a CP if it can conclude that there is reasonable assurance (1) that the activities authorized by the CP can be conducted without endangering the health and safety of the public, and (2) that such activities will be conducted in compliance with the rules and regulations of the Commission. No changes were made to the EIS in response to this comment.*

G.3 References

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87 FR 61014. October 7, 2022. "Environmental Impact Statements; Notice of Availability." *Federal Register*, Environmental Protection Agency. TN8174.

Kairos Power, LLC. 2021. Letter from P. Hastings, Vice President, to NRC Document Control Desk, dated October 31, 2021, regarding "Kairos Power LLC Submittal of the Environmental Report for the Kairos Power Fluoride Salt-Cooled, High Temperature Non-Power Reactor (Hermes)." KP-NRC-2110-003, Alameda, California. ADAMS Accession No. ML21306A131. TN7880.

Kairos Power, LLC. 2022. Letter from P. Hastings, Vice President, to NRC Document Control Desk, dated April 22, 2022, regarding "Kairos Power LLC Transmittal of Reponses to NRC Requests for Confirmation of Information for the Review of the Hermes Environmental Report." KP-NRC-2204-005, Alameda, California. ADAMS Accession No. ML22115A204. TN7902.

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NRC (U.S. Nuclear Regulatory Commission). 2022. Memorandum from T. Dozier, Project Manager, to K. Erwin, Chief, dated August 24, 2022, regarding "Issuance of Summary Report for the Environmental Audit of the Kairos Hermes Test Reactor Construction Permit Application." Washington, D.C. ADAMS Accession No. ML22196A387. TN7954.

NRC (U.S. Nuclear Regulatory Commission). 2023. Letter from M. Shams, Director, Division of Advanced Reactors and Non-Power Production and Utilization Facilities Office of Nuclear Reactor Regulation, to P. Hastings, Vice President, Regulatory Affairs and Quality, dated June 13, 2023, regarding "Safety Evaluation for the Kairos Power LLC Construction Permit Application for the Hermes Non-Power Test Reactor (EPID No. L-2021-NEW-0011). Washington, D.C. ADAMS Accession No. ML23158A265. TN8414.

TVA (Tennessee Valley Authority). 2023. *Kingston Initiative Schedule*. Knoxville, Tennessee. ADAMS Accession No. ML23186A001. TN8188.

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Docket 50-7513

11. ABSTRACT (200 words or less)

This final environmental impact statement (EIS) has been prepared in response to an application to the U.S. Nuclear Regulatory Commission (NRC) by Kairos Power, LLC (Kairos) for construction permit (CP) for a non-power research and test reactor termed Hermes at a site in Oak Ridge, Tennessee. Kairos plans to build and operate Hermes to demonstrate key elements of the Kairos Power Fluoride Salt-Cooled, High Temperature Reactor (KP-FHR) technology for possible future commercial deployment. This final EIS includes the analysis that evaluates the environmental impacts of the proposed action and considers the following two alternatives to the proposed action: (1) the no-action alternative (i.e., the CP is denied) and (2) building the proposed Hermes non-power research and test reactor at a site near Idaho Falls, Idaho.

After weighing the environmental, economic, technical, and other benefits against environmental and other costs, the NRC staff's recommendation, unless safety issues mandate otherwise, is that the operating license be issued as proposed. The NRC staff based its recommendation on the following:

- the application, including the Kairos Hermes environmental report and supplemental submittals;
- consultation with Federal, State, Tribal, and local agencies;
- consideration of public comments; and
- the staff's independent review.

12. KEY WORDS/DESCRIPTORS (List words or phrases that will assist researchers in locating the report.)
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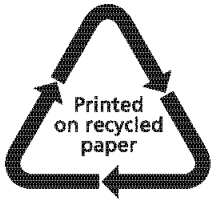

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