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

ML24103A002

Environmental Assessment and Finding of No Significant Impact for the Construction Permits for the Kairos Hermes 2 Test Reactors

Draft Report for Comment

Completed: April 2024

Environmental Center of Expertise
Division of Rulemaking, Environmental, and Financial Support

Office of Nuclear Material Safety and Safeguards

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

ML24103A002

Environmental Assessment and Finding of No Significant Impact for the Construction Permits for the Kairos Hermes 2 Test Reactors

Draft Report for Comment

Completed: April 2024

Office of Nuclear Material Safety and Safeguards

COMMENTS ON DRAFT REPORT

Any interested party may submit comments on this report for consideration by the NRC staff. Comments may be accompanied by additional relevant information or supporting data. Please specify Docket ID NRC-2023-0138 in your comments, and send them by the end of the comment period specified in the *Federal Register* notice announcing the availability of this report.

You may submit comments by using any of the following methods; however, the NRC encourages electronic comment submission through the **Federal rulemaking website**:

- **Federal rulemaking website**: Go to https://regulations.gov and search for Docket ID **NRC-2023-0138**.
- **Email**: Comments may be submitted to the NRC electronically using the email address: Kairos-Hermes2Environmental@nrc.gov.
- **Mail comments to**: Office of Administration, Mail Stop: TWFN-7-A60M, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, ATTN: Program Management, Announcements and Editing Staff.

For any questions about the material in this report, please contact: Peyton Doub, telephone: 301-415-6703; email: Peyton.Doub@nrc.gov or Mary Richmond, telephone: 301-415-7218; email: Mary.Richmond@nrc.gov. Both are staff of the Office of Nuclear Material Safety and Safeguards at the U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

The NRC cautions you not to include identifying or contact information that you do not want to be publicly disclosed in your comment submission. The NRC will post all comment submissions at https://www.regulations.gov as well as enter the comment submissions into the Agencywide Documents Access and Management System (ADAMS). The NRC does not routinely edit comment submissions to remove identifying or contact information.

If you are requesting or aggregating comments from other persons for submission to the NRC, then you should inform those persons not to include identifying or contact information that they do not want to be publicly disclosed in their comment submission. Your request should state that the NRC does not routinely edit comment submissions to remove such information before making the comment submissions available to the public or entering the comment into ADAMS.

COVER SHEET

Responsible Agency: U.S. Nuclear Regulatory Commission

Title: Environmental Assessment for the Construction Permit for the Kairos Hermes 2 Test Reactors

ABSTRACT

The draft environmental assessment (EA) describes the environmental review conducted by U.S. Nuclear Regulatory Commission (NRC) staff for an application by Kairos Power, LLC (Kairos) for construction permits under Title 10 of the *Code of Federal Regulations* Part 50, allowing construction of two non-power test reactors termed Hermes 2 on a 185-acre site in Oak Ridge, Tennessee. Hermes 2 would be built on the same site as Hermes, another non-power test reactor for which Kairos has already received a construction permit from the NRC. As with Hermes, Kairos plans to build and operate Hermes 2 to demonstrate key elements of the Kairos Power Fluoride Salt-Cooled, High Temperature Reactor technology for possible future commercial deployment. Each Hermes 2 reactor would be of similar size and design as the Hermes reactor but would include specific design differences. The draft EA follows procedures in 10 CFR 51.30, “Environmental assessment,” and 10 CFR 51.31, “Determinations based on environmental assessment,” which are NRC’s regulations for preparing EAs to implement the National Environmental Policy Act of 1969. The NRC staff concludes that the potential direct, indirect, and cumulative environmental impacts from Hermes 2 would not be significant and has determined that a draft Finding of No Significant Impact appears warranted.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

BACKGROUND

By letter dated July 14, 2023, Kairos Power LLC (Kairos) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for construction permits (CP) pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50 (TN249). The CPs would allow construction of two non-power test reactors termed Hermes 2 on a 185-acre (ac) site located in Oak Ridge, Tennessee. Kairos proposes to build the two Hermes 2 reactors on the same site for which they received a CP in 2023 to build another non-power test reactor of similar design, termed Hermes. Although the NRC issued a CP for Hermes in 2023 (NRC 2023-TN9771), Kairos has not yet started construction. Hermes and Hermes 2 are two separate test reactor projects, each requiring a separate CP from the NRC.

Section 104 of the Atomic Energy Act of 1954, as amended, (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) (TN661). The NRC's environmental protection regulations that implement NEPA in 10 CFR Part 51 (TN250) identify actions for which the NRC prepares an environmental impact statement (EIS). CPs for test reactors are an action identified as requiring an EIS. However, based on a review of the ER submitted as part of the CP application for Hermes 2 and the results of the EIS recently issued for Hermes 1, the NRC staff concluded that it would be prudent to first prepare a draft environmental assessment (EA) to determine whether preparation of an EIS would be necessary or whether a finding of no significant impact (FONSI) could be issued for Hermes 2 based on factors unique to the Hermes 2 CP application. These factors include (1) the similar design of Hermes 2 and Hermes, (2) the proposed siting of Hermes 2 within a few hundred feet of Hermes, (3) the industrial nature and heavy prior disturbance of the site, (4) the recent thorough NEPA review performed by the NRC staff as published in its final EIS for Hermes, and (5) the staff's final EIS for Hermes covering the same site as Hermes 2 and documenting all impacts as SMALL. The staff has made a preliminary determination that the proposed action would not significantly affect the quality of the human environment and, therefore, a draft FONSI appears warranted.

The staff will consider comments received on the draft EA and draft FONSI over a 30-day public comment period from Federal, State, local, and Tribal officials, and members of the public. After consideration of these public comments, the NRC staff will make a final determination as to whether preparation of an EIS is necessary or whether a FONSI can be issued for the Hermes 2 CP application. In addition, exemptions from certain regulations in 10 CFR Part 51 would be necessary to issue a final EA and final FONSI to support issuance of the Hermes 2 CPs. In accordance with 10 CFR 51.6, the NRC may grant exemptions from the requirements of 10 CFR Part 51 if it determines that the exemptions are authorized by law and are otherwise in the public interest.

PROPOSED ACTION

The proposed action is for the NRC to decide whether to issue CPs to Kairos authorizing construction of the two proposed Hermes 2 non-power test reactors. The site is situated in the Heritage Center Industrial Park of the East Tennessee Technology Park that was 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 occupied by DOE Buildings K-31

and K-33, both of which were part of the ORGDP. DOE ceased operation of the ORGDP in 1986, and both buildings were razed. Since then, the 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 CPs for Hermes 2, then Kairos still would have to obtain OLs before being able to operate the Hermes 2 reactors. To obtain an OL, Kairos would have to submit a separate application pursuant to NRC requirements and receive the license before operating the reactors. To conduct a complete and effective environmental review, this EA addresses the potential environmental impacts from the full life cycle of the Hermes 2 reactors, including construction, operation, and decommissioning. If, however, Kairos were to apply for an OL, the NRC staff would conduct another environmental review in accordance with 10 CFR Part 51 (TN250).

PURPOSE AND NEED FOR ACTION

The purpose and need of this proposed Federal action is to allow Kairos to construct two non-power test reactors termed Hermes 2 that Kairos would use to demonstrate key elements of the Kairos Power Fluoride Salt-Cooled, High Temperature Reactor technology for possible future commercial deployment. Kairos states that Hermes 2 will produce electricity but is categorized as a non-power reactor under 10 CFR 50.22, as not more than 50 percent of the annual cost of owning and operating the facility is devoted to the production of materials, products, or energy for sale or commercial distribution, or to the sale of services, other than research and development or education or training.

The technology is an advanced nuclear reactor technology that leverages TRI-structural ISOtropic particle fuel in pebble form combined with a low-pressure fluoride salt coolant. Hermes 2 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 Hermes 2 also would 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 project such as Hermes 2 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 the National Environmental Policy Act of 1969, as amended, that would lead 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

Results from an evaluation of the potential environmental impacts of the proposed action are presented in this EA. NRC staff typically characterizes environmental impacts as SMALL, MODERATE, and LARGE, as presented in the Final Interim Staff Guidance to NUREG-1537 (NRC 2012-TN5527, 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 Hermes 2. As shown in the table, the NRC staff characterized the potential environmental impacts of Hermes 2 on each relevant environmental resource as SMALL. SMALL environmental impacts are generally considered to not be significant effects on the human environment.

ALTERNATIVES

This EA also evaluates in detail the environmental impacts associated with the following two alternatives to construction, operation, and decommissioning of Hermes 2 at the proposed site in Oak Ridge, Tennessee:

- the no-action alternative
- construction, operation, and decommissioning of Hermes 2 at a site in Eagle Rock, Idaho (the Eagle Rock alternative)

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

The NRC staff evaluated each alternative considered in detail using the same resource areas that were used in evaluating impacts from the proposed action. The 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 purpose and need of Hermes 2. The staff determined that construction, operation, and decommissioning of Hermes 2 at the Eagle Rock alternative site would result in only SMALL impacts for most affected resources but 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 Hermes 2, as well as the original Hermes project, while disturbing only previously disturbed soils with a history of past industrial development. Use of the proposed site would avoid disturbing natural vegetation, wetlands, surface water features, agricultural land, and shallow subsurface cultural resources.

Table ES-1. Summary of Environmental Impacts from Construction, Operation, and Decommissioning of Hermes 2

Resource Area	EA Section	Summary of Impact	Impact Level
Land Use and Visual Resources	3.1	Same 185 ac site proposed for Hermes. Temporary disturbance of 138 ac of land previously occupied by industrial buildings. Permanent occupation of 30 ac of that land. Remainder of the site would be exclusion area throughout operation, where Kairos would have to ensure compatible land use. The site is within an established industrial park setting that is already of low scenic quality. Hermes 2 would have a compatible industrial appearance and be compatible with existing zoning. Short 161 kV electric transmission would be built extending approximately 600 feet west of the 185 ac Kairos site to connect to existing electrical grid; the transmission line would be built entirely with previous disturbed lands within an existing industrial park.	SMALL
Air Quality and Noise	3.2	Air emissions of criteria pollutants would be below 100 tons per year, and hazardous air pollutants would be below 10 tons per year individually and 25 tons per year combined. Emissions would comply with non-Title V permitting requirements. Standard control measures to minimize fugitive dust.	SMALL
Hydrogeology and Water Resources	3.3	No disturbance of geological features of economic or natural value. Disturbances limited to previously disturbed soils. Best management practices employed for soil erosion and sediment control. Water demands met through municipal or commercial suppliers. No use of groundwater and no direct use of surface water. No cooling towers, ponds, or reservoirs. Wastewater discharged for treatment to municipal wastewater treatment facilities. Limited, temporary dewatering of two reactor excavations during construction. Dewatering water to be dispositioned in accordance with DOE requirements per the quit claim deed for the site. Stormwater to be managed using best management practices.	SMALL
Ecological Resources	3.4	Ground disturbance, including for transmission lines, limited to previously disturbed soils lacking vegetation or with only ruderal vegetation. No disturbance of forest cover or other natural vegetation on natural soils, wetlands, surface waters, shorelines, or riparian land. No Clean Water Act Section 404 permit required. Best management practices would be employed to control stormwater runoff that might reach wetlands or aquatic habitats. Brief increases in noise generated during construction may affect wildlife, but area wildlife are currently exposed to industrial noise. Limited potential for wildlife to collide with new structures or be injured by vehicles. The biological evaluation presented in Table 3-4 of this EA presents NRC staff conclusions regarding effects of Hermes 2 on species protected under the Endangered Species Act of 1973 (TN1010). Conclusions for all species are no effect or may affect but not likely to adversely affect. No critical habitat present. As required under Section 7 Endangered Species Act, the NRC is requesting the U.S. Fish and Wildlife Service concurrence with these findings. The EA will include the result of this request.	SMALL

Table ES-1. Summary of Environmental Impacts from Construction, Operation, and Decommissioning of Hermes 2 (Continued)

Resource Area	EA Section	Summary of Impact	Impact Level
Historic and Cultural Resources	3.5	No historic properties in the direct effects area of potential effects. Ground disturbance limited to areas of extensive past soil disturbance with little potential for remaining archaeological resources. Kairos has developed and would implement an Archaeological Resources Monitoring and Unanticipated Discovery Plan covering any work on the 185 ac site establishing stop work and notification procedures to address unexpected discovery of human remains or archaeological material in compliance with deed requirements and Tennessee State law. The Manhattan Project National Historical Park (eligible for the National Register of Historic Places) is in the indirect effects area of potential effects but would not be adversely affected because Hermes 2 would be visually compatible with the current industrial setting. The NRC staff has made a preliminary determination of no adverse effect to historic properties from the potential issuance of a CP for Hermes 2.	SMALL
Socioeconomics and Environmental Justice	3.6	Construction of Hermes 2 would involve an average of 424 site workers per year over a 3-year period with an estimated peak of 850 workers. Staffing during an 11-year operational phase would require an estimated average of 59 workers per weekday (101 full-time positions). Decommissioning would involve an estimated peak employment level of 340 workers. These few 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. Given that the nearest potentially affected environmental justice populations are over 8 miles away, and the small footprint of and potential impacts from Hermes 2, both physically and in terms of personnel, no disproportionately high and adverse human health and environmental effects on minority and low-income populations would be expected.	SMALL
Human Health	3.7	The site was formerly occupied by buildings that were part of the DOE Oak Ridge Gaseous Diffusion Plant that was used to enrich uranium, but the DOE has already razed the buildings and has begun remediation with the end use land use designation of “unrestricted industrial land use” as the basis for defining its remedial action objectives s. The 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). Based on the calculated radiological doses, the NRC staff concludes that the radiological impacts to members of the public due to normal operation of Hermes 2 would be not significant. 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.	SMALL

Table ES-1. Summary of Environmental Impacts from Construction, Operation, and Decommissioning of Hermes 2 (Continued)

Resource Area	EA Section	Summary of Impact	Impact Level
		Emissions would comply with the Resource Conservation and Recovery Act (TN1281), Clean Air Act (TN1141), and other environmental regulations.	
Nonradiological Waste	3.8	Kairos would develop and implement a plan to manage wastes generated by Hermes 2. Management of solid waste, including construction and demolition wastes, would involve waste reduction efforts, recycling, and use of best management practices. 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 Waste Management	3.9	A low quantity of uranium would be used during the 11-year operational period. TRI-structural ISOtropic (TRISO) fuel processes (including enrichment and fuel fabrication) would be bounded by Table S-3 in 10 CFR 51.51 (TN250), developed by the NRC to protect human health and the environment. Environmental impacts from the storage of spent TRISO fuel from Hermes 2 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 2. Onsite storage of spent TRISO fuel would have to meet the same regulatory requirements as currently licensed light water reactors.	SMALL
Transportation of Radioactive Material	3.10	Transportation of radioactive fuels and wastes to and from Hermes 2 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. Based on the quantity of nuclear material and waste acceptable for disposal and employing certified packages in conforming NRC and Department of Transportation regulations, the NRC staff concludes that the transportation of fuel and waste impacts from operation and decommissioning of Hermes 2 would be not significant.	SMALL
Postulated Accidents	3.11	The NRC staff is conducting an independent review of the consequences of accidents and will document it in its Safety Evaluation. To receive CPs, the Hermes 2 test reactors would have to meet NRC requirements for postulated accidents, for which 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

RECOMMENDATION

On the basis of this EA, and its determination that the environmental impacts would be SMALL for each potentially affected resource area, the NRC staff concludes that the proposed action would not have a significant effect on the quality of the human environment. Therefore, the staff has made a preliminary determination that it will not prepare an EIS and that a draft FONSI appears warranted. Further, 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 CPs to Kairos for Hermes 2. The NRC staff based its recommendation on the following:

- the NRC staff's review of Kairos's Hermes 2 environmental report (Kairos 2023-TN9774 and associated responses to requests for clarifying information.
- the NRC staff's independent environmental review.

The NRC's staff's recommendation is tentative. Before identifying a final recommendation, the staff also will consider comments received on this draft EA over a 30-day public comment period from Federal, State, local, and Tribal officials, and members of the public.

ABBREVIATIONS AND ACRONYMS

ADAMS	Agencywide Document Access and Management Systems
APE	area of potential effect
BMP	best management practices
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CO_2	carbon dioxide
CO_2(e)	carbon dioxide equivalent
COL	combined license
CP	construction permit
CRN	Clinch River Nuclear
DOE	U.S. Department of Energy
EA	environmental assessment
EFPY	effective full-power years
EIS	environmental impact statement
EJ	environmental justice
EPA	Environmental Protection Agency
ER	environmental report
ESP	Early Site Permit
ETTP	East Tennessee Technology Park
FFA	Federal Facility Agreement
FONSI	finding of no significant impact
FWS	U.S. Fish and Wildlife Service
GCRP	Global Change Research Program
GHG	Greenhouse Gases
GWL	global warming levels
HALEU	High-Assay Low Enriched Uranium
IHTS	intermediate heat transport system
IPCC	Intergovernmental Panel on Climate Change
Kairos	Kairos Power LLC
KP-FHR	Kairos Power Fluoride Salt-Cooled, High Temperature Reactor
LLRW	low-level radioactive waste
LOS	level of service

LWR	light water reactor
MA-NLAA	may affect, but not likely to adversely affect
MEI	maximally exposed individual
MHA	maximum hypothetical accident
MOA	memorandum of agreement
MT	metric tons
MWe	megawatts electric
MWt	megawatts thermal
NAAQS	National Ambient Air Quality Standards
NCA5	Fifth National Climate Assessment
NEPA	National Environmental Policy Act of 1969
NHP	National Historical Park
NHPA	National Historic Preservation Act of 1966
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
OL	operating license
ORGDP	Oak Ridge Gaseous Diffusion Plant
ORR	Oak Ridge Reservation
PM	particulate matter
PNNL	Pacific Northwest National Laboratory
PSAR	preliminary safety analysis report
RCI	requests for confirmatory information
RFP	requests for proposals
ROD	Record of Decision
ROI	region of interest
SE	Safety Evaluation
SQG	Small Quantity Generator
SWPP	stormwater pollution prevention plan
SWU	separative work units
TDEC	Tennessee Department of Environment and Conservation
TEDE	total effective dose equivalent
THC	Tennessee Historical Commission
TRISO	Tri-structural ISOtropic
USCB	U.S. Census Bureau

1 INTRODUCTION

By letter dated July 14, 2023, Kairos Power LLC (Kairos) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for construction permits (CP) pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50 (TN249), that would allow construction of two non-power test reactors termed Hermes 2 on a 185 acre (ac) site located in Oak Ridge, Tennessee. Kairos proposes to build the two Hermes 2 reactors on the same site for which they received a CP in 2023 to build another non-power test reactor of generally similar design termed Hermes. Although the NRC issued a CP for Hermes in 2023, Kairos has not started its construction yet. Hermes and Hermes 2 are two separate test reactor projects each requiring a separate CP from the NRC.

Section 104 of the Atomic Energy Act of 1954, as amended, (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) (TN661). The NRC's environmental protection regulations that implement NEPA in 10 CFR Part 51 (TN250) identify actions for which the NRC prepares an environmental impact statement (EIS). CPs for test reactors are an action identified as requiring an EIS. However, based on a review of the environmental report (ER) submitted as part of the CP application for Hermes 2 and the results of the EIS recently issued for Hermes 1, the NRC staff concluded that it would be prudent to first prepare a draft environmental assessment (EA) to determine whether preparation of an EIS would be necessary or whether a finding of no significant impact (FONSI) could be issued for the Hermes 2 CP based on factors unique to the Hermes 2 CP application. These factors include: (1) the similar design of Hermes 2 and Hermes, (2) the proposed siting of Hermes 2 within a few hundred feet of Hermes, (3) the industrial nature and heavy prior disturbance of the site, (4) the recent thorough NEPA review performed by the staff as published in its final EIS for Hermes, and (5) the staff's final EIS for Hermes, covering the same site as Hermes 2 and documenting all impacts as SMALL. The staff has made a preliminary determination that the proposed action would not significantly affect the quality of the human environment and, therefore, a draft FONSI appears warranted.

The staff will consider comments received on this draft EA and draft FONSI over a 30-day public comment period from Federal, State, local, and Tribal officials, and members of the public. After consideration of these public comments, the NRC staff will make a final determination as to whether preparation of an EIS is necessary or whether a FONSI can be issued for the Hermes 2 CP application. In addition, exemptions from certain regulations in 10 CFR Part 51 would be necessary to issue a final EA and final FONSI to support issuance of the Hermes 2 CPs. In accordance with 10 CFR 51.6, the NRC may grant exemptions from the requirements of 10 CFR Part 51 if it determines that the exemptions are authorized by law and are otherwise in the public interest.

1.1 The Proposed Federal Action

The proposed action is for the NRC to issue CPs to Kairos authorizing construction of the two proposed Hermes 2 reactors. The site is situated in the Heritage Center Industrial Park of the East Tennessee Technology Park (ETTP), 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.

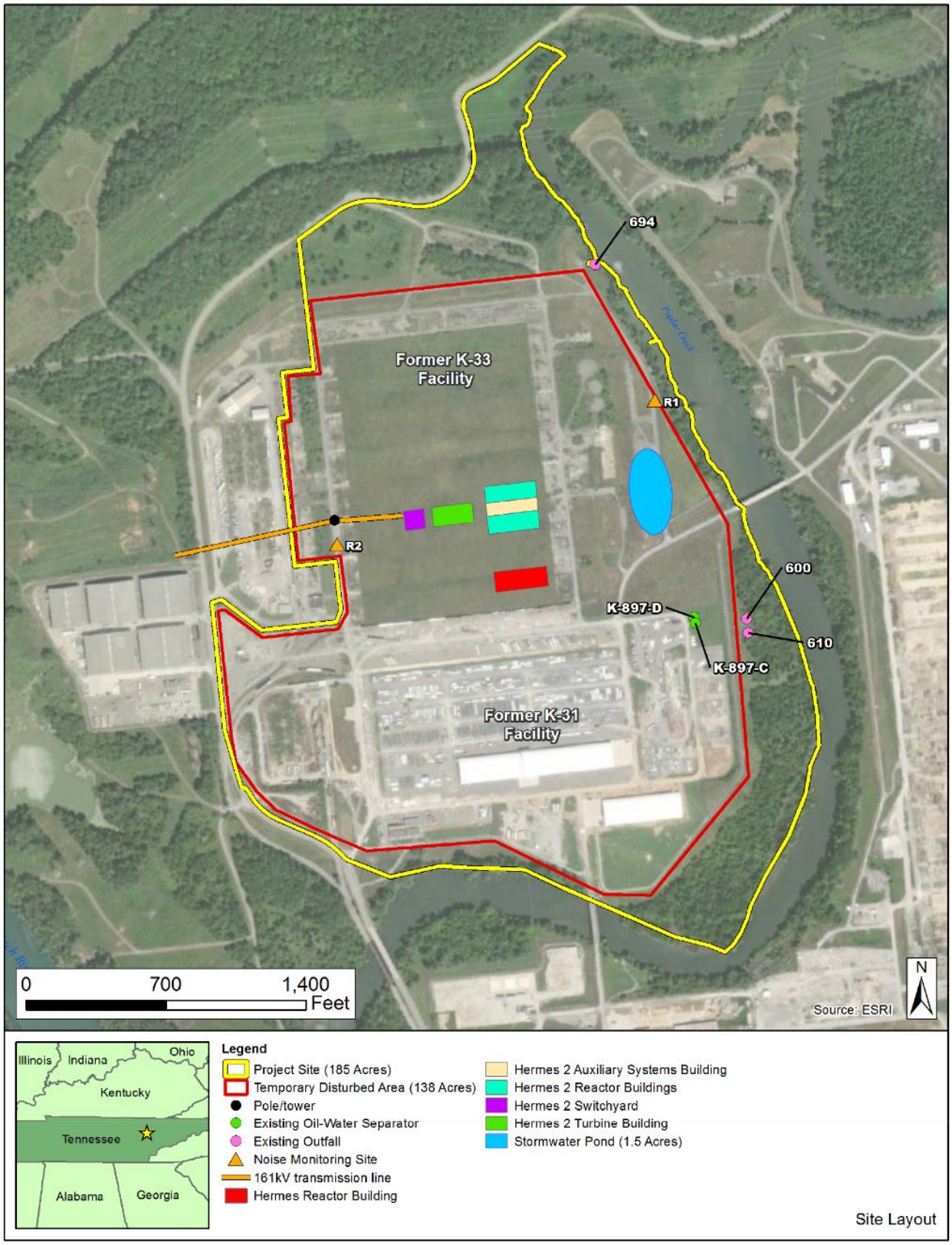


Figure 1-1 Hermes 2 Reactor Site (Source Kairos 2023-TN9774)

Historical missions at ETTP resulted in a legacy of contaminated, inactive facilities. After the Oak Ridge Reservation (ORR) was listed on the National Priorities List, environmental work at ETTP was driven by Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements. The early CERCLA actions and facility demolitions are complete. Characterization and remedial actions for soil, buried waste, and subsurface structures were implemented under a Soil Record of Decision (ROD) (DOE 2023-TN9801). The Soil ROD, which addresses soil, including the K-31/K-33 Area, has an "unrestricted industrial land use" as the basis for defining its remedial action objectives. The remaining CERCLA decisions at ETTP will address contamination in groundwater, surface water, and sediment in the ponds, wetlands, and perennial streams. These decisions will include protection of ecological receptors in aquatic environments (i.e., ponds and streams) (DOE 2023-TN9801).

The site has Land Use Control restrictions established under the Soil ROD for the K-31/K-33 Area that limit development to industrial and commercial uses; allow for continued DOE access as needed to complete CERCLA cleanup actions; and prohibit groundwater extraction, consumption, exposure, or use, in any way. The designation for an end use of unrestricted industrial use limits means any excavation or penetration below 10 feet is restricted and requires Federal Facility Agreement (FFA) tri-party (i.e., DOE, U.S. Environmental Protection Agency [EPA], and Tennessee Department of Environment and Conservation [TDEC]) approval. A series of FFA tri-party letters from 2014 was issued regarding the request and approvals of soil penetration and/or excavation to depths greater than 10 feet below the ground surface in the greater K-33 Area (DOE 2023-TN9801).

This EA constitutes the NRC staff's review of potential environmental impacts from the proposed action of issuing CPs for the Hermes 2 reactors. The issuance of a CP is a separate licensing action from the issuance of an operating license (OL). If the NRC issues CPs and Kairos were to seek NRC approval to operate the reactors, then Kairos would have to submit a separate application for OLs pursuant to the NRC's requirements, and Kairos would have to obtain NRC approval before operating the reactors. To conduct a complete environmental review, this EA covers the potential impacts from the construction, operation, and decommissioning life-cycle phases of the Hermes 2 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 OLs for the Hermes 2 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 conduct another environmental review in accordance with 10 CFR Part 51 (TN250).

1.2 Purpose and Need

The purpose and need of this proposed Federal action is to allow Kairos to construct two non-power test reactors termed Hermes 2, that Kairos would use to demonstrate key elements of the Kairos Power Fluoride Salt-Cooled, High Temperature Reactor (KP-FHR) technology for possible future commercial deployment (Kairos 2023-TN9774). Kairos states that Hermes 2 will produce electricity but is categorized as a non-power reactor under 10 CFR 50.22, as not more than 50 percent of the annual cost of owning and operating the facility is devoted to the production of materials, products, or energy for sale or commercial distribution, or to the sale of services, other than research and development or education or training.

Demonstration of the advanced nuclear reactor technology, which leverages TRI-structural ISOtropic (TRISO) particle fuel in pebble form combined with a low-pressure fluoride salt coolant, would support Kairos's reactor development program. The Kairos reactor development

program relies on learning and risk reduction by narrowing the design space through progressive test cycles. Construction and operation of Hermes 2 also would:

- provide validation and qualification data to support potential future commercial reactors using the Kairos Power Fluoride Salt-Cooled, High Temperature Reactor technology
- facilitate rapid demonstration of a multi-unit non-power reactor with shared power conversion systems in support of Kairos' iterative development approach
- reduce commercial cost uncertainty by demonstrating power conversion system and power transmission system integration and a multi-unit reactor facility
- retain construction workforce competency and demonstrate multi-unit construction and iteration of construction methods

Kairos participates in DOE's Advanced Reactor Demonstration Program, 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 2023-TN9774).

The determination of need and the decision to build a test reactor project such as Hermes 2 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 the National Environmental Policy Act of 1969, as amended, that would lead 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.

1.3 The NRC Application Review

The NRC process to review CP applications 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 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. The NRC considers the findings in both the environmental review 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). Use of the guidance is not mandatory and does not substitute for compliance with NRC regulations. Therefore, the NRC staff ensured that the environmental review documented in this EA met the applicable regulations in 10 CFR Part 51 (TN250) and used the guidance associated with NUREG-1537 only as supplementary direction.

In July 2023, Kairos submitted its ER (Kairos 2023-TN9774) as part of its CP application submittal, as discussed above. On September 11, 2023, the NRC notified Kairos of its decision that the application (including the ER) was sufficient to conduct its detailed review (NRC 2023-TN9777). The NRC staff published a Notice of Acceptance for Docketing in the *Federal Register* on September 15, 2023 (88 FR 63632-TN9776). In January–February 2024, 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 2024-TN9899).

This EA presents the NRC staff’s analysis that considers and weighs the environmental impacts of the Hermes 2 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 CPs for the proposed Kairos Hermes 2 facility at the site in Oak Ridge, Tennessee.

The NRC and other Federal agencies have prepared other NEPA documents related to the scope of the Hermes 2 project. Table 1-1 provides a brief description of the related NEPA documents issued by the NRC and other Federal agencies along with the relevance of each document. All NEPA documents that were incorporated by reference or referenced in this EA are publicly available, and links to these documents can be found in Table 1-1 and Section 7. Where parts of a NEPA document are incorporated by reference in the EA, the pertinent section(s), figures, and tables of the document are indicated in the impact discussion sections along with a brief description of the incorporated material.

Other sources of information the staff considered in its analysis also are listed in Table 1-1. For information from Kairos, the NRC staff referenced the ER specifically prepared to address Hermes 2 and submitted as part of the application (Kairos 2023-TN9774). When preparing the ER for Hermes 2, Kairos incorporated by reference frequently from an ER it had recently submitted for the Hermes project (Kairos 2023-TN8172). Where the NRC staff found it helpful to reference certain sections of the ER for the prior Hermes submittal for readability, the staff did so only after verifying that the referenced material was applicable to Hermes 2 and Kairos had incorporated by reference the applicable content from the Hermes ER in the Hermes 2 ER.

Table 1-1 List of Related NEPA Documents

Title	Relevance	Reference
NRC. Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor, Final Report. NUREG-2263.	EIS prepared for a CP for a test reactor on the same site as Hermes 2. Establishes baseline affected environment and provided environmental impact analyses of activities associated with construction, operation, and decommissioning of the Hermes reactor.	TN9771
NRC. Environmental Impact Statement for an Early Site Permit (ESP) at the Clinch River Nuclear Site. NUREG-2226.	EIS prepared for new reactor in close proximity to Hermes 2. Informs resource impact analyses such as ecological studies, transportation analyses, socioeconomic analyses, environmental justice population characteristics, cumulative impacts, and climate change.	TN6136
NRC. Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Supplement 1, NUREG-0586	Generic EIS that considers in a comprehensive manner all aspects related to the radiological decommissioning of nuclear reactor facilities by incorporating updated information, regulations, and analyses. Informs each of the decommissioning impact analyses.	TN7254
DOE. Environmental Assessment, Transfer of Land and Facilities within the East Tennessee Technology Park and Surrounding Area, Oak Ridge, Tennessee. DOE/EA-1640, Final Environmental Assessment and Finding of No Significant Impact, Oak Ridge, Tennessee.	EA in 2011 prior to transferring the land and facilities within the ETTP to the Community Reuse Organization of East Tennessee. DOE's EA provides that no prehistoric archaeological resources are known to exist within the ETTP site which encompasses the proposed Hermes 2 site.	TN4888
DOE. Covenant Deferral Request for the Proposed Title Transfer of the Former K-33 Area at the East Tennessee Technology Park, Oak Ridge, Tennessee, Final-Concurred. DOE/OR/01-2666.	DOE performed radiological surveys and environmental sampling under the DOE Environmental Management Program's Dynamic Verification Strategy process to assess the condition of the site for title transfer. As documented in these title transfer reports, there were no exceedances of the measured maximum or average remediation level.	TN7964
DOE. Environmental Assessment Property Transfer to Develop a General Aviation Airport at the East Tennessee Technology Park Heritage Center, Oak Ridge, Tennessee. Oak Ridge, Tennessee.	DOE prepared an EA for a proposed airport in Oak Ridge. That assessment indicated that 65 dBA is the maximum compatible level with a residential area.	TN7903

Table 1-1 List of Related NEPA Documents (Continued)

Title	Relevance	Reference
Kairos Power LLC. Submittal of the Environmental Report for the Kairos Power Fluoride Salt-Cooled, High Temperature Non-Power Reactor (Hermes).	This is the ER submitted by Kairos as part of the CP application for Hermes. This document is frequently cited by the ER (Kairos 2023-TN9774). It is occasionally referenced in this EA but only to the extent that it supports referencing to the ER or Hermes CP EIS (NRC 2023-TN9771).	TN8172
Kairos Power, LLC. Submittal of the Construction Permit Application for the Hermes 2 Kairos Power Fluoride Salt-Cooled, High Temperature Non-Power Reactor.	This is the ER submitted by Kairos as part of the CP application for Hermes 2. It summarizes the environmental impacts of construction, operation, and decommissioning for Hermes 2. Kairos incorporates by reference portions of the Hermes ER (Kairos 2023-TN8172).	TN9774

Key: dBA = A-weighted decibel(s); DOE = Department of Energy; EA = environmental assessment; EIS = environmental impact statement; ER = environmental report; ESP = Early Site Permit; ETTP = East Tennessee Technology Park; NRC = U.S. Nuclear Regulatory Commission.

The staff notes that prior to incorporating by reference or referencing any portion of a document in this EA, the NRC staff verified the current applicability of the referenced material to Hermes 2. Additionally, any analysis in a referenced document was independently verified by the NRC staff. The NRC's independent analysis related to any document incorporated by reference or referenced are summarized to highlight the important aspects of the analysis presented in the source document to determine impacts. This cuts down on bulk without impeding public review.

1.4 Regulatory Provisions, Permits, and Required Consultations

Appendix D to this EA lists each environmental regulatory requirement, permit, and consultation necessary for construction of Hermes 2. They are the same as for Hermes, as presented in Appendix D of the Hermes CP EIS (NRC 2023-TN9771). However, the applicant would have to obtain separate permits specifically covering Hermes 2. The applicant bears the responsibility for applying for each permit. The NRC staff bear the responsibility for performing the consultations required under the Endangered Species Act of 1973, as amended (ESA) (TN1010) and National Historic Preservation Act of 1966, as amended (NHPA) (TN4157). Separate consultation efforts specific to Hermes 2 are required.

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 test reactors are not part of the NRC action to license the reactors 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 reactors 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, Chapter 3 of this EA presents a single combined discussion of preconstruction and construction impacts for each resource. Because the conclusions determined by the staff in this EA 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

This EA is organized as follows:

- Chapter 1 is this introduction.
- Chapter 2 provides a description of the proposed Hermes 2 project, summarizing key elements of the design needed by the NRC staff to evaluate potential environmental impacts. Most of the information in Chapter 2 is drawn from the applicant's description of the project in their ER (Kairos 2023-TN9774), preliminary safety analysis report (PSAR) (Kairos 2023-TN9774), and other parts of the application.
- Chapter 3 describes the affected environment for each of the 12 environmental resources identified by the NRC staff as relevant to Hermes 2, followed by the staff's evaluation of potential environmental impacts on each resource. The staff independently verified and summarized the affected environment descriptions from prior NEPA documents issued by the NRC or other Federal agencies, the applicant's ER, and other public source documents. As described in Section 1.3, as appropriate the NRC staff relied on incorporation by reference and the referencing of source documents to the extent possible to simplify the EA. While inherent in the use of previous issued NEPA documents by the NRC, it should be noted that when referencing Kairos' ER, the staff developed their evaluations of environmental impacts independently from the applicant, relying in part on impact data presented by the applicant only after independent verification.
- Chapter 4 presents the NRC staff's evaluation of a range of reasonable alternatives to the proposed action.
- Chapter 5 summarizes the staff's conclusions and recommendation to the NRC Commission based on the environmental review.
- Chapter 6 is the draft Finding of No Significant Impact

Appendices to this EA contain additional information in the following areas:

- Appendix A – Contributors to the Environmental Assessment

- 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 – Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Cumulative Effects Analysis

2 PROPOSED PROJECT

The proposed Federal action is for the NRC to issue CPs to Kairos under 10 CFR Part 50 (TN249) to construct a two-unit non-power facility (Hermes 2) to test and demonstrate the KP-FHR technology in Oak Ridge, Tennessee. After receipt of CPs from the NRC, the applicant would be required to apply for a separate OL under 10 CFR Part 50 (TN249) before reactor operation. The NRC would perform separate environmental reviews for the OL application and for subsequent licensing actions, such as OL renewal and decommissioning. The information presented below summarizes key characteristics of the Hermes 2 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 Hermes 2 CPs would be addressed as necessary in any subsequent environmental reviews for an OL application or for decommissioning.

2.1 Project Overview

As noted in Section 2.1 of the ER (Kairos 2023-TN9774) the Hermes 2 project would test and demonstrate key technologies, design features, and safety functions of the 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. As noted in the ER, Kairos plans to begin construction of the overall Hermes 2 project as early as mid-2025, with the earliest projected completion date of mid-2027 for Hermes 2 Unit 1 and mid-2028 for Hermes 2 Unit 2. Kairos plans an operational life of 11 years for each unit, after which the units would be decommissioned. 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 ER (Kairos 2023-TN9774) and summarized below.

With specific exceptions, the design of each Hermes 2 reactor, described in the Hermes 2 PSAR, would be similar to that of the Hermes reactor (Kairos 2023-TN9774). As described in the both the PSAR and ER, the Hermes 2 project would consist of two test reactors (units), each with a maximum thermal power of 35 megawatts thermal (MWt) and intermediate heat transport system loops that reject heat via a steam superheater to a shared traditional power generation system. A heat rejection radiator provided in the primary heat transport system would reject heat directly to the atmosphere when the power generation system is not in service. The ER includes process flow diagrams for the reactor units and primary and intermediate heat transport systems (Figure 2.3-1 of the ER) and the shared power generation system (Figure 2.3-2 of the ER). Kairos states that although the Hermes 2 reactors would generate electricity, they would still be categorized as non-power reactors under the provisions of 10 CFR 50.22 (TN249), because not more than 50 percent of the annual cost of owning and operating the facilities would be devoted to the production of materials, products, or energy for sale or commercial distribution, or to the sale of services, other than research and development or education or training.

2.2 Site Location and Layout

Kairos describes the site location and layout in Section 2.2 of the ER (Kairos 2023-TN9774). Kairos proposes building the two Hermes 2 test reactors adjacent to the location of the Hermes

test reactor within a 185 ac site in the ETTP. The site had previously been occupied by Buildings K-31 and K-33, which were formerly part of the DOE ORGDP. The Hermes 2 facilities would permanently disturb approximately 30 ac within the former footprint of the K-33 facility. Figure 1-1 of this EA depicts the proposed layout of the Hermes 2 facilities, which would include the two reactor buildings, an auxiliary-systems building, a turbine building, and a switchyard. The Hermes 2 facilities complex would be built on land formerly situated within the ORR (and since excessed by DOE to the City of Oak Ridge for industrial redevelopment). The applicant states that Hermes 2 would share various administrative facilities built for the Hermes reactor.

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-TN9774). The applicant estimates that construction would require an average of 424 onsite workers, with 850 workers onsite at peak times, and would involve a monthly average of 426 truck deliveries and 8 offsite shipments of construction debris. Operation is estimated to involve an average of 59 workers per weekday (101 full-time positions), with an estimated monthly average of 30 truck deliveries and 8 offsite waste shipments. The applicant notes that the two Hermes 2 reactors (i.e., Units 1 and 2) would be decommissioned in series and estimates that figures for decommissioning would be as described for Hermes, which according to Section 2.3 of the Hermes CP EIS (NRC 2023-TN9771) would be an average of 170 workers (340 workers at peak times) and a monthly average of four truck deliveries and 170 offsite waste shipments.

2.4 Equipment and Material Usage

Kairos provides estimates of anticipated equipment and material use by Hermes 2 in Section 2.1 of the ER (Kairos 2023-TN9774). Table 2.1-1 in the ER provides the applicant's estimates of material such as concrete, structural steel, steel sheet pilings, asphalt, and stone that would be consumed during construction of Hermes 2. Equipment usage for each unit of Hermes 2 would be as outlined for Hermes in Section 2.4 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference. Section 2.4 of the EIS relies in part on Table 2.1-2 in the Hermes ER (Kairos 2023-TN8172). Kairos also estimates in Section 2.1 of the ER (Kairos 2023-TN9774) that, as a bounding assumption, that approximately 63,600 gallons (gal) of diesel fuel is assumed to be consumed on an average monthly basis during the construction phase.

As noted in Section 2.1 of the ER (Kairos 2023-TN9774), Kairos estimates shipments of a low-pressure, molten salt coolant termed FLiBe (a mixture of lithium fluoride and beryllium fluoride [BeF_2]) and intermediate coolant, BeNaF ($57NaF:43BeF_2$), would be shipped to the site prior to startup. FLiBe is estimated to be delivered in 40 shipments of 1 ton each prior to startup. An additional 40 shipments of 1 ton each of FLiBe are estimated to be delivered before the end of the first two years of operation. Kairos estimates a need for 32 shipments of 9 tons each of the intermediate coolant BeNaF prior to startup. Kairos expects to store small quantities of FLiBe, BeNaF, and anhydrous hydrogen fluoride onsite. Kairos estimates a bounding value of 43,110 gal of diesel fuel stored onsite in storage tanks for the standby diesel generator. Kairos, as stated in Section 2.1 of the ER (Kairos 2023-TN9774), expects that other materials used and stored onsite would be roughly twice those anticipated for the Hermes reactor.

2.5 Water Consumption and Treatment

The applicant provides a description of how it would obtain, use, and discharge water for Hermes 2 in Section 2.4 of the ER (Kairos 2023-TN9774). Details concerning water sourcing,

treatment, consumption, and discharge for each unit of Hermes 2 would not generally differ from those described for Hermes in Section 2.5 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference. Because Hermes 2 includes two reactors instead of just one, increased volumes would be used. The applicant's proposed water balance diagram for Hermes 2 is depicted in Figure 2.4-1 of the ER (Kairos 2023-TN9774). Water demands during construction, operation, and decommissioning of Hermes 2 would be met using municipal sources or truck deliveries, and wastewater generated by operation would be discharged into municipal sewers that service the ETTP. The project would not involve building or operation of intake or discharge pipelines, 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, EPA, and TDEC requirements and in conformance with deed restrictions, similar to Hermes as described in Section 3.3.2.2 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference.

2.6 Cooling and Heat Removal Systems

The proposed cooling and heating systems are described in Section 2.5 of the ER (Kairos 2023-TN9774). Details concerning water sourcing, treatment, consumption, and discharge for each Hermes 2 unit would not generally differ from those for the Hermes reactor, as addressed in Section 2.6 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference. Similar to Hermes, there would be no cooling water system and hence no cooling towers or intake or discharge structures for Hermes 2. Unlike Hermes, the Hermes 2 reactors would include an intermediate heat transport system (IHTS) in addition to a primary heat transport system. The primary heat transport system would transfer heat from the reactor through the intermediate heat exchanger to the IHTS, which would transfer the heat to the power generation system through superheaters. Heat not used by the shared power generation system would be rejected to air-cooled condensers and the surrounding atmosphere, which would be the ultimate heat sink. The heat load would be approximately 55 MWt (up to 70 MWt with no power conversion). A decay heat removal system using air cooled condensers would be used whenever the heat transfer systems described above are not available.

2.7 Waste Systems

The waste generated and waste systems for Hermes 2 are described in Section 2.6 of the ER (Kairos 2023-TN9774). Waste generation by each Hermes 2 unit would be as described for Hermes in Section 2.7 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference. However, as noted in Section 2.6 of the ER (Kairos 2023-TN9774), larger quantities would be generated, as expected for two reactors rather than one. The Hermes 2 reactors also would generate additional wastes resulting from operation of the IHTS. Intermediate salt would be collected in storage containers and allowed to cool and solidify during storage and then disposed of in solid form. The handling, packing, storage, and shipping areas for waste systems will be shared between the two Hermes 2 units. The tritium management system described for Hermes also would have to separate tritium from argon in the IHTS cover gas and from dry air in heat rejection radiator enclosure, producing an additional waste stream for Hermes 2. Operation of Hermes 2 is estimated to generate approximately 776,000 used pebbles between the two units over the 10 effective full-power years (EFPY) of the 11-year operating life. The onsite spent fuel pebble canister storage system would have sufficient storage capacity for 10 EFPY of licensed reactor operation.

The estimated types, quantities, and number of shipments of radioactive wastes are listed in Table 2.6-1 of the ER (Kairos 2023-TN9774) 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.

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-TN9774). The sourcing, storage, treatment, and transportation of radioactive and nonradioactive materials for each Hermes 2 unit would generally not differ from that for Hermes. Information on the storage, treatment, and transportation of radioactive and nonradioactive material for Hermes is also described in Section 2.8 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference. Fuel shipments for Hermes 2 would continue over the estimated 11 years of operation. The spent fuel storage area, the storage pool, and the air-cooled cavity would be similar to those for Hermes but with a total storage capacity sufficient for 10 EFPY of the 11 years of licensed reactor operation of both units.

3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

This section presents the affected environment and potential environmental impacts from the proposed action to issue CPs for the Kairos Hermes 2 facility. This section is organized into separate sections addressing specific environmental resources identified by the NRC staff as 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 (construction, operation, and decommissioning); and cumulative impacts. 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 Chapter 1 of this EA.

To present a complete environmental review, this EA covers the potential impacts from the construction, operation, and decommissioning life-cycle phases of the Hermes 2 project. The NRC staff recognizes that new and significant information regarding the operation and decommissioning may become available after issuance of the Hermes 2 CPs. The NRC staff would therefore review any application for OLs for Hermes 2 for new and significant information that might alter the staff's conclusions made for this CP application. If Kairos were to apply for OLs, the NRC staff would prepare another environmental review in accordance with 10 CFR Part 51 (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. The staff termed the latter "Uranium Fuel Cycle and Radiological Waste Management" to also capture uranium fuel cycle impacts.

In determining the cumulative environmental impacts associated with the construction, operation, and decommissioning of Hermes 2, the combination of past, present, and reasonably foreseeable actions or projects presented in Appendix A were evaluated along with the potential effects of the Hermes facility.

Additionally, 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]).

3.1 Land Use and Visual Resources

3.1.1 Affected Environment

The two proposed Hermes 2 non-power test reactors would be built on the same site proposed for the Hermes non-power test reactor. Baseline land use conditions on and around that site, designated as the Kairos site, were characterized in Section 3.1 of the Hermes CP EIS, which is incorporated by reference and was used to develop baseline land use conditions for Hermes 2 (NRC 2023-TN9771). The site consists of approximately 185 ac situated in the Heritage Center in the ETTP within the City of Oak Ridge, Tennessee. The site was previously included within the DOE ORR and accommodated two large buildings (i.e., Buildings K-31 and K-33) that were operated by DOE until 1985 as part of the ORGDP.

The DOE ceased operation of the ORGDP in 1986. Historical missions at the ETTP resulted in a legacy of contaminated, inactive facilities. After the ORR was listed on the National Priorities List, environmental work at the ETTP was driven by CERCLA requirements. The early CERCLA actions and facility demolitions are complete. Characterization and remedial actions for soil, buried waste, and subsurface structures were implemented under a Soil ROD (DOE 2023-TN9801). The Soil ROD, which addresses soil in the K-31/K-33 Area, the location of the Hermes 2 facilities, used the designation “unrestricted industrial land use” as the basis for defining its remedial action objectives. The remaining CERCLA decisions at the ETTP address contamination in groundwater, surface water, and sediment in the ponds, wetlands, and perennial streams. These decisions will include protection of ecological receptors in aquatic environments (i.e., ponds and streams).

The DOE transferred approximately 1,300 ac of those lands, including the 185 ac presently comprising the Kairos site, to the City of Oak Ridge for industrial development. The deeds transferring the properties to Kairos contain Land Use Control restrictions established under the Soil ROD for the K-31/K-33 Area that limit development to industrial and commercial uses; allow for continued DOE access as needed to complete CERCLA cleanup actions; and prohibit groundwater extraction, consumption, exposure, or use, in any way (DOE 2023-TN9801). The designation for an end use of “unrestricted industrial use” restricts any excavation or penetration below 10 ft and requires FFA tri-party (DOE, EPA, and TDEC) approval. A series of FFA tri-party letters from 2014 was issued regarding the request and approvals of soil penetration and/or excavation to depths greater than 10 ft below the ground surface in the greater K-33 Area where the Hermes 2 facility will be located (DOE 2023-TN9801). According to the applicant, Kairos purchased the site in July 2021 and has full control of the property, with all deed restrictions (Kairos 2024-TN9866).

By the time Kairos begins construction of Hermes 2, construction of the Hermes reactor may be underway. Kairos states in Section 2.1 of the ER that it anticipates beginning construction of Hermes 2 in early to mid-2025 (Kairos 2023-TN9774). Section 3.1.2 of the Hermes CP EIS, used to inform construction impacts, and incorporated by reference, indicates that as much as 138 ac of the 185 ac site could be in a state of temporary disturbance at that time (NRC 2023-TN9771). Those areas could at the time be accommodating the partially built Hermes facilities

as well as construction equipment, temporary construction facilities, construction laydown, temporary parking, and other land uses typical of industrial construction sites.

Baseline visual conditions of the Kairos site and its surroundings are characterized in Section 3.1 of the Hermes CP EIS, which was used to inform visual impacts and is incorporated by reference (NRC 2023-TN9771). The site is visually typical of an industrial park, with forested areas to the north. Using a subjective rating process developed by the Bureau of Land Management, the Hermes CP EIS characterizes the site and surroundings as being of low scenic quality. However, at the time the staff prepared the Hermes CP EIS, the entire Kairos site was vacant. Because of the presence of site disturbance, construction equipment, and the partially built Hermes test reactor, the NRC staff expects that the site will have an even greater industrial appearance by the time construction begins on the Hermes 2 reactors.

3.1.2 Environmental Impacts of Construction

Land use impacts from construction of Hermes 2 would generally be as described for Hermes in Section 3.1.2 of the Hermes CP EIS, which is incorporated by reference (NRC 2023-TN9771). Section 4.1.1 of the ER (Kairos 2023-TN9774) indicates that Hermes 2 would be consistent with the existing zoning for the Kairos site and be compatible with nearby existing land uses. Hermes 2 would not affect any special land uses or agricultural land, such as prime or unique farmland. Temporary land disturbance would be confined within the same 138 ac subject to temporary disturbance to build Hermes. According to the Section 2.2.2 of the ER (Kairos 2023-TN9774), permanent land occupied by Hermes 2 would consist of approximately 30 ac, which would overlap with land permanently occupied by Hermes. Hermes 2 would be built directly north of Hermes and like Hermes be situated within the former footprint of the razed DOE Building K-33 (Figure 1-1). No land disturbance for Hermes 2 would take place in floodplains.

Activities to build Hermes 2 would be visually compatible with the existing industrial setting of the Kairos site. The height and size of the two Hermes 2 test reactor buildings would visually resemble the Hermes test reactor characterized in Section 3.1 of the Hermes CP EIS, which is incorporated by reference (NRC 2023-TN9771). The applicant has indicated that the visual analysis presented for Hermes in the EIS would not generally change because of construction of Hermes 2 (Kairos 2024-TN9866).

As characterized by the applicant in Appendix A of the ER (Kairos 2023-TN9774), developing Hermes 2 would also require building a short 161-kilovolt electrical transmission line extending from an onsite switchyard westward across other private property in the Heritage Center to an existing Tennessee Valley Authority transmission line. Based on Figure 1-1, the NRC staff estimates that the transmission line would extend approximately 600 ft west of the Kairos site and require approximately 1.4 ac of additional land in the ETTP, assuming a right-of-way width of 100 ft. Building the transmission line would involve only existing industrial land on the Kairos site and elsewhere within the Heritage Center of the ETTP and would not substantially interfere with use of that land.

3.1.3 Environmental Impacts of Operation

Land use impacts from operation of Hermes 2 would generally be as described for Hermes in Section 3.1.2 of the Hermes CP EIS, which is incorporated by reference (NRC 2023-TN9771). There would not be any substantial land use changes from Hermes 2 over its anticipated 11-year operational period. The staff does not expect there to be any substantive changes to the overall visual appearance of the Hermes 2 project over operations. Kairos would likely commence decommissioning of the Hermes reactor while the Hermes 2 reactors remain in

operation, which may result in the need for temporary disturbance to additional land on the Kairos site. Because of the large size of the 185 ac Kairos site, the NRC staff does not expect that the land demands for decommissioning Hermes would interfere with operations of Hermes 2. Operation of the transmission line is unlikely to affect land use or the visual appearance of the site or surrounding land.

3.1.4 Environmental Impacts of Decommissioning

Land use impacts from decommissioning Hermes 2 would generally be as described for Hermes in Section 3.1.3 of the Hermes CP EIS, which is incorporated by reference (NRC 2023-TN9771). As with Hermes, decommissioning impacts to land use and visual resources would be bounded by the analyses in the generic EIS for decommissioning (NRC 2002-TN7254). There may be a need to temporarily use other land on the 185 ac Kairos site. The 30 ac of land occupied by Hermes 2 could be available for other future industrial land uses after decommissioning, as allowed by future zoning. The general industrial appearance of the Kairos site would remain generally the same during decommissioning, although the vacant site following decommissioning may be less visually obtrusive, depending on its future disposition.

3.1.5 Cumulative Impacts

As presented in Section 3.0, Section 4.13 of the ER (Kairos 2023-TN9774) indicates that the same past, present, and future actions contributing to the cumulative impacts from Hermes could also contribute to those from Hermes 2, but it notes that Hermes should itself be recognized as an additional contributor to the cumulative impacts from Hermes 2. Included in the list of projects contributing to cumulative impacts to the Hermes 2 analysis (Appendix F) is the TRISO X fuel fabrication facility under development in the Horizon Center of the ETTP to the east. The NRC staff expects that other industrial lots in the Heritage and Horizon Centers of the ETTP could become developed over the course of the Hermes 2 project. As stated for Hermes in Section 3.1.5 of the Hermes CP EIS (NRC 2023-TN9771), incorporated by reference, the NRC staff expects that the cumulative effects of the actions noted above would not generally alter existing land use patterns in the Oak Ridge area or the aesthetic qualities of the surrounding landscape.

3.1.6 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative land use and visual resource impacts from Hermes 2 would be SMALL. As with Hermes, the staff bases this conclusion on the fact that Hermes 2 would be consistent with the City of Oak Ridge's zoning and land use objectives for the Heritage Center, would comply with applicable deed restrictions for the Kairos site, and would be functionally and visually compatible with the existing land uses and aesthetics of the industrial park setting. As with Hermes, reuse of former industrial land in an existing industrial park offers an opportunity to achieve energy development objectives without disturbing natural resources such as forests, wetlands, or agricultural land.

3.2 Air Quality and Noise

3.2.1 Affected Environment

3.2.1.1 Climatology and Meteorology

The proposed Hermes 2 non-power test reactors would be built on the same site proposed for the Hermes non-power test reactor. Climate conditions for the Kairos site are described

in Section 3.2.1.1.1 of the Hermes CP EIS, which is incorporated by reference, and were used to inform climatology and meteorology impacts for Hermes 2.(NRC 2023-TN9771). The applicant used multiple sources including the National Climatic Data Center to collect climatological data. The applicant updated climate conditions for the region for Hermes 2, relative to what they presented in their application for Hermes, in Section 3.1 of the ER (Kairos 2023-TN9774). Updated temperatures differ from the values presented for Hermes by approximately 1°F. Relative humidity in the region averaged 71 percent based on a 30-year period of record from the Knoxville local climatological data (1991–2020) from the National Climatic Data Center, compared to the 73 percent reported for Hermes. Table 3-1 of the Hermes 2 ER presents updated precipitation extremes for the region. Otherwise, the existing climatology and meteorology data presented for the site in the EIS applies to Hermes 2 as well.

3.2.1.2 Air Quality

The region of influence for this air quality analysis is Roane County. Under the Federal Clean Air Act of 1970, as amended (CAA) (TN1141), the EPA established National Ambient Air Quality Standards (NAAQS) to limit the concentrations of the six 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. Air quality designations are generally made at the county-level, but designations may also be made for smaller localized areas. The characterization and analysis of the existing air quality in Section 3.2.1.1.2 of the Hermes CP EIS (NRC 2023-TN9771) is incorporated by reference. As noted in the Hermes CP EIS, the City of Oak Ridge spans parts of Roane and Anderson Counties, which are part of the Knoxville-Sevierville-LaFollette, Tennessee air quality area and the immediate areas of Roane and Anderson Counties are currently in attainment for all criteria pollutants (NRC 2023-TN9771). Because other areas within Roane and Anderson Counties are designated as maintenance areas under the CAA, the NRC staff uses the thresholds for maintenance areas when assessing impacts of NAAQS emissions from Hermes 2. These thresholds are presented in Table 3-1 below.

Table 3-1 Total Estimated National Ambient Air Quality Emissions (metric tons/year) During Construction and Operations

Criteria Pollutant[(a)]	National Ambient Air Quality Standard Threshold (TPY)	Construction (T)[(b)]	Operation (TPY)
VOC	50	1.02	0.33
NO_x	100	11.58	10.06
CO	100	4.98	2.57
$PM_{2.5}$	100	0.76	0.30
PM_{10}	100	0.80	0.31
SO_2	100	0.02	0.16

Key: CO = carbon monoxide; NO_x = nitrogen oxides; PM = particulate matter; SO_2 = sulfur dioxide; T = ton(s); TPY = ton(s) per year; VOC = volatile organic compounds.
(a) Air emission estimates are not provided for Lead (Pb) as they are negligible.
(b) The emissions totals presented are for the 3-year construction period.
Source: 40 CFR Part 93-TN2495; Kairos 2023-TN8172

Gases found in the Earth's atmosphere that trap heat and play a role in the Earth's climate are collectively termed Greenhouse Gases (GHG). 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[1]. Estimates of GHG emissions from a reference 1000 megawatt electric (MWe) advanced 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). 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. The GHG emissions estimates from the 1000 MWe advanced reactor and the scaling calculations for Hermes 2 are presented in Appendix E. The NRC staff calculated the GHG emissions for Hermes 2 to be approximately 38,000 metric tons (MT) of CO2e using the assumptions discussed in Appendix E. Comparing the entire life cycle estimated GHG emissions from construction, operation, the uranium fuel cycle, transportation of fuel and waste, and decommissioning activities to the 2019 total gross annual U.S. energy sector emissions, the Hermes 2 GHG emissions would be about 0.0007 percent of the 2019 GHG emissions from the U.S. energy sector.

3.2.1.3 Noise

Noise is unwanted or unwelcome sound usually caused by human activity that is added to the natural acoustic setting. Although sound pressure levels are measured in decibels, 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 sound. The characterization and analysis of existing noise conditions in Section 3.2.2.1 of the Hermes CP EIS (NRC 2023-TN9771) is incorporated by reference. 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). The nearest resident is situated approximately 1.1 mi from the reactor center and 0.7 mi north of the Hermes site boundary but is separated from the site by forests.

3.2.2 Environmental Impacts of Construction

3.2.2.1 Air Quality

Air quality impacts from construction of Hermes 2 would be similar to those described for Hermes in Section 3.2.1 of the Hermes CP EIS, which is incorporated by reference and is relied upon in development of the Hermes 2 impact analysis (NRC 2023-TN9771). The applicant lists the total emission estimates during construction of the Hermes 2 reactors Table 4.2-1 in the ER (Kairos 2023-TN9774). The impacts of air quality due to the construction of the Hermes and Hermes 2 reactors would be similar. By the time Kairos begins construction of the Hermes 2 reactors, construction of the Hermes reactor may be underway. If so, then the emissions presented for Hermes 2 in Table 3-1, would take place simultaneously with those for Hermes, as presented in Section 3.2.1.2 of the Hermes CP EIS (NRC 2023-TN9771). Even if added

[1] 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).

together the totals would be well below the corresponding NAAQS standards presented in Table 3-1.

GHG emissions estimates during construction for Hermes 2 are presented in Table 3-5 in Appendix E of this EA. The applicant lists the total emission estimates during construction of the Hermes 2 reactors Table 4.2-1 in the ER (Kairos 2023-TN9774). The impacts of air quality due to the construction of the Hermes and Hermes 2 reactors would be similar. By the time Kairos begins construction of the Hermes 2 reactors, construction of the Hermes reactor may be underway. If so, then the emissions presented for Hermes 2 in Table 3-1, would take place simultaneously with those for Hermes, as presented in Section 3.2.1.2 of the Hermes CP EIS (NRC 2023-TN9771). Even if added together the totals would be well below the corresponding NAAQS standards presented in Table 3-1. GHG emissions estimates during construction for Hermes 2 are presented in Table E-5 in Appendix E of this EA.

3.2.2.2 Noise

Noise generation from construction of the Hermes 2 reactors is expected to be similar to that described for the Hermes reactor, and as such, Section 3.2.2 of the Hermes CP EIS, is used to inform the environmental impacts of noise and is, therefore incorporated by reference (NRC 2023-TN9771). Table 4.2-3 of the Hermes ER, (Kairos 2023-TN8172) lists the typical noise in dBA from the construction equipment anticipated for Hermes. Similar equipment would be used to construct Hermes 2. In its ER submittal (Kairos 2022-TN7912), Kairos states that the nearest residence is approximately 1.1 mi from where the reactors would be built. As noted in Section 3.2.2.2 of the Hermes CP EIS, noise from most construction equipment would not increase by more than 3 dBA over ambient levels, and therefore, would not likely be perceptible to persons at nearby sensitive locations, and this is also the case for Hermes 2. Similar to Hermes, it is possible that noise increases from Hermes 2 might be temporarily perceptible at sensitive locations during operation of certain heavy equipment such as pile drivers. But the Hermes CP EIS characterized the effects of these temporary noise events as minimal which is expected to also be the case for Hermes 2.

3.2.3 Environmental Impacts of Operation

3.2.3.1 Air Quality

Air emissions during operations of Hermes 2 would be similar to those described and analyzed for Hermes in Section 3.2.1.3 of the Hermes CP EIS (NRC 2023-TN9771), which is, therefore, incorporated by reference and used in the Hermes 2 evaluation. Table 3-3 in the EIS presents emission estimates during Hermes operation. The emission estimates are well below the NAAQS thresholds for maintenance areas, shown in Table 3-1 of the EIS. Similar to Hermes, the design of Hermes 2 does not call for use of auxiliary boilers or cooling towers. The design does include a cooling system that uses external mechanical air-cooled condensers but does not use open-cycle, evaporative cooling. For this reason, the staff does not expect there to be any impacts to local meteorology (localized icing or fogging) or impacts from cooling plumes. Table 3-1 lists the NAAQS emissions estimates for Hermes 2 operations. The impacts of air quality due to the operation of Hermes and each unit of Hermes 2 would be generally similar. GHG emissions estimates for operations for Hermes 2 are presented in Table E-5 in Appendix E of this EA.

3.2.3.2 Noise

Noise impacts during operation of Hermes 2 would be similar to those described and analyzed for Hermes in Section 3.2.2.3 of the Hermes CP EIS (NRC 2023-TN9771), which is, therefore, incorporated by reference, and used in the Hermes 2 evaluation. But as noted in Section 4.2.2.2 of the ER (Kairos 2023-TN9774), there would be additional noise generation from simultaneous operation of the Hermes reactor; the two Hermes 2 reactors; the Hermes 2 power generation systems, including a turbine; and dry air-cooled condensers. The nearest resident is approximately 1.1 mi away from the project site and is separated by forest and the Black Oak Ridge, creating a sound buffer. The power generation systems would be housed within the turbine building. As explained by the applicant during the audit (Kairos 2024-TN9866), the air-cooled condensers would not generate noise levels in excess of 70 dBA at 1000 ft from the condensers. Noise generation from three Hermes reactors operating simultaneously would be estimated at 75 dBA. Additional attenuation offered by vegetation and topography would serve to lower the average noise level from the estimated 61 dBA at the nearest resident. As noted by DOE in an EA prepared for a proposed airport in Oak Ridge (DOE 2016-TN7903), 65 dBA is the maximum compatible level with a residential area. As noted in Section 3.2.2.3 of the Hermes CP EIS, the NRC staff expects that the noise generated by operation of reactors such as Hermes within an established industrial park would effectively blend in with other industrial noises and not generally be noticeable to residents in the surrounding area.

3.2.4 Environmental Impacts of Decommissioning

Air emission impacts from decommissioning Hermes 2 would generally be as evaluated for Hermes in Section 3.2.1.4 of the Hermes CP EIS (NRC 2023-TN9771), which is, therefore, incorporated by reference and used in the evaluation for Hermes 2. The only differentiation is that the area to be decommissioned would be slightly larger since Hermes 2 is for two reactors. Activities, equipment usage, and associated emissions are expected to be similar but less than those during construction of Hermes 2 because decommissioning activities are less extensive.

Similarly, the analysis of noise impacts from decommissioning of Hermes 2 would generally be as described and evaluated for Hermes in Section 3.2.2.4 of the Hermes CP EIS, which is, therefore, incorporated by reference. There would however be longer periods of noise generation because Hermes 2 involves two reactors (Kairos 2023-TN9774), but the staff expects that impacts would still be bounded by the generic EIS for decommissioning (NRC 2002-TN7254) and be brief and temporary enough to not be objectionable to the surrounding community. GHG emissions estimates for decommissioning activities for Hermes 2 are presented in Table E-5 in Appendix E of this EA.

3.2.5 Cumulative Impacts

Cumulative impacts on air quality and noise from Hermes 2 would generally be as described and evaluated for Hermes in Sections 3.2.1.5 and 3.2.2.5 of the Hermes CP EIS (NRC 2023-TN9771), which are, therefore, incorporated by reference. However, the staff also considered the additional emissions and noise from Hermes 2 and Hermes in the evaluation of cumulative impacts. As described in Section 3, other past, present, and currently foreseeable actions are listed in Appendix F, Table F-1. Implementation of the mitigation measures described in the Hermes CP EIS would minimize impacts to local ambient air quality and the nuisance impacts to the public in proximity to the project. Impacts to air quality from construction activities are expected to be minor, localized, and short-term; therefore, overlapping construction schedules are not expected to contribute significantly to cumulative effects. The projects would both be

governed by air permits processed through TDEC. Noise during construction of the Hermes 2 would be temporary. Though construction of the Hermes and Hermes 2 facilities may be concurrent, the equipment and workforce for the two projects would largely be shared, thereby limiting noise generation.

3.2.6 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 Hermes 2 would be well below NAAQS thresholds and not be a major source of air emissions. The NRC staff concludes that the potential direct, indirect, and cumulative noise impacts of the proposed action would be SMALL. Noise from heavy construction equipment may increase during construction of Hermes 2. However, the noise would be unlikely to noticeably interfere with use and enjoyment of surrounding properties. The noise generated by construction, operation, and decommissioning of Hermes 2 would likely blend in with typical noise of an active industrial park.

3.3 Hydrogeology and Water Resources

3.3.1 Hydrogeology

3.3.1.1 Affected Environment

The geographic location and geologic conditions at the site are characterized in Section 3.3.1 of the Hermes CP EIS (NRC 2023-TN9771), which describes the Valley and Ridge physiographic province where the site is located and the geologic history that created the conditions of the site prior to its development. Weathering of ridges composed of limestone, shale, and dolomite resulted in an accumulation of approximately 20 ft of clay, silt, and sand in the lower lying areas. Soils on the site have been physically disturbed by decontamination, decommissioning, and demolition activities for the industrial facilities that once occupied the land. This soil remediation was conducted to a depth of 10 ft. The primary pollutant in these soils is mercury. Geotechnical properties of the site's soils are provided in Section 2.5.2.2 of the Hermes 2 facility PSAR (Kairos 2023-TN9774). Past development, use, and decommissioning of industrial facilities by the DOE has resulted in a relatively flat site with no distinguishable surface water drainage features. Decommissioning of the former DOE facilities left slabs and portions of the foundations behind. The remnants of the foundations have been discovered less than 12 ft beneath the ground surface (Kairos 2023-TN8172 | Sec 3.3.3.3).

3.3.1.2 Environmental Impacts of Construction

Because land disturbance for Hermes 2 would take place within the same 138 ac portion as the site as Hermes, the evaluation of construction impacts of Hermes 2 would be as described for Hermes in Section 3.3.1.2 of the Hermes CP EIS (NRC 2023-TN9771), which is, therefore, incorporated by reference. The maximum temporarily disturbed area for construction of Hermes 2 would encompass the same 138 ac. Geological disturbance to the site would include excavation and may include blasting if conditions require. These disturbances could expose soil contaminated by previous site occupants. Excavated soil suitable for backfill would be stockpiled onsite. Soil that is not suitable for structural backfill would instead be used as non-structural fill (Kairos 2023-TN8172 | Sec 4.3.2).

As noted in Section 4.3 of the ER (Kairos 2023-TN9774), the estimated quantities of geologic material necessary for the construction of the Hermes 2 facility would be:

- backfill: 222,666 cubic yards around structures in main excavation (reuse of suitable material excavated onsite)
- topsoil: 1,066 cubic yards, acquired from onsite sources
- granular road base: 9,284 cubic yards
- asphaltic pavement: 17,846 cubic yards
- gravel surfacing: 1,000 cubic yards
- underground utilities: 2,344 cubic yards for backfill (reuse of suitable material excavated onsite)
- site grading: quantity is to be determined, and to be acquired from material excavated onsite

As with Hermes, excavation would not exceed 30 ft below grade, for the Reactor Building and the Auxiliary Systems Building. Utilities would be placed 5 ft below grade, and any additional buildings necessary for construction of Hermes 2 would be excavated to depths of up to 10 ft below grade (NRC 2023-TN9771).

3.3.1.3 Environmental Consequences of Operation

Geologic resources would not be used or altered during the operation of the Hermes 2 reactors; therefore, the impact of operations on geologic resources would be negligible. At the OL stage, NRC staff would review the application for any new and significant information that might alter the staff's conclusions made for this CP.

3.3.1.4 Environmental Consequences of Decommissioning

Decommissioning would have little additional impact on the geologic environment relative to construction (Kairos 2023-TN9774). In addition to NRC requirements for decommissioning, applicable demolition permits and best management practices (BMPs) would minimize the effects of decommissioning impacts on the geologic environment.

3.3.1.5 Cumulative Impacts

Cumulative geological impacts from Hermes 2 would generally be as described for Hermes in Sections 3.3.1.5 and 3.3.1.6 of the Hermes CP EIS (NRC 2023-TN9771), which is, therefore, incorporated by reference. In addition to the Hermes and Hermes 2 projects, as described in Section 3, past, present, and currently foreseeable actions evaluated are listed in Appendix F, Table F-1. Soil erosion and sediment runoff is a typical effect of surface disturbances. Past, current, and reasonably foreseeable projects in the area would add to the total extent of disturbed soil. Within the site, most of the ongoing and reasonably foreseeable proposed actions would take place on previously industrialized land. The staff also recognizes that Kairos may build a planned fuel fabrication facility (referred to as Kairos Atlas Fuel Fabrication Facility) on the same 185 ac site as that used for Hermes and Hermes 2. The staff anticipates that the applicant would use the same construction BMPs noted above in compliance with Federal, State, and local environmental laws, rules, regulations, and statutes. Neither existing projects nor Hermes or Hermes 2 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 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 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 project 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

As can be seen in Figure 3.2-1 of the ER (Kairos 2023-TN9774), hydrologically, the 185 ac site is bounded by Poplar Creek to the east and south and the Clinch River arm of the Watts Bar Reservoir. Secondary drainage features include the K-901 Holding Pond to the west. There is a rapid increase in topography from approximately 765 ft over much of the site to over 1,000 ft just north of the site. Poplar Creek is also a part of the Clinch River arm of the Watts Bar Reservoir, for which water levels and flow patterns are controlled by the power generation and release schedules of the Watts Bar, Fort Loudon, and Melton Hill Dams.

The groundwater under the site has been contaminated by previous DOE industrial activities. Nonradiological contaminants of concern for the groundwater are volatile organic compounds and polychlorinated biphenyls. Radiological contaminants of concern are uranium, tritium, and strontium-90. The DOE monitors surface and groundwater within the site and surrounding area (DOE 2021-TN7913 | Figure 2.2) (DOE 2021-TN7915 | Figure 3.24).

The applicant indicates in the ER (Kairos 2023-TN9774) that the groundwater monitoring plan for Hermes 2 would be the same as that for Hermes (Kairos 2023-TN8172 | Sec 4.4.3.2.1). The groundwater monitoring plan is a quarterly radiological environmental monitoring plan consistent with NUREG-1301 (NRC 1991-TN5758) and would be implemented alongside monitoring through existing DOE sampling locations. The aquifers beneath or near the site are not classified as sole source by the EPA. There are no liquid effluent release pathways for radionuclides to escape to the surrounding surface waters; therefore, surface water monitoring has been omitted from the radiological environmental monitoring plan.

3.3.2.2 Environmental Consequences of Construction

The construction of the Hermes 2 reactors would be of similar construction and occupy the same site as Hermes, and, therefore, the evaluation of construction impacts for water resources would have very similar consequences as those described in Section 3.3.2.2 of the Hermes CP EIS (NRC 2023-TN9771) which is, therefore, incorporated by reference. Construction would temporarily disturb the same 138 ac that would be disturbed for construction of Hermes, with 30 ac of that land being permanently disturbed when construction is completed.

The maximum excavation depth would be 30 ft below the finished grade of 765 ft for the Reactor Building and the Auxiliary Systems Building. The water table for the site is 6 to 8 ft below grade. Groundwater would not be used during construction activities but may be extracted as a consequence of dewatering for Reactor Building and the Auxiliary Systems Building excavation. The upper bound of the total dewatering during the 30-day foundation construction period would be 2.2 million gal. The impacts of this dewatering were determined in the Hermes CP EIS (NRC 2023-TN9771 | Section 3.3.2.2) to be limited to the shallow groundwater system on site. Extracted groundwater would be managed in compliance with DOE, EPA, and TDEC, and any water discharge from dewatering or from other construction activities would be handled in accordance with the storm-water discharge permit in compliance with these three agencies.

There are neither surface water features on the site that could be affected nor discernable surface water features that drain the site. Runoff flows to either Poplar Creek or to the K-901-A Holding Pond. Stormwater runoff from construction activities would be mitigated by a stormwater pollution prevention plan (SWPP) and other BMPs.

As described in Section 3.3.2.2 of the Hermes CP EIS (NRC 2023-TN9771) for the similar excavation needed to build Hermes, dewatering activities from excavations to build Hermes 2 are unlikely to have any demonstrable effects on the environment beyond the boundaries of the site. The ER (Kairos 2023-TN9774) reported that no additional information was identified specific to Hermes 2, beyond what was presented for Hermes.

3.3.2.3 Environmental Consequences of Operation

As noted in Section 4.4.2 of the ER (Kairos 2023-TN9774), water usage during operation of Hermes 2 would be similar to water usage for Hermes; estimated water usage during operation would be 0.17 million gal per day. Water would be supplied by the City of Oak Ridge. Because Hermes 2 would not use raw surface water or groundwater, any effects the facility may have on groundwater during operation are negligible. Section 4.4 of the ER (Kairos 2023-TN9774) reported that no additional information regarding surface water or groundwater was identified for Hermes 2, beyond what was presented for Hermes.

3.3.2.4 Environmental Consequences of Decommissioning

There may be minor impacts from decommissioning associated with discharge of groundwater from the site to Poplar Creek, but these discharges would be managed in accordance with DOE, EPA, and TDEC requirements. Stormwater runoff from decommissioning activities would be mitigated by a SWPP and BMPs similar to those used during construction. It is expected that decommissioning impacts on water resources would be similar to those described in the generic EIS for decommissioning (NRC 2002-TN7254).

3.3.2.5 Cumulative Impacts

As described in Section 3, in addition to Hermes, the past, present, and currently foreseeable projects and other actions evaluated are listed in Appendix F, Table F-1. Past and present actions currently affecting water resources in the affected area include Federal facilities for nuclear and energy research such as the Y-12 Plant, Oak Ridge National Laboratory, and other energy research facilities. A housing development is under construction 2 miles (mi) to the west of the site. The construction of this development and future construction in the area, such as the construction of a general aviation regional airport in the vicinity of the site, may impact water

resources in the area. However, it is unlikely that the proposed action will have a demonstrable cumulative impact in the areas of surface water and groundwater due to mitigating measures such as the SWPP and other BMPs limiting discharge to surface water during construction and decommissioning.

3.3.2.6 Conclusion

The NRC staff concludes that the potential impacts of the proposed action on surface and subsurface water resources would be SMALL. This conclusion is based on the usage of the City of Oak Ridge's water supply and wastewater treatment infrastructure for construction, operation, and decommissioning. Compliance with Federal, State, and local regulations regarding the handling of stormwater will ensure any stormwater runoff impacts are small or mitigated to be small. Groundwater will not be used as a source of water for operations, and any impact on subsurface water resources during construction due to dewatering would be temporary in nature.

3.4 Ecological Resources

3.4.1 Affected Environment

The applicant indicates in Chapter 3 of the ER (Kairos 2023-TN9774) that the ecological characterization provided for the site for Hermes is applicable to Hermes 2. The terrestrial and aquatic habitats surrounding the Kairos site are described in Section 3.4.1 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference. The terrestrial habitat within 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. The developed land and herbaceous grassland areas largely correspond to areas previously occupied by industrial development. The forested areas only occur on the perimeter of the site and in riparian zones separating previously developed land from Poplar Creek. This border between Poplar Creek and the forest includes the only wetlands on the site. There are no aquatic habitats within the site, but it is adjacent to Poplar Creek. There is also a 17 ac holding pond approximately 700 ft west-southwest of the site.

The site provides poor quality ecological habitat due to its previous industrial history. The grasses and forbs there are typical of previously disturbed soils. Terrestrial wildlife expected to occur on the site, including mammals, birds, reptiles, and amphibians, is described in Section 3.4.1 of the Hermes CP EIS (NRC 2023-TN9771). Species of wildlife expected to visit the previously developed lands formerly occupied by DOE Buildings K-31 and K-33 are the regionally abundant species typical of open field habitats. Aquatic biota of the Clinch River arm of the Watts Bar Reservoir is described in Section 3.4.1 of the Hermes CP EIS (NRC 2023-TN9771). Poplar Creek is a tributary of the Clinch River, and the applicant expects the habitats to be similar. Because of the heavy previous disturbances of the site and the aquatic habitat adjoining it, invasive species occur in large quantities on and around the site.

The NRC staff searched the U.S. Fish and Wildlife Service (FWS) Information for Planning and Consultation database and generated a species list for a Hermes 2 action area consisting of the entire 185 ac site on February 28, 2024, updating the earlier searches reported for the same site in Section 3.4.1 of the Hermes CP EIS (NRC 2023-TN9771). The species list (Table 3-2) identified the following with regulatory status under the Federal ESA.

Table 3-2 Species with Regulatory Status under the Federal ESA

Species Type	Species	Status
Mammal	Gray Bat (*Myotis grisescens*)	Endangered
Mammal	Indiana Bat (M*. soldalis*)	Endangered
Mammal	Northern Long-eared Bat (*M. septentrionalis*)	Endangered
Mammal	Tricolored Bat (*Perimyotis subflavus*)	Proposed Endangered
Bird	Whooping Crane (*Grus americana*)	Experimental Population Nonessential
Fish	Spotfin Chub (*Erimonax monachus*)	Threatened
Insects	Monarch Butterfly (*Danaus plexippus*)	Candidate
Flowering Plants	Virginia Spiraea (*Spiraea virginiana*)	Threatened
Flowering Plants	White Fringeless Orchid (*Platanthera integrilabia*)	Threatened

The species list did not identify any critical habitat in the action area. The NRC staff recognizes that the species noted above are unlikely to occur anywhere in the action area (i.e., the 185 ac site) other than perhaps in the small areas of forest and other riparian vegetation separating the proposed locations for Hermes and Hermes 2 from Poplar Creek, or in the channel of Poplar Creek. None can be expected to occur in the developed land and herbaceous grassland areas formerly occupied by DOE Buildings K-31 and K-33, where the land disturbance for construction, operation, or decommissioning of Hermes or Hermes 2 would take place.

Table 3-3, together with the information included in the subsections below, constitute the NRC staff's biological evaluation for the Hermes 2 CP application.

3.4.2 Environmental Impacts of Construction

The construction impacts of Hermes 2 would be similar to those described for Hermes in Section 3.4.2 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference. Section 4.5.1 of the ER (Kairos 2023-TN9774) indicates that approximately 138 ac of developed land and herbaceous grassland could be temporarily disturbed to build Hermes 2, the same 138 ac of land the applicant proposes to disturbance to build Hermes. As noted in the EIS, no wetlands or aquatic habitat would be disturbed, lands disturbed but not permanently occupied by the new facilities would be restored to herbaceous grassland, and stormwater would be managed using BMPs as required by TDEC. Construction would therefore not promote the further establishment of invasive species, and the effects on ecological quality of habitat and wildlife would be minimal.

Noise from construction of Hermes 2 may be noticeable to wildlife. As noted in Section 3.2.2.2 of this EA, most noise generated by construction of Hermes 2 would be within 3 dbA of ambient noise within 1 mi from the site, but temporary periods of greater noise could occur. The temporary duration of the construction noise and low quality of habitat within the site's industrial setting, as well as the probable acclimation of the local wildlife to current levels of industrial noise, suggest that the noise impacts of construction are unlikely to have a significant impact.

3.4.3 Environmental Impacts of Operations

The impacts from operation of Hermes 2 would be similar to those described for Hermes in Section 3.4.3 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference. In Section 4.5.2 of the ER (Kairos 2023-TN9774), the applicant characterizes the ecological impact of operations for Hermes 2 as similar to Hermes. As noted in the EIS, no additional land would be physically disturbed during operations, and operational noise would be less than for construction. The risk of avian collisions with structures would be similar to construction.

Occasional maintenance of the site would utilize herbicides for weed control. For these reasons, operation is unlikely to adversely affect threatened or endangered species.

As noted in Section 3.1 of this EA, the applicant would build a short 161 kV electric transmission line of approximately 600 ft to connect the operating Hermes 2 project to the power grid. The NRC staff recognizes that flying wildlife, including birds and bats, can be physically injured by collisions with transmission towers and conductors or electrocuted if they contact two or more conductors simultaneously. However, the NRC staff describes in Section 4.6.1.1 of the License Renewal Generic EIS (NRC 2013-TN2654) that the potential impacts on migratory bird populations from collisions with nuclear reactor related structures, including electric transmission lines, are minimal (characterized as SMALL). Additionally, the short length of the new transmission line and its presence entirely within an existing industrial area make the potential for substantial collisions with the transmission line low. The License Renewal Generic EIS does not specifically address bat collisions. However, the absence of trees or other high quality bat habitat in or adjacent to the proposed path of the transmission line makes substantial bat collisions unlikely.

3.4.4 Environmental Consequences of Decommissioning

The impacts from decommissioning Hermes 2 would be similar to those described for Hermes in Section 3.4.4 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference. Land disturbance, noise impacts, and bird collisions would be expected to be similar to construction. The NRC staff expects that decommissioning impacts on ecological resources would be bounded by the analyses in the generic EIS for decommissioning (NRC 2002-TN7254), which is incorporated by reference.

3.4.5 Cumulative Impacts

As described in Section 3, in addition to Hermes, the past, present, and currently foreseeable projects and other actions evaluated are listed in Appendix F, Table F-1. The NRC staff expects that other industrial lots in the ecologically disturbed and fragmented Heritage and Horizon Centers of the ETTP could become developed over the course of the Hermes 2 project. The cumulative impacts from Hermes 2 on ecological resources would be as described for Hermes in Section 3.4.5 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference. The Atlas facility, like Hermes and Hermes 2, would likely be sited in unused areas of the 185 ac Kairos site previously disturbed by the former DOE Buildings K-31 and K-33, and it would not likely further contribute to loss or degradation of ecological habitats. The close proximity of Hermes, Hermes 2, and Atlas suggests that the addition of Atlas would not likely alter the patterns of noise and physical obstruction experienced by wildlife in the surrounding areas. The current state of the ETTP and adjoining areas is that of fragmented terrestrial habitat and forest land mixed with industrial land.

3.4.6 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative ecological impacts of Hermes 2 would be SMALL. This conclusion is based on the project affecting only previously industrial land in an established industrial park. Noise, light, and physical obstructions may cause negligible to small impacts to local wildlife in the industrial park setting. Anticipated projects in the surrounding area are recognized to have potential impacts, but the proposed action is not expected to contribute to these impacts. The NRC staff's biological evaluation in Table 3-3 concludes that Hermes 2 may affect, but is not likely to adversely affect, (or have no effect on), each species considered.

Table 3-3 Biological Evaluation of Federally Listed Species from Proposed Kairos Hermes 2 Project

Species	Federal Status	NRC Staff Evaluation	Conclusion
Gray bat (*Myotis grisescens*)	Endangered	Baseline information: Flying mammal. See Table 3-5 of the Hermes CP EIS (NRC 2023-TN9771), incorporated by reference. Impacts: May forage transiently in riparian forest along Poplar Creek. Unlikely to enter lands where Hermes 2 would be built, operated, and decommissioned because those lands are not currently forested or contain trees and would not for the duration of the Hermes 2 life cycle. Bats are expected to avoid areas of human activity, so the potential for injuries is minimal. Impact would be discountable and likely limited to minor disturbances while transiting the area due to temporary increases in noise or other human activity.	May affect, but not likely to adversely affect (MA-NLAA)
Indiana bat (*M. soldalis*)	Endangered	Baseline information: Flying mammal. See Table 3-5 of the Hermes CP EIS (NRC 2023-TN9771). Impacts: May forage transiently in the riparian forest along Poplar Creek. Expected to avoid lands where Hermes 2 would be built, which presently contain only ruderal vegetation of no foraging value. Impact would be discountable and likely limited to minor disturbances while transiting the area due to temporary increases in noise or other human activity.	MA-NLAA
Northern long-eared bat (*M. septentrionalis*)	Endangered	Baseline information: Flying mammal. See Table 3-5 of the Hermes CP EIS (NRC 2023-TN9771). Impacts: May forage transiently in riparian forest along Poplar Creek. Expected to avoid lands where Hermes 2 would be built, which presently contain only ruderal vegetation of no foraging value. Impact would be discountable and likely limited to minor disturbances while transiting the area due to temporary increases in noise or other human activity.	MA-NLAA
Tricolored Bat (*Perimyotis subflavus*)	Proposed Endangered	Baseline information: Flying mammal. Information on life history and threats is presented in Section M.6.1.4 of the EIS for the Clinch River Nuclear project (NRC 2019-TN6136), proposed for a site roughly 2 mi to the south. This section is incorporated by reference. Individuals have been recorded in mist net surveys in that area and in acoustic surveys across the ORR. Impacts: As noted in the Clinch River Nuclear EIS, the tri-colored bat is found in a variety of terrestrial habitats but generally avoids large open fields. It may forage occasionally in the riparian forest along Poplar Creek but can be expected to avoid the large open area of previously developed industrial land where Hermes 2 would be built. Impact would be discountable and likely limited to minor disturbances while transiting the area due to temporary increases in noise or other human activity.	MA-NLAA

Table 3-3 Biological Evaluation of Federally Listed Species from Proposed Kairos Hermes 2 Project (Continued)

Species	Federal Status	NRC Staff Evaluation	Conclusion
Whooping Crane (*Grus americanus*)	Experimental Population Non-essential	Baseline information: Wading bird. The whooping crane is limited in the wild to a single population that nests in Wood Buffalo National Park in Canada and coastal marshes in Aransas, Texas, and occurs in captivity at other specific locations that do not include Oak Ridge (FWS 2023-TN8854). Impacts: The ruderal upland vegetation on the disturbed soils where Hermes 2 would be built is not suitable habitat.	No Effect
Spotfin chub (*Erimonax monachus*)	Threatened	Baseline information: Fish. See Table 3-5 of the Hermes CP EIS (NRC 2023-TN9771). Impacts: Hermes 2 would not involve physical disturbances of aquatic or riparian habitats. Water demands would be met by municipal or commercial suppliers. Stormwater to be managed by BMPs. BMPs to control sedimentation and runoff. Impact would discountable and limited to non-significant changes in water quality levels due to stormwater runoff.	MA-NLAA
Virginia spiraea (*Spiraea virginiana*)	Threatened	Baseline information: Shrub. See Table 3-5 of the Hermes CP EIS (NRC 2023-TN9771). Impacts: Potential occurrence limited to forested areas. Physical disturbance for Hermes 2 would be limited to soils previously disturbed for past industrial development. Plants not affected by noise. BMPs to control sedimentation and runoff. Stormwater to be managed by BMPs. Impact would discountable and limited to non-significant changes in water quality levels due to stormwater runoff.	MA-NLAA
White fringeless orchid (*Platanthera integrilabia*)	Threatened	Baseline information: Herbaceous wildflower. See Table 3-5 of the Hermes CP EIS (NRC 2023-TN9771). Impacts: Potential occurrence limited to acidic seeps and stream heads. Physical disturbance for Hermes 2 would be limited to soils previously disturbed by past industrial development. Plants not affected by noise. BMPs to control sedimentation and runoff. Stormwater to be managed by BMPs. Impact would discountable and limited to non-significant changes in water quality levels due to stormwater runoff.	MA-NLAA

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

- Species identified through Information for Planning and Consultation 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 the 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.

3.5 Historic and Cultural Resources

3.5.1 Affected Environment

The NHPA (TN4157), as amended, requires Federal agencies to consider the effects of their undertakings on historic properties; the potential approval of a construction permit for Hermes 2 is an undertaking that could potentially affect historic properties, should such properties be present. The NHPA defines historic properties as any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places (NRHP). The procedures in 36 CFR Part 800 (TN513) define how Federal agencies meet the statutory responsibilities of the NHPA Section 106 process. If cultural resources are present, their NRHP-eligibility is determined through the application of the NRHP criteria in 36 CFR 60.4 (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). Historic properties are a subset of cultural resources that are considered during the NEPA process. Cultural resources include, but are not limited to, properties that may not be NRHP-eligible or listed; places or landscapes of traditional cultural importance; and sacred, ceremonial, and religious sites.

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, 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). Through 36 CFR 800.8(c) (TN513), the NRC will complete the NHPA Section 106 process using procedures described in Regulatory Guide 4.2 (NRC 2018-TN6006).

The current NRC undertaking and action is the issuance of a CP to Kairos that allows for the construction of the proposed Kairos Hermes 2 project. If Kairos chooses to proceed with its proposed project, they will need to apply for and receive separate OLs from the NRC. The NRC staff would then conduct another environmental review in accordance with 10 CFR Part 51 and complete a separate NHPA Section 106 review and consultation.

The NRC has determined that the area of potential effect (APE) for the CP review includes the area at the 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 auditorily) 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, as depicted in Figure 3-2 of the Kairos Hermes CP (NRC 2023-TN9771).

3.5.1.1 Cultural Background

Because of the recency of the Hermes CP EIS (NRC 2023-TN9771), the cultural background description in Section 3.5.1.1 of that document remains accurate for support of an assessment for Hermes 2 and is incorporated by reference in this EA.

3.5.1.2 Historic and Cultural Resources at the Kairos Site

As noted in Section 3.5.1.2 of the Hermes CP EIS (NRC 2023-TN9771), the DOE completed an EA in 2011 (DOE 2011-TN4888) prior to transferring the land and facilities within the ETTP to

the Community Reuse Organization of East Tennessee. According to DOE's EA, no prehistoric archaeological resources are known to exist within the ETTP, which also includes the proposed Hermes 2 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., Buildings K-33 and K-31 buildings). DOE concluded that there are likely no intact archaeological sites to be found within the ETTP (DOE 2011-TN4888). As noted in Section 3.5.1.1 of the Hermes CP EIS (NRC 2023-TN9771), the DOE and the THC signed a memorandum of agreement (MOA) in 1998 to resolve the adverse effects of decontamination, decommissioning, and 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). This MOA was amended in 2001 to address 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). Currently, the site is a brownfield site, and there are no historic properties or intact historic and cultural resources known within the APE.

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 this conveyance and shall comply with the procedures set forth in attached Exhibit C (DOE 2017-TN8206, 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, DOE 2017-TN8207). It further states that the owner of the record shall consult with the State of Tennessee Historic Preservation Officer (i.e., 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, DOE 2017-TN8207). The NRC reviewed the THC files and confirmed that there are no extant architectural (i.e., above-ground structures) resources within the direct effects APE.

As part of field investigation activities that Kairos performed to support NRC's Section 106 consultation for the Hermes project, Kairos also considered the Hermes 2 location and undertaking (Kairos 2024-TN9866). A reconnaissance geoarchaeological investigation was completed due to the nature of the landscape, the past cut and fill construction process, and the possibility for resources on the deeply buried 1949 surface and potential paleosols. The need for this investigation was identified due to new information about the landform and construction process for buildings K-33 and K-31 that was confirmed by DOE as the previous landowner. The investigation also was requested by one of the consulting Tribes upon initiating consultation for the Hermes project. The report documenting the results of this investigation was completed in October 2023 and resulted in the subsequent development of an Archaeological Resources Monitoring and Unanticipated Discovery Plan (Kairos 2024-TN9866).

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 K-25 gaseous diffusion process 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 (DOE 2022-TN7897).

To verify its decision to delineate the indirect effects APE for the Hermes project to a 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 2 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, the Gallaher and Ellis cemeteries; and the NRHP-eligible George Jones Memorial Baptist Church. Kairos provided the photographs as supplemental information, and they are presented in Appendix F of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference. The photographs confirm that the proposed project location for Hermes, as well as the proposed adjoining location for Hermes 2 on the same site, are not visible from these historic and cultural resources due to screening from topographic features and vegetation.

3.5.1.3 Traditional Cultural Properties

Section 3.6.2 of the Hermes ER (Kairos 2023-TN8172), which supports Section 3.5.1.3 of the Hermes CP EIS (NRC 2023-TN9771), states that previous cultural resource surveys throughout the Kairos site, including the location proposed for Hermes 2, have identified eight sites within the vicinity of Oak Ridge that include mounds and/or are known human burial sites, which could be considered sacred sites. None of these sites is located within the direct or indirect effects APE. To date, the results of NRC's NHPA Section 106 consultation efforts for Hermes and Hermes 2, conducted with Tribes that attach cultural or religious significance to historic properties, indicate that no traditional cultural properties are known to be located within the direct or indirect effects APE at the time of publishing this EA.

3.5.1.4 Consultation

The NRC initiated consultation via a letter dated January 31, 2024, with the THC (NRC 2024-TN9778), the Advisory Council on Historic Preservation (NRC 2024-TN9779), and NPS (NRC 2024-TN9780); and February 2, 2024, with 16 Federally recognized Tribes (NRC 2024-TN9781): (1) Absentee Shawnee Tribe, (2) Alabama-Coushatta Tribe of Texas, (3) Alabama-Quassarte Tribal Town, (4) Cherokee Nation Eastern Band of Cherokee Indians, (5) Coushatta Tribe of Louisiana, (6) Eastern Shawnee Tribe of Oklahoma, (7) Jena Band of Choctaw Indians, (8) Kialegee Tribal Town, (9) Muscogee (Creek) Nation, (10) Poarch Band of Creek Indians, (11) Seminole Nation of Oklahoma, (12) Seminole Tribe of Florida, (13) Shawnee Tribe, (14) Thlopthlocco Tribal Town,(15) United Keetoowah Band of Cherokee Indians, and (16) the Cherokee Nation. There are no Federally recognized Tribes currently located within the State of Tennessee. The results of the NHPA Section 106 consultation efforts will be reported in the final version of this EA.

3.5.2 Environmental Impacts of Construction

The proposed footprint of disturbance for the Hermes 2 project is composed entirely of land that was previously used for industrial purposes (i.e., brownfield). No intact historic or cultural resources currently are known to exist within the proposed project site 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. During development of the EIS for the Hermes CP (NRC

2023-TN9771), new information regarding the potential for the buried 1949 surface and deeply buried paleosols that could contain archaeological deposits was raised (NRC 2023-TN8208). This new information was addressed through consultation for the Hermes CP project and identification efforts for both the Hermes and Hermes 2 CP undertakings completed through the geoarchaeological reconnaissance investigation and subsequent development by Kairos of the Archaeological Resources Monitoring and Unanticipated Discovery Plan (Kairos 2024-TN9866).

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, tools, etc.) or sites is made during any development activities, all ground-disturbing activities in the vicinity of the discovery would be halted immediately. Kairos has developed an Archaeological Resources Monitoring and Unanticipated Discovery Plan for implementation that would establish stop work and notification procedures to address the unexpected discovery of human remains or archaeological material (Kairos 2021-TN7880 │ Section 4.6.1 |, Kairos 2022-TN7902, DOE 2017-TN5081). These procedures 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 also would notify appropriate local law enforcement. If the human remains were determined to be archaeological in nature, Kairos would notify the Tennessee Division of Archaeology and the THC to determine what further actions would be taken (Kairos 2021-TN7880│Sec 4.6.1 |, Kairos 2022-TN7902).

No impacts are expected to occur to traditional cultural properties because none have been identified in the direct or indirect effects APE at the time of publishing this EA.

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. As noted in Section 4.1.2 of the ER (Kairos 2023-TN9774), the proposed Hermes 2 reactor building complex 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 Hermes 2 would not adversely affect the Manhattan Project NHP.

3.5.3 Environmental Impacts of Operation

No impacts to intact historic and cultural resources are expected to occur from operations and maintenance activities. 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 Archaeological Resources Monitoring and Unanticipated Discovery 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 intact historic and cultural resources located within the proposed Hermes 2 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. However, because there is potential for the buried 1949 surface and deeply buried paleosols to contain archaeological

deposits, Kairos would follow its Archaeological Resources Monitoring and Unanticipated Discovery 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 intact historic and cultural resources are known to exist within the proposed Hermes 2 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. As described in Section 3, in addition to Hermes, the other past, present, and currently foreseeable projects and other actions evaluated are listed in Appendix F, Table F-1. 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 the DOE via execution of MOA(s). Ongoing and future projects include Hermes, cleanup and redevelopment activities at the ETTP, 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. history, most of the historic structures formerly at the ETTP have already been demolished. Additionally, no known historic properties would be affected by development on the proposed Hermes 2 site; therefore, no additional cumulative impacts on historic and cultural resources would occur.

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 2 project combined with other past, present, and reasonably foreseeable future actions is substantial, but the contribution of the proposed Hermes 2 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 site have resulted in past impacts and may potentially result in future impacts on historic and cultural resources, the Hermes 2 project would not contribute further to those impacts. The NRC staff has made a preliminary determination of no adverse effect to historic properties from the potential issuance of a CP for Hermes 2.

3.6 Socioeconomics and Environmental Justice

3.6.1 Affected Environment

3.6.1.1 Socioeconomics

This section describes the baseline socioeconomic and EJ characteristics of the Kairos site, including the population demographics and the economy of the region, and the region's infrastructure and public services. Socioeconomic information has been updated from that documented for Hermes in the Hermes CP EIS (NRC 2023-TN9771) to reflect the availability of more recent data where applicable. The NRC staff applies the same five-county economic region of interest (ROI) described in Section 3.6.1 Hermes CP EIS (NRC 2023-TN9771), which is, therefore, incorporated by reference for the socioeconomic and EJ analysis for Hermes 2.

The baseline demographic information of the resident populations in the five-county ROI is characterized in Section 3.6.1 of the Hermes CP EIS (NRC 2023-TN9771) and shown in Table 3-4 below. Data were gathered from the most recent decennial census or the most current 5-year data from the American Community Survey. Based on the population projection discussion in Section 3.6.1 of the Hermes CP EIS, the NRC staff assumed that economic region's population will continue to grow around 1 percent per year until about 2080.

Table 3-4 Demographic Profile of the Population in the Region of Influence in 2020

	Tennessee	Anderson County	Knox County	Loudon County	Morgan County	Roane County	ROI
Total	6,910,840	77,123	478,971	54,886	21,035	53,404	685,419
Hispanic or Latino	479,187	2,820	28,568	5,356	299	1,011	38,054
White	4,900,246	66,044	373,790	46,419	19,029	48,094	553,376
Black or African American	1,083,772	2,841	39,853	578	971	1,302	45,545
American Indian and Alaska Native	15,539	217	1,079	95	54	161	1,606
Asian	134,302	975	11,881	450	41	341	13,688
Hawaiian/Other Pacific Islander	3,594	53	300	2	8	19	382
Some Other Race	23,977	272	1,776	161	64	157	2,430
Two or More Races	270,223	3,901	21,724	1,825	569	2,319	30,338

Source: USCB 2020-TN9782

The regional economic characteristics (including employment, income, etc.) of the five-county ROI have been updated according to the most recent American Community Survey data. Based on the U.S. Census Bureau's (USCB) 2018–2022 American Community Survey 5-Year Estimates, the number of civilian labor force in the five-county ROI was 344,826 persons and the number of individuals employed was 330,707 (USCB 2022-TN9783). The unemployment rate in the five-county ROI was 4.1 percent. Comparatively, the unemployment rate in Tennessee during the same time period was 5.0 percent (USCB 2022-TN9783). The educational services, and healthcare and social assistance industry, has the largest employment in the socioeconomic ROI, followed by professional, scientific, and management, and administrative and waste management services (USCB 2022-TN9783).

Estimated income information for the socioeconomic ROI is presented in Table 3-5 according to USCB's 2018–2022 American Community Survey 5-year estimates. As shown in the table,

people living in Knox County, Loudon County, and Roane County had a median household income higher than the state average while people living in the Anderson County and Morgan County had a median household income lower than the state average (USCB 2022-TN9783).

Table 3-6 updates the total number of occupied and vacant housing units, and vacancy rates in the five-county ROI based on the USCB's most recent 2018–2022 American Community Survey 5-year estimates. There were 306,185 housing units in the ROI, of which 277,653 were occupied. The vacancy rate is 9.3 percent.

Table 3-5 Estimated Income Information for the Socioeconomic ROI (2018–2022, 5-Year Estimates)

Parameter	Anderson County	Knox County	Loudon County	Morgan County	Roane County	Tennessee
Median household income (dollars)[(a)]	60,633	68,580	75,008	51,971	66,460	64,035
Per capita income (dollars)[(a)]	32,803	39,608	40,425	27,320	36,579	36,040
Families living below the poverty level (percent)	10.7	7.6	8.7	16.9	8.3	10.0
People living below the poverty level (percent)	15.4	12.4	11.8	20.9	12.2	14.0
Unemployment rate	5.4	3.8	3.0	8.4	4.9	5.0

(a) In 2021 inflation-adjusted U.S. dollars.
Source: USCB 2022-TN9783

Table 3-6 Housing in the ROI (2018–2022, 5-Year Estimate)

	Anderson County	Knox County	Loudon County	Morgan County	Roane County	ROI
Total housing units	35,326	212,074	24,780	8,546	25,459	306,185
Occupied housing units	31,275	194,842	22,487	7,093	21,956	277,653
Vacant housing units	4,051	17,232	2,293	1,453	3,503	28,532
Vacancy rate (percent)	11.5	8.1	9.3	17.0	13.8	9.3

Source: USCB 2022-TN9784

The applicant indicates in the ER (Kairos 2023-TN9774), that the transportation details related to the construction, operation, and decommissioning of the Hermes 2 facility are similar to Hermes. Because the proposed Hermes 2 reactors would be built on the same site proposed for the Hermes reactor, the NRC staff, also, expects the transportation network baseline is the same for Hermes 2 as that for Hermes. As noted in Table 3.7-1 of the Hermes ER (Kairos 2023-TN8172), referenced in Section 3.6.1 of the Hermes CP EIS (NRC 2023-TN9771), the baseline level of service (LOS) estimates for major roads and corridors approaching the site including Perimeter Road, N Perimeter Road, and two bridges over Poplar Creek were ranked as "C" in 2019. The minimum standard for LOS on Tennessee roadways is "D" NRC 2019-TN6136│Section 2.5.2.4). Meanwhile, Section 3.6.1 of the Hermes CP EIS (NRC 2023-TN9771) accepted the applicant's 2 percent annual growth assumption for the annual average daily traffic volumes of roads serving the ORR based on the historical data analysis. The NRC staff relied on the same assumption for Hermes 2 by estimating the existing road volumes would grow by 2 percent annually over 2019–2025.

Tax information is updated to the most recent data with respect to the information presented in Section 3.6.1 of the Hermes CP EIS (NRC 2023-TN9771). Because Hermes 2 would be located within Roane County, a property tax rate of $2.34 per $100 assessed value would apply. In addition, the City of Oak Ridge property tax of $2.3136 per $100 assessed value also would apply (RCT 2024-TN9785).

Baseline public infrastructure information (including local land use plans, water and sewer facility, recreation venues, police, fire and medical services, social services, education system) in the economic region is characterized in Section 3.6.1 of the Hermes CP EIS (NRC 2023-TN9771). The staff expects this information, based on its recency, still is valid for consideration of the Hermes 2 project.

3.6.1.2 Environmental Justice

The NRC staff used the same approach for EJ impact assessment applied in the Hermes CP EIS. Because Hermes 2 would be built on the same site proposed for Hermes, the NRC staff determined that the characteristics of the EJ population for Hermes 2 would be the same as indicated in Section 3.6.1.2 of the Hermes CP EIS (NRC 2023-TN9771), which was completed in 2019 and is incorporated by reference. Section 2.6 of the Clinch River Nuclear (CRN) Site EIS (NRC 2019-TN6136) analyzed the 760 census block groups within a 50-mi radius of the nearby proposed CRN Site, of which 27 were identified as aggregate minority and 58 were identified as low-income. Also, the closest EJ block groups are over 5 mi north of the Kairos site. No subsistence or other practices were identified.

3.6.2 Environmental Impacts of Construction

3.6.2.1 Socioeconomics

In Section 2.1 of the ER (Kairos 2023-TN9774), the applicant stated that “the construction phase of this project is estimated to require an average of 424 onsite workers (850 at peak times).” The estimated duration of construction for each unit of Hermes 2 is 2 years. Total duration of the Hermes 2 construction is estimated to be 3 years, with an overlap in construction of the two units of approximately 1 year, which could be considered the peak construction period (Kairos 2024-TN9866). The socioeconomic impacts related to the construction of Hermes 2 are similar to those described in Section 3.6.2 of the Hermes CP EIS (NRC 2023-TN9771) which is, therefore, incorporated by reference. The NRC staff assumed that a third of the maximum construction workforce (about 280 workers) would need to in-migrate, following the approach taken in the Hermes CP EIS. The NRC concludes that the available housing units in the ROI would be adequate to support 850 peak workers and their families.

At peak employment, the NRC staff assumed 850 round trip employee commutes per day. Using the Highway Capacity Manual (TRB 2000-TN9065 and AECOM 2015-TN5000), distribution of the 850 construction workers commuting for a single-shift construction schedule would not degrade the LOS for major roads and corridors approaching the site (Kairos 2023-TN8172│Table 3.7-12, Section 3.7.2). The LOS for these locations would remain as “C”, which is acceptable by the State of Tennessee.

As noted in Section 2.1 of the ER (Kairos 2023-TN9774) and in the RCI Confirmation Letter from the applicant (Kairos 2024-TN9866), deliveries and shipments during construction would require an average 426 truck deliveries of construction materials per month, eight offsite shipments of construction debris per month, 63,600 gal of diesel fuel per month (primarily trucks are used for deliveries), and occasional deliveries of equipment and supplies. The small number

of shipments and deliveries for Hermes 2 would be minimal given the industrial nature of the ETTP. Additionally, prior to startup, the applicant expects delivery of 40 1-ton shipments of low-pressure molten salt coolant and 32 shipments of approximately 9 tons each of the intermediate coolant to the site (Kairos 2023-TN9774│ Section 2.1). Given the one-time, temporary, nature of these deliveries, the impact of the coolant shipments on traffic in the vicinity would be minor. Kairos is not expecting to need local access road improvements to handle the volume and weight of deliveries to the site (Kairos 2024-TN9866).

Based on the above assessment, the NRC staff concludes that the impacts of construction of the Hermes 2 project on socioeconomics would be minimal.

3.6.2.2 Environmental Justice

As discussed in Section 4.5.6 of the CRN FEIS (NRC 2019-TN6136), which is incorporated by reference, no unique EJ population characteristics or practices could be affected by the CRN construction activities. Given the proximity of the CRN Site to the Kairos site (within 4 mi), the distance from the Kairos site to the nearest potentially affected EJ populations (8 mi), and the small footprint of the Hermes 2 project, both physically and in terms of personnel, no disproportionately high and adverse health or environmental impacts would be expected and no pathways could be identified linking minority or low-income populations with any adverse impacts from the construction of the Hermes 2 project. Therefore, the NRC staff concludes that the construction of Hermes 2 would not result in disproportionately high and adverse impacts to minority or low-income populations.

3.6.3 Environmental Impacts of Operation

3.6.3.1 Socioeconomics

In Section 2.1 of the ER (Kairos 2023-TN9774), the applicant stated that “During operations, an estimated average of 59 workers per weekday (101 full-time positions) are required for staffing.” The NRC staff considered the construction workforce impacts as a basis to establish an upper bound for the impacts expected from the operation workforce for the duration of the anticipated 11-year operations period, given that the operation workforce is much smaller. There may be planned outages or maintenance activities that could approximately double the workforce size on site during operations, but these activities are not expected to last more than a few months and are not expected to occur more than a few times during the operational life of Hermes 2 (Kairos 2024-TN9866).

Of all 101 operations positions, 59 workers are expected to be required onsite during normal weekday operations (including nightshifts), and the remaining 42 workers would cover weekend shifts (Kairos 2024-TN9866). During work commuting times, the addition of a maximum of 59 operation worker vehicles distributed across the 11 main routes into the ORR would constitute negligible increase in traffic congestion and delay. The small number of shipments and deliveries to Hermes 2 during operation, including an estimated monthly average of 30 truck deliveries and eight offsite waste shipments (Kairos 2023-TN9774│Section 2.1) would be minor given the industrial nature of the ETTP. Additionally, 32 shipments per year of the intermediate coolant (9 tons each) would be delivered to the facility during operations. Before the end of the first two years of operation, the Hermes 2 test reactors would require a resupply of 40 one-ton shipments of low-pressure molten salt coolant. The disruption to the quality of traffic during these deliveries in the vicinity would be of short duration.

The NRC staff expects that the maximum temporary increase in property tax revenues associated with the operation of Hermes 2 would be substantially less than 10 percent of the total tax revenue at the city and county levels. Given the current baseline tax revenues for Roane County of $16,938,367 in FY 2019 (RCT 2020-TN9788) and $209,371,435 for the City of Oakridge in FY 2022 (City of Oak Ridge 2022-TN9789), revenue impacts would be minimal and beneficial at the community level.

Based on the information provided by the applicant and the resulting assessment above, the NRC staff concludes that the socioeconomic impacts from operations of the Hermes 2 project would be minimal.

3.6.3.2 Environmental Justice

The NRC staff identified no unique EJ population characteristics or practices that could be affected by operation of the Hermes 2 project, similar to the discussions in Section 3.6.3 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference. Project operations would not be expected to create impact pathways between the Hermes 2 project and EJ communities. Therefore, the NRC staff concludes that no disproportionately high and adverse human health and environmental effects on minority and low-income populations would be expected.

3.6.4 Environmental Impacts of Decommissioning

3.6.4.1 Socioeconomics

In Section 2.1 of the ER (Kairos 2023-TN9774), the applicant stated that “the post-operational decommissioning information and requirements are identical to those detailed for the Hermes reactor, as the Hermes 2 units will be decommissioned in series.” Based on this statement and the similarity of Hermes 2 to Hermes, the NRC staff concludes that the socioeconomic impacts from decommissioning of the Hermes 2 project would be the same as Hermes 1 and would be minimal, as described in Section 3.6.4.1 of the Hermes CP EIS (NRC 2023-TN9771) which is, therefore, incorporated by reference.

3.6.4.2 Environmental Justice

The NRC staff identified no unique EJ population characteristics or practices that could be affected by decommissioning of the Hermes 2 project, similar to the discussions in Section 3.6.4 of the Hermes CP EIS (NRC 2023-TN9771), which is, therefore, incorporated by reference. Decommissioning activities would not be expected to create impact pathways between the Hermes 2 project and EJ communities. Therefore, the NRC staff concludes that no disproportionately high and adverse human health and environmental effects on minority and low-income populations would be expected.

3.6.5 Cumulative Impacts

As described in Section 3, in addition to Hermes, the other past, present, and currently foreseeable projects and other actions evaluated are listed in Appendix F, Table F-1. The cumulative impacts on the socioeconomic and EJ aspects associated with construction, operation, and decommissioning activities of the proposed Hermes 2 project are similar to those indicated for Hermes in Section 3.6.5 of the Hermes CP EIS (NRC 2023-TN9771), which is, therefore, incorporated by referenced. Cumulative impacts were determined to be SMALL in the EIS.

Construction of the Hermes and Hermes 2 facilities would be partially concurrent. The equipment and workforce for the Hermes and Hermes 2 projects would largely be shared, thus limiting cumulative impacts to socioeconomic resources (Kairos 2023-TN9774 | Section 4.13.7). Consequently, the NRC staff determined the cumulative impacts on the socioeconomic aspects of the Hermes 2 project would be minimal. Meanwhile, no disproportionately high and adverse human health and environmental effects on minority and low-income populations would be expected.

3.6.6 Conclusions

The NRC staff concludes the potential direct, indirect, and cumulative socioeconomic impacts from Hermes 2 would be SMALL. Meanwhile, no disproportionately high and adverse human health and environmental effects on minority and low-income populations would be expected. This conclusion is based on the following considerations: First, staff relied heavily on the Hermes CP EIS because Hermes 2 will be built on the same site proposed for the Hermes. Second, the surrounding land is already in a state of industrial use and further disturbance of the proposed site would be minor. Third, building or operating additional infrastructure (i.e., utilities, roadways, or rail systems) for the proposed facilities is not anticipated. Given that the nearest potentially affected environmental justice populations are over 8 mi away, and the small footprint of Hermes 2, both physically and in terms of personnel, no disproportionately high and adverse human health and environmental effects on minority and low-income populations would be expected.

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 2 site, including effects caused by physical, electrical, and chemical sources.

3.7.1.1 Affected Environment

The nonradiological background of the site is characterized in Section 3.7.1.1 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference. The Kairos site where Hermes 2 would be sited is an industrial site formerly occupied by DOE buildings. The site has been remediated and levels of radioactive and nonradioactive contaminants are below risk-based standards for industrial sites but above background levels. The surrounding area is occupied by other industrial sites and fragmented forest habitat.

3.7.1.2 Environmental Consequences of Construction

During construction, nonradiological hazards such as diesel emissions and fuel, oil, chemical solvents, and other material would be present and stored onsite. As noted in Section 4.8.1 of the ER (Kairos 2023-TN9774), emissions from construction activities are expected to remain below 100 tons per year for criteria pollutants during concurrent construction of the Hermes unit and construction of the two Hermes 2 units. Section 3.7.1.2 of the ER (Kairos 2023-TN9774) references Table 4.8-2 of the Hermes ER (Kairos 2023-TN9774), which details the occupational hazards associated with construction activities for the similarly designed Hermes. The applicant also reports in Section 4.8.1 (and Table 4.8-2) of the ER (Kairos 2023-TN9774) that the only additional occupational physical hazards for Hermes 2 (compared to Hermes) would be related to BeNaF and anhydrous hydrogen fluoride.

3.7.1.3 Environmental Consequences of Operation

According to Section 2.1 of the ER (Kairos 2023-TN9774), an estimated 43,110 gal of diesel fuel would be kept onsite for the standby generator during Hermes 2 operations. Additional chemical inventory projected to be kept onsite during Hermes operations is provided in Table 4.8-1 of the ER (Kairos 2023-TN9774). Bounding inventory values include 80,000 lb of FLiBe and 2,000,000 lb of BeNaF.

Process safety management of highly hazardous chemicals per 29 CFR 1910.119 (TN654) applies to the facility due to onsite presence of BeNaF and FLiBe at greater than threshold quantity. As noted in Section 4.8.1 of the ER (Kairos 2023-TN9774), anhydrous hydrogen fluoride would be kept at levels below threshold quantity. Workers would have no exposures to biocides, discharge streams, or any microbial threat from warmed surface water, because Hermes 2, like Hermes, would not discharge to surface water. As for Hermes, discharge of gaseous waste would be passed through a high efficiency particulate air filtration system prior to venting to the atmosphere, and additional controls might be implemented as required. Section 4.8.1 of the ER (Kairos 2023-TN9774) indicates that the same would be true for Hermes 2.

Compliance with Occupational Safety Health Administration and National Institute of Occupational Safety and Health regulations is mandatory and would ensure the safety of properly qualified and trained site workers on the site where hazardous materials and wastes would be present.

3.7.1.4 Environmental Consequences of Decommissioning

In Section 4.8.1 of the ER (Kairos 2023-TN9774), the applicant states that there is no additional information that would differentiate the decommissioning of Hermes 2 from Hermes. In Section 3.7.1.4 of the Hermes CP EIS (NRC 2023-TN9771), the NRC staff determined that the decommissioning impacts of the Hermes facility would be bounded by the analyses for physical, chemical, ergonomic, and biological hazards in the generic EIS for decommissioning (NRC 2002-TN7254). Because the applicant presents no additional information specific to decommissioning for Hermes 2 in Section 4.8 of the ER (Kairos 2023-TN9774), Hermes 2 also would be bounded by the generic EIS for decommissioning.

3.7.1.5 Cumulative Impacts

As described in Section 3, in addition to Hermes, the other past, present, and currently foreseeable projects and other actions evaluated are listed in Appendix F, Table F-1 (Tables 4.13-1 and 4.13-2 of the Hermes ER (Kairos 2023-TN8172) and referenced in the CP EIS (NRC 2023-TN9771)). Construction of the Hermes 2 facility overlapping with construction of the Hermes facility would result in longer exposures to occupational hazards associated with construction and higher emissions; however, this effect would be mitigated by previously mentioned safety measures, and emissions are anticipated to remain under 100 tons per year. In Section 4.13.8 of the ER (Kairos 2023-TN9774), the applicant states that there is no new information regarding cumulative impacts related to nonradiological human health. Other projects in the surrounding area may contribute to air quality reaching a non-attainment status. Construction and decommissioning activities of the proposed action could further decrease air quality temporarily, but dust suppression and other BMPs would limit these emissions and mitigate their human health impacts. The limited amounts of gaseous emissions during operation is unlikely to have a significant impact on air quality in the area.

3.7.1.6 Conclusions

The NRC staff concludes that the potential direct, indirect, and cumulative nonradiological human health impacts of the proposed action would be SMALL. This conclusion is based on the applicant's plan for mitigation measures such as training, safety practices, and physical control measures. For Hermes, the applicant proposed to perform environmental monitoring to protect human health as required by permitting requirements and committed to procedures and protective measures to ensure protection of human health and the environment (NRC 2023-TN9771). Section 4.8.1 of the ER (Kairos 2023-TN9774) indicates that the same would be true for Hermes 2.

3.7.2 Radiological Human Health

The two proposed Hermes 2 non-power test reactors would be built on the same site proposed for the Hermes non-power test reactor. Figure 1-1 of this EA depicts the physical layout of the Hermes 2 site indicating features, structures, and designated areas. The reactor buildings would contain spent fuel storage with capacity sufficient for 10 EFPYs for each unit.

3.7.2.1 Affected Environment

No radioactive or hazardous materials are currently stored on the site. The description of the affected environment is summarized in Section 3.7.2.1 of the Hermes CP EIS (NRC 2023-TN9771). This information is applicable to the Hermes 2 reactors and is incorporated by reference. The analyses in the Hermes CP EIS Section 3.7.2 (NRC 2023-TN9771) and in the Hermes 2 ER Section 4.8 (Kairos 2023-TN9774) are based on the analysis in the Hermes ER Section 4.8 (Kairos 2023-TN8172). The proposed units would be built in the footprint of the former K-31 and K-33 gaseous diffusion plants. The DOE remediated past levels of chemical and radiological contamination as a part of the demolition and decontamination of the areas prior to releasing for industrial uses. The 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 properties for title transfer (DOE 2015-TN7964, DOE 2015-TN7964). As documented in these title transfer reports, there were no exceedances of the measured maximum or average remediation level. Therefore, the K-31 and K-33 Areas have a negligible radiological risk to Hermes 2 workers consistent with EPA's guidance for the protection of human health and the environment.

The baseline radiation levels for the Hermes 2 facility are similar to those described in Section 3.7.2.1 of the Hermes CP EIS (NRC 2023-TN9771).

The ORR Annual Site Environmental Report (DOE 2023-TN9801) provides the maximum radiation dose a hypothetical offsite individual could receive from DOE activities at the ORR, which was estimated by DOE to be 0.2 mrem from air pathways, 0.9 mrem from water pathways, and 2 mrem from consumption of wildlife harvested on ORR for a total about 3 mrem/yr, which is significantly less than 310 mrem annual average dose to people in the United States from background radiation. The two main sources of natural background radiation in the surrounding the East Tennessee area include cosmic radiation produced by collisions of high-energy particles in the upper atmosphere in range of 27 to 31 mrem per year, and naturally occurring terrestrial radionuclides in rocks and soils in the range of 62 to 106 mrem per year. The breathing of radon gas typically adds to natural background dose of 200 rem per year to give an average total natural background dose of approximately 300 mrem per year.

3.7.2.2 Environmental Impacts of Construction

Environmental impacts from construction of Hermes 2 would be similar as described in Section 3.7.2.2 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference, but for two test reactors rather than one. During the construction phase, radioactive material present on site would be present for construction-related activities such as compaction testing and radiography. 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. These radioactive materials would be present as sealed sources covered by contractor radioactive materials licenses and are operated according to standard operating procedures as described in Section 3.7.2.2 of the Hermes CP EIS (NRC 2023-TN9771). This information is incorporated by reference. These sealed sources of low-level radiation are required to be controlled by the radiation protection program of the holder of the radioactive material license. The sources must have very specific uses that are carried out under controlled conditions. The required radiation protection procedures and monitoring of the radioactive material would ensure that doses to construction workers from such uses of these radiation sources would be well below the annual dose limits for members of the public set forth in 10 CFR 20.1301 (TN283), if not negligible. The impacts from the use of these radioactive materials on Hermes 2 construction workers would not be significant.

Because Hermes 2 will be built adjacent to the Hermes test reactor, the expected Hermes 2 construction worker dose would be the Hermes test reactor's site boundary annual estimated dose of 2.4 mrem/yr (Kairos 2024-TN9866). This dose is significantly below the regulatory limits of 10 CFR 20.1301 (TN283) of 100 mrem for members of the public and a small fraction of the annual natural background radiation levels at this site. Therefore, based on the controls required for the use of radioactive devices or radioactive material during construction, DOE’s remediation of the land prior to any Kairos construction activity, and the low dose to construction workers from Hermes test reactor operation, the NRC staff concludes the radiological impacts during construction would not be significant.

3.7.2.3 Environmental Impacts of Operation

The radiation sources and expected radioactive effluent of Hermes 2 facility are similar to those described in Section 3.7.2.3 of the Hermes CP EIS (NRC 2023-TN9771) with the exception of additional liquid source of radiation to include BeNaF salt as intermediate coolant, which is cooled and solidified at the end of its life for Hermes 2. This section presents estimated annual doses to facility workers and members of the public from the operation of the Hermes 2 reactors along with radiological environmental monitoring over the anticipated 11-year licensed operational period. The pertinent information presented in Section 3.7.2.3 of the Hermes CP EIS (NRC 2023-TN9771) is similar and applicable for the Hermes 2 reactors and therefore is incorporated by reference.

3.7.2.3.1 Occupational Doses

Occupational doses due to radiation exposure to workers from all sources at the Hermes 2 facility would not result in a dose greater than the occupational dose limits (annual total effective dose equivalent [TEDE] limit of 5 rem) provided in 10 CFR Part 20 (TN283), Subpart C, by incorporating as-low-as-reasonably-possible provisions of 10 CFR 20.1101. Therefore, the NRC staff concludes that the dose impacts to workers from direct exposure sources would be minimal.

3.7.2.3.2 Doses from Radiological Gaseous Effluent Releases

The calculated annual total effective dose equivalent, annual average airborne radioactivity concentration, annual average waterborne radioactivity concentration, and other radiological health considerations would be nearly identical on a per unit basis to those addressed in Section 3.7.2.3.2 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference. The dose evaluation methodology and assumptions are the same for Hermes 2 as those applied for the Hermes test reactor. Because the Hermes 2 facility consists of two units, the conservatively determined long-term TEDE values for Hermes are doubled to account for the two units at Hermes 2. As noted in Section 4.8.2.4 of the Hermes 2 ER (Kairos 2023-TN9774), tritium release is conservatively assumed to be 125,000 Curies/yr for the two-unit Hermes 2 project, based on 62,500 Curies/yr per unit. This bounding tritium emissions rate does not evaluate the anticipated retention of tritium from the reactors and engineered systems. In addition, the Hermes 2 facility also would employ molecular sieve desiccants to capture tritium from the intermediate loop cover gas and the heat rejection radiator enclosure. The gaseous radioactive effluent doses for Hermes 2 are assumed to be bounded by the doses calculated for the Hermes test reactor facility on per unit basis and the dispersion values are assumed to be co-located. This is conservative because the actual maximum atmospheric dispersion (χ/Q) values for each unit would not be co-located, and additionally no credit is taken for the retention of tritium from tritium management system functions present in the Hermes 2 facilities.

Based on the design of Hermes test reactor, the expected exposure pathways to members of the public would principally be from radiological gaseous effluent release as only a small volume of radioactive liquid effluent releases to sewer lines. The analysis pertaining to environmental impacts of operation of Hermes test reactor is summarized and presented in Section 3.7.2.3 of the Hermes CP EIS (NRC 2023-TN9771). This analysis is similar and applicable to the Hermes 2 reactors and is incorporated by reference. The analysis in the Hermes CP EIS Section 3.7.2 (NRC 2023-TN9771) is based on the analysis in Hermes ER Section 4.8.2 (Kairos 2023-TN8172).

The calculated dose to maximally exposed individual (MEI) located at 0.5 mi south-southeast within the boundary of the ETTP and the dose to the analytical nearest resident located at 1.1 mi north-northwest from air emissions, reported for the Hermes reactor in Table 4.8-3 of the Hermes ER (Kairos 2023-TN8172), as evaluated in the Hermes CP EIS (NRC 2023-TN9771), are doubled to account for two-unit operation of Hermes 2. The calculated annual total effective dose equivalent values are summarized in Table 4.8-3 of the ER (Kairos 2023-TN9774). The resulting annual TEDE from Hermes 2 to the MEI in an unrestricted area and nearest full-time resident is 2.8 mrem and 2.4 mrem, respectively, which is much less than the limiting radiation protection value of 10 mrem of 10 CFR 20.1101(d) (TN283). The external dose rate to the MEI from Hermes 2 reactor operations is assumed to be 2 mrem/yr (based on assumed 1 mrem/yr per unit Hermes test reactor operation). The total annual TEDE from Hermes 2 operations to the MEI in an unrestricted area, and the full-time resident is 4.8 mrem and 4.4 mrem, respectively. The total cumulative annual TEDE (to include combined external dose and gaseous effluent dose) from the operation of both Hermes and Hermes 2 reactors to the MEI in an unrestricted area and nearest full-time resident is calculated to be 7.2 mrem and 6.6 mrem, respectively, which is less than the limiting value 100 mrem (10 CFR 20.1301(a)(1)) (TN283). The calculated total annual TEDE from all three Hermes reactors is much lower than the average background dose in Tennessee from natural sources of 564 mrem/yr (Kairos 2023-TN9774 | Section 4.8.2.4). Based on the calculated radiological doses, NRC staff concludes that the radiological impacts to members of public due to normal operation of both Hermes and Hermes 2 would be not significant.

3.7.2.3.3 Radiological Environmental Monitoring

The details regarding radiological monitoring that include effluent monitoring and environmental monitoring are similar to those addressed in Section 3.7.2.3.3 of the Hermes CP EIS (NRC 2023-TN9771). This information in Section 3.7.2.3 of that EIS is incorporated by reference.

Monitoring instrumentation and sampling equipment may be shared between the facilities where differentiation of the facility of origin is not feasible. A description of the environmental monitoring program for the Hermes 2 facilities would be provided with the OL application. Molecular sieve desiccants would capture tritium from the intermediate loop cover gas in addition to other capture functions. The ingestion exposure pathway, its analysis, and supplemental actions for Hermes 2 are identical to those for Hermes as presented by the applicant in Section 4.8.3.2.4 of the Hermes ER (Kairos 2023-TN8172) and as summarized in Section 3.7.2.3.2 of the Hermes CP EIS (NRC 2023-TN9771).

No additional significant information is identified for Hermes 2. Impacts to public health from implementing monitoring would not be significant.

3.7.2.3.4 Conclusions

Based on the radiological gaseous effluent releases and estimated annual doses to members of the public described above, the doses would be below the appropriate dose limits of 10 CFR Part 20 (TN283). The NRC staff would perform an independent safety review of Kairos's plans for exposure control and radiological effluent monitoring and compliance with applicable regulatory requirements of 10 CFR Part 20, such as 10 CFR 20.1301 (TN283). The NRC staff's independent safety review would be documented in its Hermes 2 SE. Based on the discussion in this section, and the NRC staff's completion of a thorough independent safety review and evaluation of the applicant's commitment to comply with applicable requirements, the NRC staff concludes that the environmental impacts from radiological gaseous effluent releases due to operation of the Hermes 2 reactors would not be significant, and further mitigation would not be warranted.

3.7.2.4 Environmental Impacts of Decommissioning

The impacts from decommissioning Hermes 2 would generally be similar to those for Hermes test reactor as described in Section 3.7.2.4 of the Hermes CP EIS (NRC 2023-TN9771). This EIS section is incorporated by reference. Prior to decommissioning the facility, Kairos would provide the NRC with a license termination plan as described in NUREG-1757 (NRC 2006-TN6599, NRC 2022-TN8031). The Hermes 2 facility, which consists of two small reactors each of 35 MWt capacity, are only a small fraction of a large light water reactor (LWR) with approximately 3,300 MWt and would have only a fraction of radiological impacts discussed in the generic EIS for decommissioning (NRC 2002-TN7254). Decommissioning impacts from the Hermes 2 project—with its two small test reactors and associated additional electrical generation equipment and materials requiring disposal—would be bounded by the expected radiological impacts that could occur during the decommissioning of a large LWR as discussed in the generic EIS for decommissioning (NRC 2002-TN7254). Therefore, the decommissioning impacts for Hermes 2 would be small fraction of the impacts discussed in the above noted generic EIS for decommissioning.

Because the two Hermes 2 reactors would be built and operate adjacent to the Hermes test reactor, the expected Hermes test reactor decommission worker dose would be the 4.8 mrem/yr

(0.048 mSv/yr) based on each of the Hermes 2 reactor's site boundary annual estimated dose of 2.4 mrem/yr (Kairos 2024-TN9866). This dose is significantly below the regulatory limits of 10 CFR Part 20 (TN283).

3.7.2.5 Cumulative Impacts

As described in Section 3, in addition to Hermes, the other past, present, and currently foreseeable projects and other actions evaluated are listed in Appendix F, Table F-1. Potential cumulative environmental impacts on human health associated with construction, operation, and decommissioning activities for the Hermes 2 facility in combination with other past, present, and reasonably foreseeable actions or projects in the area are similar to those described in Section 3.7.2.5 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference, with the exception of the additional potential cumulative environmental effects of the Hermes 2 facility.

The estimated total body dose presented in Table 4.8-3 of the ER (Kairos 2023-TN9774) to the analytical nearest resident from gaseous effluents and direct radiation during operation of the Hermes 2 facility combined would be 4.4 mrem/yr (4.8 for the MEI in an unrestricted area). The estimated total body dose to the analytical nearest resident from gaseous effluents and direct radiation during operation of the Hermes 2 facility from all onsite reactors would be 6.6 mrem/yr (7.2 for the MEI in an unrestricted area).

Operations on the ORR release small quantities of radionuclides to the environment. In the 2023 ORR Annual Site Environmental Report (ORR 2023-TN9739), detailed analysis of the effective dose received by the MEI from air pathways was determined to be 0.2 mrem/yr. The effective dose to the MEI from water, including drinking, bathing, irrigating, recreating, and fish consumption, was determined to be 0.9 mrem/yr. The effective dose from consumption of wildlife harvested on the ORR, including turkeys, geese, and deer, was determined to be 2 mrem/yr. Combined, the annual dose to the MEI in an unrestricted area from normal operations at the ORR is 3 mrem/yr (ORR 2023-TN9739). This dose is approximately 0.5 percent of the average background radiation dose in Tennessee (564 mrem/yr).

The cumulative radiological impact to members of public from the Hermes test reactor is described in Section 3.7.2.5 of Hermes CP EIS (NRC 2023-TN9771), and the NRC staff concluded that the impacts would be SMALL (not significant). This information is incorporated into this EA by reference. Because there is no additional information regarding potential cumulative radiological impacts in the area, other than the addition of Hermes 2, and because the radiological impacts for Hermes 2 would be minimal, the cumulative impacts are determined to be not significant.

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 Hermes 2 operation and during decommissioning, along with cumulative impacts would be SMALL. This conclusion is based primarily on the fact that the proposed Hermes 2 project is estimated to have radiological effluent releases that would be well below NRC requirements for potential doses to members of the public (e.g., the nearest resident). With appropriate radiological environmental monitoring, expected 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

The Kairos site, within which Hermes 2 would be sited, and its surrounding vicinity are characterized in Section 3.1 of the Kairos Hermes CP EIS (NRC 2023-TN9771). Current land use categories within 5 mi surrounding the site include croplands, forested areas, and developed land. Currently, there are no chemical plants, refineries, mining or quarrying facilities, or military facilities within 5 mi, and no radioactive or hazardous materials currently are stored on the site. Residual radioactive and hazardous contamination from previous industrial use have left the site above radiation background levels but below risk-based standards.

3.8.2 Environmental Impacts of Construction

The applicant states in Section 4.9.1 of the ER (Kairos 2023-TN9774) that the types of nonradiological waste generated by Hermes 2 would be similar to those generated by Hermes, although the quantities would be increased reflecting two rather than one unit. As noted in Section 3.8.2 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference, the applicant characterized solid nonradiological waste generated during construction in Section 4.9.1.1 of the Hermes ER (Kairos 2023-TN8172). Solid nonradiological waste would include scrap lumber, bricks, sandblast grit, glass, wiring, non-asbestos insulation, roofing materials, building siding, scrap metal, concrete with reinforcing steel, and other similar materials. Liquid nonradiological waste produced during normal activities of Hermes would include fuels, oils, solvents, paints, stains, and other chemicals. Human waste would be the most common liquid waste that would be produced during construction and would be discharged through municipal sewers to the Rarity Ridge Wastewater Treatment Facility. By the applicant's estimations, air emissions for Hermes would fall below the 100 ton/yr threshold established by the TDEC for criteria pollutants during construction. Because of the similarities between Hermes and Hermes 2, the NRC staff expects that the information about nonradiological waste presented in this paragraph statement above concerning Hermes would also apply to Hermes 2.

3.8.3 Environmental Impacts of Operation

The applicant states in Section 4.9.1 of the ER (Kairos 2023-TN9774) that the types of nonradiological waste generated by Hermes 2 would be similar to Hermes, although the quantities would be increased reflecting two rather than one unit. Section 3.8.3 of the Hermes CP EIS (NRC 2023-TN9771) indicates that the applicant plans to register Hermes as a Small Quantity Generator (SQG) under the Resource Conservation and Recovery Act of 1976. Because of the similarities between Hermes 2 and Hermes, the NRC staff expects that Kairos would also register each Hermes 2 reactor as an SQG and might perhaps register Hermes and Hermes 2 together as one SQG. No significant sources of nonradiological hazardous waste were previously identified for the similarly designed Hermes. Based on information for Hermes noted in Section 3.8.3 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference, the NRC staff expects that the primary sources of solid waste generated by Hermes 2 operations would include food waste, food product packaging waste, and disposable office items, and that these waste streams would be managed by recycling, waste reduction efforts, and other BMPs. The NRC staff expected that no nonradiological liquid chemicals would be generated. The primary liquid waste from the site is expected to be human waste. Anhydrous hydrogen fluoride and BeNaF would likely be disposed of on an annual basis, but FLiBe would be stored onsite until decommissioning and would not be disposed of during operations. Any

gaseous effluent from the site during operation would pass through high efficiency particulate air filters prior to release to atmosphere through a vent stack.

3.8.4 Environmental Impacts of Decommissioning

Waste management during decommissioning would be addressed in a license termination plan developed in accordance with NUREG 1757 (NRC 2006-TN6599, NRC 2022-TN8031). Nonradiological waste generated during decommissioning activities is anticipated to be similar to construction impacts. Structural material waste such as glass, concrete rubble, wood, and drywall would be generated during decommissioning. Office supplies from the operation of the facility would also be removed from the site during decommissioning and can be reasonably expected to be disposed of.

3.8.5 Cumulative Impacts

As described in Section 3, in addition to Hermes, the other past, present, and currently foreseeable projects and other actions evaluated are listed in Appendix F, Table F-1. Nonradiological waste generated by the Hermes 2, with the exceptions of the anhydrous hydrogen fluoride, BeNaF, and FLiBe, would be typical to that of an industrial park. The Hermes facility also will generate BeNaF and FLiBe waste, and storage and disposal methods for Hermes 2 will follow the same paths as the Hermes facility. Anhydrous hydrogen fluoride will be used in small quantities only and will only be disposed of on an annual basis. The addition of the Hermes 2 facility is unlikely to strain or overwhelm nearby hazardous waste disposal facilities. Additional hazardous waste generators in the area or proposed projects that could reasonably be developed in the area may require a larger fraction of waste disposal facilities capacity, but it is unlikely that the small fraction used by the proposed action would prevent future projects or compound on existing hazardous waste generators significantly.

3.8.6 Conclusions

The NRC staff concludes that the nonradiological waste impacts of the proposed action would be SMALL. This conclusion is drawn from the expected categorization of the Hermes 2 facility as an SQG under Resource Conservation and Recovery Act of 1976 and its potential to be considered as an SQG even when its hazardous waste outputs are combined with the Hermes facility. Nonhazardous waste generation by the construction and decommissioning of the facility is unlikely to have an adverse effect beyond the immediate area of the site and any adverse effects would be temporary.

3.9 Uranium Fuel Cycle and Waste Management

3.9.1 Uranium Fuel Cycle

Each Hermes TRISO fuel pebble is estimated to contain 6 g of uranium. The Hermes reactor is designed to use a maximum enrichment of 19.55 weight-percent uranium-235, which is known as High-Assay Low Enriched Uranium (HALEU). The current state of the uranium fuel cycle is presented in Section 3.9.1 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference. An estimated 77,600 pebbles, or approximately 466 kg of uranium would be consumed by Hermes 2 each year. An estimated total of 776,000 pebbles, or approximately 4,660 kg (4.66 metric tons of uranium) would be consumed over 10 EFPY.

Since the publication of the Hermes CP EIS, DOE continues to advance its efforts to secure a domestic supply of HALEU under the HALEU Availability Program with $700 million from the

Inflation Reduction Act to support the development of a domestic supply chain for HALEU (DOE 2024-TN9790). First, on November 7, 2023, the Centrus Energy Corporation announced the production of the nation's first 20 kg of HALEU at their Advanced Centrifuge Cascade in Piketon, Ohio. This enrichment facility is expected to boost its annual production of HALEU material to 900 kg in 2024 under the DOE contract, with options to produce more in the future (DOE 2023-TN9791). The DOE has issued two requests for proposals (RFPs) regarding HALEU deconversions services (GSA 2023-TN9792) and enrichment acquisition (GSA 2023-TN9793). Under the HALEU enrichment acquisition RFP issued on January 9, 2024, the DOE is seeking proposals to award one or more contracts to acquire mining, milling, conversion, and enrichment services to produce and store HALEU in the form of uranium hexafluoride gas (DOE 2024-TN9790). The HALEU deconversions services RFP issued on November 28, 2023, seeks proposals to acquire deconversion services to then reconvert HALEU uranium hexafluoride gas to various chemical forms (i.e., uranium metal or an oxide form) that will be used to fabricate fuels required by many advanced reactor developers. The DOE also published on February 29, 2024 for public comment the HALEU programmatic draft EIS that analyzes the impacts of DOE's proposed action to acquire HALEU for commercial use or demonstration projects and to facilitate the domestic commercialization of HALEU production (DOE 2024-TN9826). Section 3.9.1 of the Hermes CP EIS (NRC 2023-TN9771) indicates that the Hermes test reactor requires approximately 931 kg of uranium over 4 years (232.8 kg/yr), and Section 4.9 of the Hermes 2 ER (Kairos 2023-TN9774) indicates that the HALEU needs for the operation of the two Hermes 2 reactors would be approximately 4,660 kg of uranium over 10 years (233 kg/yr per reactor). For any year that the three test reactors are in operation, the annual amount of HALEU required would be approximately 700 kg. Because these amounts are below the annual HALEU production amount of 900 kg to be produced by Centrus, the DOE could supply the Hermes and Hermes 2 test reactors with the necessary amount of HALEU for operation.

Because of the much lower quantity of uranium needed for Hermes 2 than for a 1,000 MW reference large LWR and support from the prior evaluation in the Hermes CP EIS, the NRC staff finds that the impacts from the uranium fuel cycle to produce and fabricate the HALEU TRISO fuel would be much less than the impacts presented in WASH-1248 (AEC 1974-TN23) and Table S-3 in 10 CFR 51.51 (Table S-3) would still be bounding (Kairos 2022-TN9796). GHG emissions estimates of the uranium fuel cycle for Hermes 2 are presented in Table 3-5 in Appendix E of this EA.

3.9.2 Radiological Waste Management

The radioactive wastes generated and waste systems designed and implemented to limit discharges of radioactive materials in accordance with 10 CFR Part 20 (TN283) are addressed in Section 3.9.2 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference. Section 4.9.1 of the ER (Kairos 2023-TN9774) indicates that the radioactive wastes associated with Hermes 2 would be similar to those associated with Hermes, except for increases because of two units, operated for 11 rather than 4 years, and for the intermediate coolant. A portion of liquid waste would be expected to be recycled or packaged and shipped offsite for treatment and disposal. Small amounts may be released to the wastewater treatment plant which would be monitored to be within limits of 10 CFR Part 20 (TN283), Appendix B, Table 3. Liquid (molten) salt wastes would be separated to containerize salt waste where the salt would be collected in storage containers to cool and solidify. This solidified FLiBe would be stored onsite until decommissioning and then disposed as solid radioactive waste. Solid radioactive waste systems produced wet and dry radioactive waste from normal operations and maintenance would be shipped offsite as low-level radioactive waste (LLRW) periodically or stored onsite until decommissioning.

The radioactive waste that would be generated by the operation of Hermes 2 would be similar to that for Hermes as described in Section 3.9.2 of the Hermes CP EIS (NRC 2023-TN9771), with an increase in total waste generation to account for the two Hermes 2 units and an 11 year period. The general information pertaining Hermes reactor radiological waste management presented in Section 3.9.2 of the Hermes CP EIS (NRC 2023-TN9771) is applicable to the Hermes 2 project, which is incorporated by reference in this EA. Analyses in the Hermes CP EIS Section 3.9.2 (NRC 2023-TN9771) and in Hermes 2 ER Section 4.9 (Kairos 2023-TN9774) are based on the analysis in Hermes CP ER Section 4.9 (Kairos 2023-TN8172). Additional radioactive wastes, not already identified in the Hermes ER, that would be generated by the operation of Hermes 2 would include the removal of intermediate BeNaF salt coolant from its circulating system, and an additional waste stream of high specific activity tritium on molecular sieves produced by the tritium management system. Both of these wastes would be disposed of in solid form. The estimated quantities of radioactive waste generated at the Hermes 2 facility are provided in Table 2.6-1 of the ER (Kairos 2023-TN9774), accounting for both units. Based on the information presented for Hermes and Hermes 2, the NRC staff concludes that the impacts from radiological waste generated by Hermes 2 facility would be SMALL.

Information pertaining to Fuel Handling and Storage System and New and Irradiated Fuel is described in Sections 2.6.1.2.4 and 2.7.1 of the Hermes ER (Kairos 2023-TN8172) and is similar to that for Hermes 2. The TRISO fuel and moderator pebbles are continually cycled through the pebble handling and storage system, which removes pebbles from the reactor for inspection. When they meet pre-set standards for burnup and integrity, they are removed and replaced. The pebbles that are removed are placed in storage canisters for transfer to onsite canister storage. If necessary, spent fuel canisters would be loaded into dry storage casks for onsite storage on an exterior spent fuel storage pad. Spent fuel would eventually be transported by truck or rail to a final spent fuel repository or a regional spent fuel storage facility. The same annual amounts of spent fuel produced per unit basis for the Hermes reactor is assumed for each of the two Hermes 2 units. The total storage capacity between both units of Hermes 2 is sufficient for 10 EFPY of the 11 years of licensed reactor operation. The radiological impacts associated with the uranium fuel impacts and radiological impacts from wastes generated and managed by the Hermes 2 would not be significant.

3.9.3 Conclusions

The NRC staff concludes that the uranium fuel cycle impacts and radiological waste management impacts from the operation of Hermes 2 would be SMALL. This conclusion is based on the following.

- The relatively low total quantity of uranium (4.66 metric tons of uranium) estimated to be used for the license period of 11 years is much less than the annual amount used to assess Table S-3 impacts.
- The TRISO fuel processes impacts for Hermes 2 reactors are bounded by Table S-3 assessments.
- The spent TRISO fuel environmental impacts from storage onsite or offsite upon cessation of operations would be bounded by the Continued Storage generic EIS.
- 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 Hermes 2 operations would be comparable to or less than the LLRW volume from a nuclear power plant. Additionally, there is adequate capacity

at LLRW disposal sites for potential disposal, 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 LWRs and must meet same regulatory safety requirements.

3.10 Transportation of Radioactive Material

The radiological environmental impacts resulting from shipment of unirradiated fuel to the Hermes 2 site at the ETTP, shipment of LLRW and mixed waste to offsite disposal facilities during operations, and shipment of spent fuel to an interim storage or permanent repository during decommissioning are addressed in this section. GHG emissions estimates for transportation of unirradiated fuel, spent fuel, and radioactive wastes for Hermes 2 are presented in Table E-5 in Appendix E of this EA.

3.10.1 Environmental Impacts of Operation

Details of transportation of nuclear materials during operation and decommissioning of the Hermes 2 reactors would be similar to those described for the Hermes reactor in Section 3.10 of the Hermes CP EIS (NRC 2023-TN9771), but with an increase in total material generated and transported to account for two units rather than one, the use of the intermediate heat transport system, and the power conversion system. Analyses in the Hermes CP EIS Section 3.10 (NRC 2023-TN9771) and in Hermes 2 ER Section 4.10 (Kairos 2023-TN9774) are based on the analysis in Hermes CP ER Section 4.10 (Kairos 2023-TN8172). The information addressed in Section 3.10 of the Hermes CP EIS is incorporated by reference in this EA. Section 4.10 of the ER (Kairos 2023-TN9774), additional material for Hermes 2 (relative to Hermes) would include construction materials, BeNaF salt, hydrogen fluoride, construction and demolition wastes, and tritium capture materials. The Hermes 2 facility also would receive new intermediate coolant salt (BeNaF). When shipped to the facility site, the coolant salt would be nonradioactive; however, the intermediate BeNaF salt coolant would become radioactive during operation of the two reactors. This BeNaF salt would be transported in 32 shipments of approximately 9 tons each. Approximately 300 tons of BeNaF salt would be needed for startup of both units, and an additional 300 tons of BeNaF would be needed annually. The BeNaF salt would be radioactive at the end of its useful life, and some it is expected to be disposed of during operations. The Hermes 2 reactors would receive shipments of hydrogen fluoride. When shipped to the site, it would be nonradioactive; however, it would become radioactive as it is used in the tritium management system-intermediate heat transport system. The total quantity of hydrogen fluoride onsite would be maintained below 1,000 pounds. This hydrogen fluoride would be transported to the facility in approximately two annual shipments of about 100 pounds each. The estimated quantity of radioactive wastes and corresponding annual number of shipments are summarized in Table 2.6-1 of the ER (Kairos 2023-TN9774).

As presented in Section 4.10 of the ER (Kairos 2023-TN9774), fuel would be transported to the Hermes 2 facility either periodically or once per year, and 77,600 pebbles would be consumed by the Hermes 2 reactors each year. This would require approximately 222 containers of new fuel shipped each year consisting of 350 fuel pebbles in a VP-55 container. Assuming a 40,000 pound cargo weight limit for shipping, at 750 pounds per fuel container containing 350 fuel pebbles, approximately six truck shipments would be needed to transport a year's supply of fuel for the facility when operating both units at 35 MWt.

Incident-free transportation impacts of radioactive materials for Hermes reactor are addressed in Section 3.10.1 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference in this EA. Radiological impacts were determined for two crew members and the general population exposed along the route of vehicle transport. The details of transportation of radioactive materials and associated environmental impacts from facility operation would be similar for the consideration of Hermes 2 facility. The per-shipment and annual incident free radiological doses due to transportation of radioactive materials from the Hermes reactor facility are addressed in Section 3.10.1 of the Hermes CP EIS (NRC 2023-TN9771), summarized from information provided in Section 4.10 of the ER submitted by Kairos for Hermes and Hermes 2 (Kairos 2023-TN8172, Kairos 2023-TN9774). The dose and risk factors per shipment of radioactive materials and annual dose and risk factors for shipment of radioactive materials are presented in those above referenced tables, respectively. Using these dose and risk factors per shipment, the updates to annual incident-free radiological doses due to transportation of new nuclear fuel reflecting the two reactors operation annual total shipments are given in Table 4.10-1 of the ER (Kairos 2023-TN9774). The dose values and corresponding risk values are changed due to doubling the number of shipments for new fuel transport. Nevertheless, the change is very small. Therefore, the crew and population doses from annual incident-free radioactive material transport reported for Hermes 2 ER are the same as for Hermes. The total dose to transportation crews transporting radioactive material due to Hermes 2 facility operation is 3.16 person-rem/yr. The dose to the members of public due to transportation of radioactive material due to Hermes 2 facility operation is 2.37 person-rem/year. 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 (i.e., 100 mrem in a year under 10 CFR 20.1301) and is a small fraction of the natural background dose of 300 mrem per year. Therefore, the NRC staff concludes that the Hermes 2 facility effect of radiation exposure from incident-free transportation is not significant.

3.10.2 Environmental Impacts from Decommissioning

Spent TRISO fuel would be stored in the Reactor Building of Hermes 2 over the life span of the facilities (Kairos 2023-TN9774). Following cessation of operations, the spent TRISO fuel would have to be further stored at the ETTP or shipped offsite to an interim storage facility or a permanent geologic repository. There also would 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 in Section 3.10.2 of the Hermes CP EIS (NRC 2023-TN9771), which is also incorporated by reference for decommissioning impacts.

The Hermes 2 facility would not ship spent fuel offsite during reactor's expected 11-year OL period and would hold all spent fuel shipments until decommissioning. The spent TRISO fuel could be shipped to an interim storage facility or permanent geologic repository, as discussed in Section 3.10.2 of the Hermes CP EIS (NRC 2023-TN9771). The NRC staff has extensively analyzed the shipments of spent fuel in a number of new reactor licensing reviews to the once-proposed Yucca Mountain repository and for three away-from-reactor interim storage facility licensing reviews, as discussed in Section 3.10.2 of the Hermes CP EIS (NRC 2023-TN9771). Prior NRC transportation analyses of spent LWR fuel environmental impacts were bounded by Table S-4 in 10 CFR 51.52. The assessment of LWR spent fuel shipments in NUREG-2125 demonstrates providing adequate protection of public health and safety during transportation of spent fuel (NRC 2014-TN3231). The transportation analysis in Section 6.2.2 of the CRN Early Site Permit (ESP) final EIS (NRC 2019-TN6136) assessed 137 normalized annual spent LWR shipments to the once-proposed Yucca Mountain geologic repository, and is incorporated by

reference. The Hermes 2 spent fuel would be transported from the site within a 2–3-year time period resulting in approximately 103 shipments over a 2-year period, assuming 1,900 spent TRISO pebbles in a spent storage container and two spent storage containers in a shipment. Therefore, the annual spent TRISO shipments expected during Hermes 2 decommissioning would be within those of CRN annual spent fuel shipments and would be bounded by the CRN spent fuel transportation environmental impacts.

There would be some LLRW shipments for disposal to commercial LLRW sites during decommissioning. Additional LLRW would be generated due to Hermes 2 pertaining to spent FLiBe and intermediate salt BeNaF. However, the number of shipments would be bounded by a total of 46 shipments considered for an 880 MWe reference reactor. The potential environmental impacts for decommissioning of the Hermes test reactor consisting of spent TRISO fuel to interim storage or permanent geologic repository and LLRW shipments to licensed LLRW disposal facilities are addressed in Section 3.10.2 of the Hermes CP EIS (NRC 2023-TN9771). These shipments are bounded by an 880 MWe reference reactor. This addressed information is comparable to Hermes 2 operations with an exception to include increased number of potential shipments to account for two units. Nevertheless, these shipments also are bounded by an 880 MWe reference reactor; therefore, the transportation impacts would be minimal.

Because of the small size of the facility, its reactors, and support systems, facility decommissioning is considered to be bounded by the NRC assessment in the generic EIS for decommissioning (NRC 2002-TN7254). The NRC also concluded decommissioning of non-LWRs (i.e., fast breeder reactor and high-temperature gas reactor) would be bounded by the analyses addressed in generic EIS for decommissioning. Based on this, the NRC staff considers the decommissioning impacts form Hermes would not be significant. Therefore, the impacts from the transportation of radioactive waste from decommissioning the facility would be minimal.

3.10.3 Conclusions

Based on the quantity of nuclear material and waste acceptable for disposal and employing certified packages in accordance with NRC and U.S. Department of Transportation regulations, the NRC staff concludes that the transportation of fuel and waste impacts from operation and decommissioning of the Hermes 2 would be SMALL.

3.11 Postulated Accidents

3.11.1 Environmental Impacts of Operation

The analysis of the postulated events that are within the design basis of the Hermes test reactor facility are addressed in Section 3.11 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference. This analysis is similar and applicable for Hermes 2. The analyses in the Hermes CP EIS Section 3.11 (NRC 2023-TN9771) and in Hermes 2 ER Section 4.11 (Kairos 2023-TN9774) are based on the analysis in Hermes CP ER Section 4.11 (Kairos 2023-TN8172). According to Section 4.11 of the ER (Kairos 2023-TN9774), postulated events for Hermes 2 are within the design basis of the Hermes reactor and a maximum hypothetical accident (MHA) that bounds the radiological consequences of postulated events, with the exception of considerations for the intermediate heat transport loop and power generation systems. The NRC staff performed its review of and discussed the consequences of MHA in Section 3.11.1 of the Hermes CP EIS (NRC 2023-TN9771). Eight potential design basis

accidents are considered within design basis of Hermes test reactor facility. Of the eight events considered, the MHA is an event that could result in radiological consequences exceeding those of any other credible accident. Of the eight event groups considered in the Hermes ER for evaluation, four groups consisting of salt spills, radioactive releases from subsystem component, general challenges to normal operation and internal and external hazard events include new information in consideration for the intermediate heat transport and power generation systems. However, this additional new information has no meaningful change to the insertion of excess reactivity, and therefore, dose consequences are unchanged.

The MHA is a heat-up event where hypothetical conditions result in a conservatively analyzed release of the radionuclides circulating in FLiBe, and the risk of radioactive material release distributed in primary system. The MHA analysis is required for the 10 CFR 100.11 (TN282) determination of exclusion area, low population zone, and population center distance. The MHA is a bounding event with conservative radionuclide transport assumptions that challenge the important radioactive retention features of the functional containment. Dose consequences of the MHA for Hermes are addressed in Section 3.11.1 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference, and indicate the whole body dose to be 0.227 rem at the exclusion area boundary and 0.059 rem at low population zone, which are well below the regulatory limit (10 CFR Part 100-TN282) of 25 rem to whole body. Therefore, the MHA also bounds the radiological consequences of the postulated accident for the Hermes 2 reactor facility.

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 determines in its SE that Kairos Hermes 2 has met all the regulatory requirements described above and clearly demonstrates adequate protection of public health and safety, then the likelihood of accidents would be reliably controlled.

3.11.2 Cumulative Impacts

Cumulative impacts are related to present, and reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts of the proposed action. The cumulative risk considers the total 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 Hermes 2 facility site. As described in Section 3, in addition to Hermes, the other past, present, and currently foreseeable projects and other actions evaluated are listed in Appendix F, Table F-1. Key past and present actions affecting the area include Sequoyah Units 1 and 2, Watts Bar Units 1 and 2, and DOE facilities on the ORR. As discussed in Section 7.10 of the CRN ESP final EIS (NRC 2019-TN6136), which is incorporated by reference, the environmental impacts of building and operating two small modular reactors (larger than Hermes) in close proximity to Hermes site, the cumulative impacts when considered along with these facilities were found to be SMALL. Based on the discussion presented in Section 3.11.2 of the Hermes CP EIS (NRC 2023-TN9771), incorporated by reference, the NRC staff concludes that the cumulative risks of severe accidents at any location within 50 mi of the Hermes test reactor site likely would not be significant. Based on the additional estimated insignificant risk due to potential MHA at Hermes 2 and cumulative risk addressed in CRN ESP, NRC staff concludes that the cumulative risks of severe accidents within 50 mi of the Hermes 2 site would still not be significant, and no further mitigation is 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 2 facility must 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 reactor siting. The potential doses from Hermes 2, 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, 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 construction, operation, and decommissioning of Hermes 2 would not appreciably alter. However, it is necessary to consider whether climate change could result in a changed environment that could substantially alter the environmental impacts from Hermes 2. As part of the CRN ESP EIS, Appendix L, the NRC previously analyzed the potential changes to the Oak Ridge region as a result of climate change (NRC 2019-TN6136). Appendix L is, therefore, incorporated by reference.

In Appendix L of the CRN ESP EIS, the NRC staff used the 2014, 2017, and 2018 U.S. Global Change Research Program (GCRP) reports as the basis for its description of the potential climate change effects in the CRN Site region (USGCRP 2014-TN3472, USGCRP 2017-TN5848, USGCRP 2018-TN5847). The staff considered the period of time during which the CRN ESP, a combined construction permit and operating license, and a renewed license could potentially be valid. The staff determined that this period of time extended into the late 21st century and 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 following resource areas were analyzed in the assessment:

- land use
- hydrology
- terrestrial and wetland ecology
- aquatic ecology
- socioeconomics
- EJ
- historic and cultural resources
- meteorology and air quality
- nonradiological health
- radiological impacts
- nonradioactive waste
- accidents
- transportation of radiological materials

For all resource areas considered, the NRC staff concluded that the projected climate change effects would not alter impact determinations for the CRN project (NRC 2019-TN6136).

Because of the proximity of Hermes 2 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 CRN Site and the proposed Hermes 2 site. The NRC staff therefore incorporates by reference the analysis from the CRN ESP EIS (NRC 2019-TN6136) to evaluate climate effects on the Hermes 2 project impacts. However, the proposed Hermes 2 reactor units are smaller than those considered in the CRN ESP (70 vs. 2,420 MWt total power output) with correspondingly smaller magnitudes of impacts. In addition, the proposed Hermes 2 units are anticipated to operate for only 11 years compared to the 60 years analyzed for CRN (40 years for the combined construction permit and operating license and 20 years for the renewed license). As a result, the potential climate changes to the affected environment analyzed in CRN ESP EIS Appendix L would not be fully realized during the anticipated operation of the proposed Hermes 2 facilities. The smaller size and shorter operating period indicate that the CRN ESP climate change effects would be bounding for the Hermes 2 project.

The staff reviewed the latest National Climate Assessment (NCA5) produced by the GCRP (USGCRP 2023-TN9762) to determine whether the climate change summary prepared for the CRN ESP is still bounding for the region given the new information on the projected impacts of climate change. The NCA5 Interactive Atlas (USGCRP 2024-TN9798) provides climate projection maps downscaled to the county level. Available maps show projected values of climate variables (temperature and precipitation) under four global warming levels (GWLs) corresponding to global temperature increases of 1.5, 2, 3, and 4°C, respectively, above the pre-industrial (1851–1900) average. The current global average temperature is about 1.1°C above the pre-industrial level. The year a GWL is projected to occur depends on the emissions scenario and the climate model. Under the “very high” emissions scenario (SSP5-8.5, similar to the bounding scenario considered in the CRN ESP), the 2°C GWL is projected to be reached, on average, in 2042 (USGCRP 2023-TN9762), a date consistent with the projected end of the Hermes 2 operating period. The staff therefore assumes that climate change effects for a GWL of 4°C are bounding for the Hermes 2 project.

According to the NCA5 Interactive Atlas (USGCRP 2024-TN9798), the average annual temperature in Roane County is projected to increase by 3.9°C compared to 1991–2020 if the global temperature rises 4°C above the pre-industrial average. This is similar to, but less than, the 8–9°F increase considered in the CRN ESP assessment. The highest temperature of the year in Roane County is projected to increase by 4.4°C for the 4°C GWL, comparable to the 10–15°F increase considered in the CRN ESP assessment. The annual number of days when the lowest temperature is 0°C or lower is projected to decrease by 18 days for the 2°C GWL and 38 days for the 4°C GWL; these values fall within the ranges considered in the CRN ESP. Annual precipitation in Roane County is projected to increase 6 percent compared to 1991–2020 under the 2°C GWL and 8 percent under the 4°C GWL. The projected changes in climatic water deficit in eastern Tennessee are small, with the small increase in precipitation offset by a small increase in water evaporation and plant transpiration (USGCRP 2023-TN9762). Growth in the southeastern United States is projected to increase climate risks, worsen human health, and widen health inequities (USGCRP 2023-TN9762). These conclusions are consistent with the regional climate effects considered in the CRN ESP assessment.

The NRC staff determined that the new information in NCA5 does not significantly differ from the climate change information considered for the CRN ESP assessment, and that the climate change effects considered in the CRN ESP EIS would bound the effects for the Hermes 2 project. Therefore, the staff concludes that the projected effects of climate change would not alter any of the impact determinations described in this EA.

4 ALTERNATIVES

This section describes alternatives to granting construction permits for the proposed Hermes 2 test reactor project and the environmental impacts of those alternatives. For EAs, NRC regulations in 10 CFR 51.30(a)(ii) (TN250) call for a brief discussion of alternatives in an EA.

In accordance with NUREG–1537 (NRC 2012-TN5527, NRC 2012-TN5528), 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. The applicant followed a systematic process for identifying a range of reasonable alternative sites, as outlined in Sections 5.2 and 5.3 of the ER (Kairos 2023-TN9774). The applicant relied on the same systematic consideration of alternative sites used for siting the Hermes project, described in Section 4.2.1 of the Hermes CP EIS (NRC 2023-TN9771), which led to identification of two reasonable sites: (1) the proposed site in Oak Ridge, Tennessee, and (2) an alternative site in Eagle Rock, Idaho. As with Hermes, the applicant did not consider alternative layouts of the proposed Hermes 2 facilities on either site. Land disturbance on the proposed site in Oak Ridge would be limited to lands previously disturbed by the former ORGDP. Furthermore, the proposed site is situated in an existing industrial park already served by 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, do not offer opportunities to reduce environmental impacts. As described in Section 4.2.2.1 of the Hermes CP EIS (NRC 2023-TN9771), the Eagle Rock site is a large tract of relatively uniform undeveloped rangeland and cropland without wetlands or surface water features. 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 is developed, the applicant did not consider opportunities to repurpose existing facilities in lieu of building new facilities.

As noted in Section 5.2 of the ER (Kairos 2023-TN9774), because the purpose of Hermes 2 is to demonstrate and test specific new technologies, the applicant did not consider alternative technologies. As noted in Section 4.0 of the Hermes CP EIS (Kairos 2023-TN9774), which is incorporated by reference, the applicant indicated that transportation alternatives to the proposed site for Hermes (where Hermes 2 would also be sited) are limited to using existing road and rail facilities already servicing the ETTP. As also noted there, the applicant indicated that the Eagle Rock site is served only by roads and cannot be served by alternative transportation such as waterways or railroads. These statements remain true for Hermes 2 and support why other transportation alternatives were not considered.

4.1 No-Action Alternative

Under the no action alternative, the NRC would not issue construction permits to Kairos to build the proposed Hermes 2 test reactors. Not issuing CPs for Hermes 2 would not change that the NRC has already issued a CP for the Hermes test reactor on the same site. The applicant could still build Hermes but would not have the ability to test elements of the Hermes 2 design absent from the Hermes design, such as the intermediate cooling loop. While forgoing the opportunities provided by Hermes 2 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.

The applicant notes in Section 5.1 of the ER (Kairos 2023-TN9774) that the adverse environmental impacts from Hermes 2 would not take place under the no-action alternative. But

because Chapter 3 of this EA characterizes potential environmental impacts of the proposed action as SMALL, any environmental benefits from selecting no action instead of the proposed action would be minimal. Furthermore, because the applicant would still retain the ability to build the Hermes test reactor, some impacts resulting from partial occupancy of the site could still occur. Other areas of the site would remain available for other government or private industrial development, resulting in similar environmental impacts resulting from land disturbance and building new industrial facilities on the site.

4.2 Site Alternatives

Based on its review of available and relevant information, including Section 5.3 of the ER (Kairos 2023-TN9774), the NRC staff identified one alternative site for detailed evaluation. This alternative site, termed the Eagle Rock site, is situated approximately 20 mi west of Idaho Falls, Idaho, on Federally owned property in eastern Idaho. Figure 4-1 of this EA 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 the DOE and other agencies. As explained in Section 5.3 of the ER (Kairos 2023-TN9774), the applicant is relying on the same site selection process it performed to site Hermes as the basis for siting Hermes 2. Considering the similarity of the two projects, and the recency of the Hermes site selection process, the NRC staff finds that the applicant's reliance on the same site selection process for Hermes 2 is reasonable.

4.2.1 Process for Identifying Reasonable Alternative Sites

The applicant's process for siting Hermes, and hence Hermes 2, is described in Section 4.2.1 of the Hermes CP EIS (NRC 2023-TN9771), which is incorporated by reference. The process follows the outline presented by the Electric Power Research Institute in *Advanced Nuclear Technology: Site Selection and Evaluation Criteria for New Nuclear Power Generation Facilities* (EPRI 2015-TN5285).

4.2.2 Affected Environment and Environmental Consequences for Eagle Rock Site

4.2.2.1 Affected Environment:

The characterization of the Eagle Rock site presented Section 5.1 of the Hermes CP EIS (Kairos 2023-TN9774) is still current given its recency and is, therefore, incorporated by reference. The Eagle Rock site constitutes approximately 4,200 ac of undeveloped land consisting of irrigated cropland, non-irrigated pasture, and natural sagebrush steppe. Multiple wilderness study areas, national natural landmarks, national forests, national monuments, and national wildlife refuges are located within 50 mi of the site. The site is zoned as G-1 Grazing, which allows for industrial development. The site and surrounding counties are attainment areas under the Clean Air Act, and Clean Air Act Class I areas 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. A search by the applicant of the FWS Information for Planning and Consultation database on February 2, 2022, identified no threatened or endangered species or critical habitat listed under the ESA (TN1010) for an action area consisting of that portion of the site where 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.

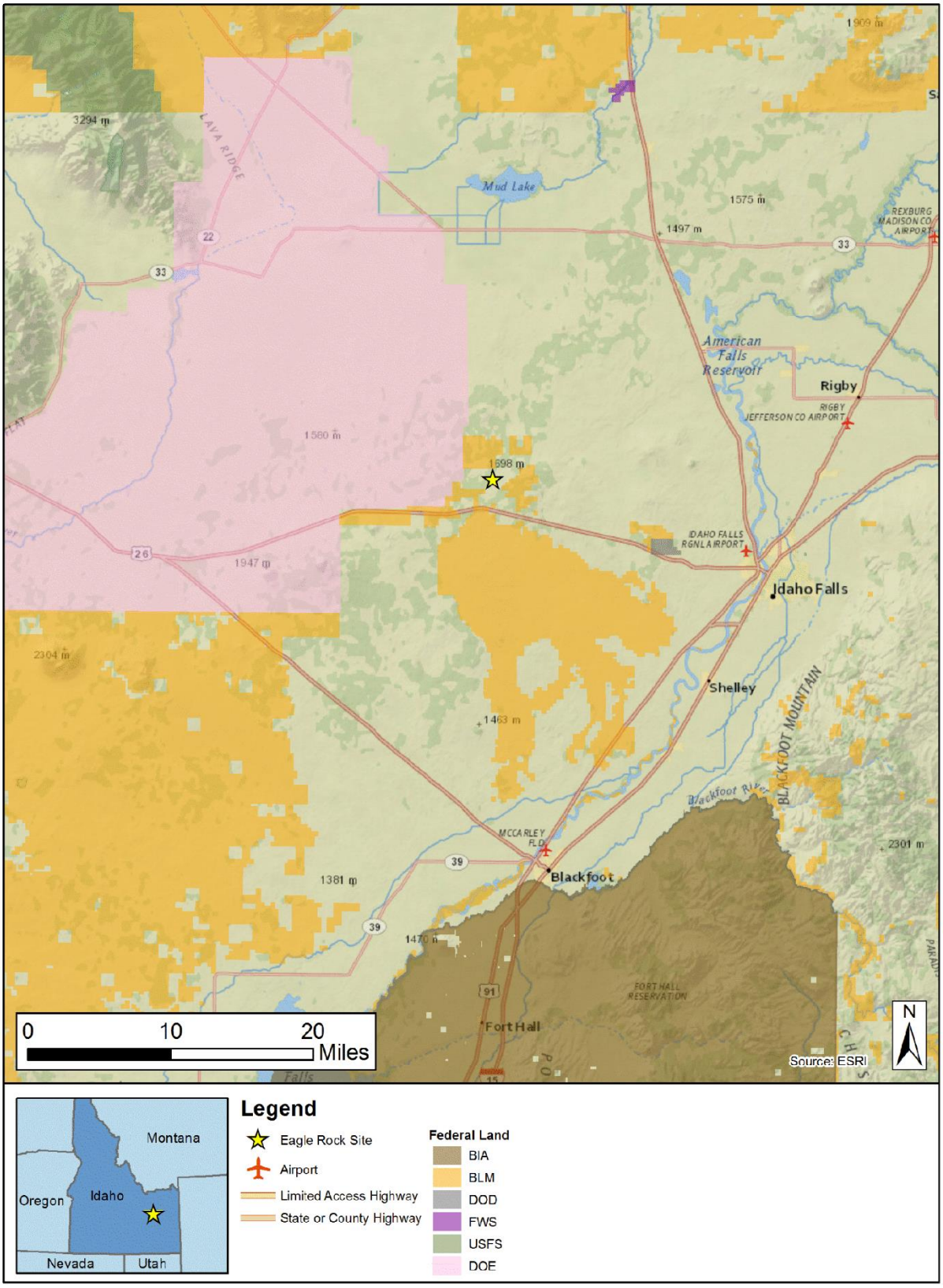


Figure 4-1 Location of the Eagle Rock Site (Source Kairos 2023-TN8172)

4.2.2.2 Environmental Consequences of Construction

The characterization of environmental impacts from construction of Hermes on the Eagle Rock site presented in Section 4.2.2.2 of the Hermes CP EIS (NRC 2023-TN9771) would apply to building Hermes 2 and is therefore incorporated by reference. Building Hermes 2 at the Eagle Rock site would involve the temporary disturbance of approximately 95 ac, with permanent occupation of approximately 30 ac, of cultivated cropland, sagebrush, pasture, open space, upland grasslands, and prime farmland. As with Hermes, the visual changes to the landscape in the surrounding relatively undeveloped, flat, and treeless natural setting would be noticeable, thus altering scenic vistas extending long distances into the mostly flat and treeless landscape.

Air emissions would be as for the proposed site in Oak Ridge, low enough to be offset by mitigation and below the threshold required for Class I area modeling. Noise generation would be at levels indicated for similar test reactor facilities in Oak Ridge but may be imperceptible to the nearest residence, which is approximately 4.8 mi away. Building Hermes 2 on the Eagle Rock site would not require physical disturbance of surface water features, wetlands, or floodplains. The applicant would have to develop groundwater supply wells, although usage rates would be substantially below the annual water right appropriation. Municipal water sources and municipal wastewater treatment facilities would not be available. Loss and disruption of sagebrush steppe habitat and other natural vegetation within the land subject to temporary disturbance could noticeably affect wildlife. 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. Impacts related to nonradiological and radiological human health, fuel cycle and transportation, and nonradiological waste management would be as described for the Hermes 2 project at the Oak Ridge site. As noted in Section 4.2.2.1 of the Hermes CP EIS (Kairos 2023-TN9774), which is incorporated by reference, there are no low-income populations subject to consideration as potential environmental justice communities of concern within 5 mi of the Eagle Rock site. Hence, there is no potential for EJ impacts.

4.2.2.3 Environmental Consequences of Operation

The characterization of environmental impacts from operation of Hermes on the Eagle Rock site presented in Section 4.2.2.3 of the Hermes CP EIS (NRC 2023-TN9771) is incorporated by reference. There would be no further land use or visual changes resulting from operation of Hermes 2, and there would be no additional physical disturbance to natural habitats or subsurface cultural resources. Water usage for operations would generally be as described for the proposed action, but the water supply would be obtained from onsite groundwater wells. Impacts to other environmental resources would be as described for Hermes 2 at the proposed site. As noted for Hermes 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 presented in Section 3.10.1 of the Hermes CP EIS for Hermes at the proposed site in Oak Ridge, which formed the basis of a SMALL conclusion, would still bound the transportation impacts for Eagle Rock for Hermes 2 if one applies the same assumptions. For fresh fuel, 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, Virginia, which is located approximately 2,200 mi away from the Eagle Rock Site in Idaho, versus approximately 2,390 mi from Framatome Fuel Fabrication in Richland, Washington, to the Hermes 2 site in Oak Ridge, Tennessee. The radioactive waste transportation analysis would still be bounding for shipping shorter distances (e.g., shipping

waste from the Eagle Rock site in Idaho to the Energy*Solutions* LLRW disposal site in the adjacent state of Utah, or to the LLRW disposal site of Waste Control and Storage Services in Texas, which is approximately 1,200 mi away, versus approximately 1,260 mi from Oak Ridge to Waste Control and Storage Services).

4.2.2.4 Environmental Consequences of Decommissioning

The characterization of environmental impacts from decommissioning of Hermes on the Eagle Rock site presented in Section 4.2.2.4 of the Hermes CP EIS (NRC 2023-TN9771) would apply to Hermes 2 and which is incorporated by reference. The staff expects that potential environmental impacts would generally resemble those described for construction. Potential impacts from transportation of radioactive material during decommissioning would be bounded by the transportation impacts described in Section 3.10 of this EA, because the LLRW disposal sites are nearer to Eagle Rock than to Oak Ridge. Eagle Rock is approximately 300 mi from the *EnergySolutions* 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 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. 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. As noted for construction, there are no low-income populations subject to consideration as potential environmental justice communities of concern within 5 mi of Eagle Rock and hence no potential environmental justice impacts.

4.2.2.5 Cumulative Impacts

The characterization of cumulative environmental impacts developed for Hermes on the Eagle Rock site, presented in Section 4.2.2.5 of the Hermes CP EIS (NRC 2023-TN9771), would also apply to Hermes 2 at that site, and which is therefore incorporated by reference. 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. Section 4.2.2.5 of the EIS identifies three reasonably foreseeable future projects that could cumulatively contribute to the environmental impacts of Hermes 2 if sited at Eagle Rock. These include two transmission line projects and the Idaho National Laboratory Carbon-Free Power Project, which was cancelled in November 2022. The NRC staff recognizes that the environmental impacts from the other major projects might be noticeable in the context of their immediate surroundings. However, the staff finds that the incremental effects of the Hermes 2 project added to the effects of these other proposed projects would be minimal, except maybe for visual resources, ecological, and cultural resources. The cumulative adverse visual effects of the projects could be noticeable in the flat, largely treeless landscape. Similarly, the combined loss of sagebrush and other terrestrial habitats and combined disturbance of subsurface cultural resources from building Hermes 2 at the Eagle Rock site combined with 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 of Hermes 2 at the Eagle Rock site would be SMALL, 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 Eagle Rock could disturb archaeological resources. Otherwise, the small size and limited land disturbance needed for Hermes 2, abundance of land on the Eagle Rock site, presence of similar land cover in the surrounding rural area, low employment and water demands, and absence of sensitive natural and hydrological features suggest that implementing the project at Eagle Rock would have at most minimal adverse environmental impacts. Furthermore, although rural and remote, Eagle Rock is still proximate to the City of Idaho Falls and Idaho National Laboratory, a DOE facility with technical staff and capabilities much like those in Oak Ridge.

4.3 Cost-Benefit of the Alternatives

The applicant states in Section 5.4 of the ER (Kairos 2023-TN9774) that the costs and benefits of Hermes 2 would be similar to those for Hermes, with the exception of a general increase in costs resulting from two test reactors for Hermes 2 instead of only one reactor for Hermes. The staff recognizes the similarity of the Hermes 2 reactors to the Hermes reactor and proposed location of the two projects on the same site. The analysis of costs and benefits completed for Hermes in Section 4.3 of the Hermes CP EIS (NRC 2023-TN9771) would therefore apply to Hermes 2 and which is incorporated by reference. On the basis of the assessments summarized in this EA, the NRC staff concludes that building, operating, and decommissioning Hermes 2 (taking the appropriate mitigation measures identified by the NRC staff and acknowledging that Hermes 2 consists of two rather than only one reactor as for Hermes) would have accrued benefits that would likely outweigh its economic, environmental, and social costs. The staff draws this same conclusion regardless of whether the project is sited at Oak Ridge or Eagle Rock.

4.4 Comparison of the Potential Environmental Impacts

Potential environmental impacts from the no action alternative and the proposed action would be SMALL for each environmental resource identified for evaluation in this EA. 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 2 test reactors at the Eagle Rock site would require disturbance of soils that support natural vegetation and could contain subsurface archaeological resources. Additionally, the visual appearance of the facilities could be noticeably intrusive in the rural setting of the Eagle Rock site.

Based on the analysis presented above, 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 from the proposed action, the no action alternative would not meet the purpose and need for Hermes 2. Furthermore, the analyses in this EA 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 CONCLUSIONS AND RECOMMENDATION

This EA describes the environmental review conducted by the NRC staff for the Kairos application for CPs under 10 CFR Part 50 (TN249) that would allow construction of the two Hermes 2 non-power test reactors on a 185 ac site within the Heritage Center of ETTP (Heritage Center) in Oak Ridge, Tennessee. This EA follows procedures in 10 CFR 51.30, "Environmental assessment" and 10 CFR 51.31, "Determinations based on environmental assessment," which are the NRC's regulations for preparing EAs to implement NEPA requirements (TN661). This chapter presents conclusions and recommendations based on the NRC staff's environmental review of the application. The chapter is organized as follows:

- Section 5.1 summarizes the environmental impacts from construction, operation, and decommissioning of Hermes 2.
- 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.
- Section5.4 presents the NRC staff's conclusions and recommendations.

5.1 Environmental Impacts of the Proposed Action

As indicated in Section 1.1 of this EA, the proposed action is NRC issuing CPs to Kairos authorizing construction of two proposed Hermes 2 non-power test reactors on a site in Oak Ridge, Tennessee. Section 1.2 of this EA presents the purpose and need of the Federal action, which is to demonstrate key technology of the KP-FHR technology for possible future deployment. Chapter 3 of this EA characterizes the direct, indirect, and cumulative impacts from construction, operation, and decommissioning of the proposed Hermes 2 reactors. As indicated in Chapter 3, the NRC staff concludes that the potential impacts from Hermes 2 would be SMALL for each potentially affected environmental resource. The NRC staff based its conclusions on independent reviews of information provided in Kairos' application for the Hermes 2 CPs, including an ER (Kairos 2023-TN9774) and PSAR (Kairos 2023-TN9774), 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 Hermes 2

Resource Area	EA Section	Summary of Impact	Impact Level
Land Use and Visual Resources	3.1	Same 185 ac site proposed for Hermes. Temporary disturbance of 138 ac of land previously occupied by industrial buildings. Permanent occupation of 30 ac of that land. Remainder of the site would be exclusion area throughout operation, where Kairos would have to ensure compatible land use. The site is within an established industrial park setting that is already of low scenic quality. Hermes 2 would have a compatible industrial appearance and be compatible with existing zoning. Short 161 kV electric transmission would be built extending approximately 800 ft west of the Hermes 2 site to connect to existing electrical grid; the transmission line would be built entirely with previous disturbed lands within the existing Heritage Center industrial park.	SMALL

Table 5-1 Summary of Environmental Impacts from Construction, Operation, and Decommissioning of Hermes 2 (Continued)

Resource Area	EA Section	Summary of Impact	Impact Level
Air Quality and Noise	3.2	Air emissions of criteria pollutants would be below 100 tons/yr, and hazardous air pollutants would be below 10 tons/yr individually and 25 tons/yr combined. Emissions would comply with non-Title V permitting requirements. Standard control measures to minimize fugitive dust.	SMALL
Hydrogeology and Water Resources	3.3	No disturbance of geological features of economic or natural value. Disturbances limited to previously disturbed soils. BMPs employed for soil erosion and sediment control. Water demands met through municipal or commercial suppliers. No use of groundwater and no direct use of surface water. No cooling towers, ponds, or reservoirs. Wastewater discharged for treatment to municipal wastewater treatment facilities. Limited, temporary dewatering of two reactor excavations during construction. Dewatering water to be dispositioned in accordance with DOE requirements per the quit claim deed for the site. Stormwater to be managed using BMPs.	SMALL
Ecological Resources	3.4	Ground disturbance, including that for transmission line, limited to previously disturbed soils lacking vegetation or with only ruderal vegetation. No disturbance of forest cover or other natural vegetation on natural soils, wetlands, surface waters, shorelines, or riparian land. No Clean Water Act Section 404 permit required. BMPs to control stormwater runoff that might reach wetlands or aquatic habitats. Brief increases in noise during construction may affect wildlife, but area wildlife already exposed to industrial noise. Limited potential for wildlife to collide with new structures or be injured by vehicles. Biological evaluation presented in Table 3.4-2 of this EA presents NRC staff conclusions regarding effects of Hermes 2 on species protected under the ESA (TN1010). Conclusions for all species are no effect or may affect but not likely to adversely affect. No critical habitat present. The final EA will indicate whether the FWS concurs.	SMALL
Historic and Cultural Resources	3.5	No historic properties in the direct effects APE. Ground disturbance limited to areas of extensive past soil disturbance with little potential for remaining archaeological resources. Kairos has developed and would implement an Archaeological Resources Monitoring and Unanticipated Discovery Plan covering any work on the 185 ac site establishing stop work and notification procedures to address unexpected discovery of human remains or archaeological material in compliance with deed requirements and Tennessee State law. The Manhattan Project National Historical Park (eligible for the National Register of Historic Places) is in the indirect effects APE but would not be adversely affected because Hermes 2 would be visually compatible with the current industrial setting.	SMALL
Socioeconomics and environmental justice	3.6	Construction of Hermes 2 would involve an average of 424 site workers per year over a 3-year period with an estimated peak of 850 workers. Staffing during an 11-year operational phase would require an estimated average of 59 workers per weekday (101 full-time positions). Decommissioning would involve an estimated	SMALL

Table 5-1 Summary of Environmental Impacts from Construction, Operation, and Decommissioning of Hermes 2 (Continued)

Resource Area	EA Section	Summary of Impact	Impact Level
		peak employment level of 340 workers. These few 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. Given that the nearest potentially affected EJ populations are over 8-mi away, and the small footprint of Hermes 2, both physically and in terms of personnel, no disproportionately high and adverse human health and environmental effects on minority and low-income populations would be expected.	
Human Health	3.7	The site was formerly occupied by buildings that were part of the DOE ORGDP that was used to enrich uranium, but the DOE has already razed the buildings and has begun remediation with the end use land use designation of “unrestricted industrial land use” as the basis for defining its remedial action objectives. The 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). Based on the calculated radiological doses, the NRC staff concludes that the radiological impacts to members of the public due to normal operation of Hermes 2 would be not significant. 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	3.8	Kairos would develop and implement a plan to manage wastes generated by Hermes 2. 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 Waste Management	3.9	A low quantity of uranium would be used during the 11-year operational period. TRISO fuel processes (including enrichment and fuel fabrication) would be bounded by Table S-3 in 10 CFR 51.51 (TN250), developed by the NRC to protect human health and the environment. Environmental impacts from the storage of spent TRISO fuel from Hermes 2 is bounded by the analysis in the Continued Storage Generic EIS. The estimated volume of LLRW is less than or comparable to that from an LWR, and the staff determined that there is adequate capacity at LLRW disposal sites that LLRW from Hermes 2 could be accepted. Onsite storage of spent TRISO fuel would have to meet the same regulatory requirements as currently licensed LWRs.	SMALL

Table 5-1 Summary of Environmental Impacts from Construction, Operation, and Decommissioning of Hermes 2 (Continued)

Resource Area	EA Section	Summary of Impact	Impact Level
Transportation of Radioactive Material	3.10	Transportation of radioactive fuels and wastes to and from Hermes 2 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. Based on the quantity of nuclear material and waste acceptable for disposal and employing certified packages in conforming NRC and Department of Transportation regulations, the NRC staff concludes that the transportation of fuel and waste impacts from operation and decommissioning of Hermes 2 would be not significant.	SMALL
Postulated Accidents	3.11	The NRC staff is conducting an independent review of the consequences of accidents and will document it in its Safety Evaluation (SE). To receive CPs, the Hermes 2 test reactors would have to meet 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 Chapter 4 of this draft EA, the NRC staff considered two alternatives to construction, operation, and decommissioning of Hermes 2 at the proposed site in Oak Ridge, Tennessee: (1) the no action alternative and (2) construction, operation, and decommissioning of Hermes 2 at an alternative site in Eagle Rock, Idaho.

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 Hermes 2 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. Section 4.4 presents and compares the staff's conclusions about the no action alternative, proposed action, and Eagle Rock alternative. The NRC 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 Hermes 2 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 Hermes 2 at the proposed Oak Ridge site would be confined to areas of previously disturbed soils within the footprint of former industrial development, building Hermes 2 at the Eagle Rock site would

involve disturbance of natural vegetation, possibly including shrub-steppe vegetation, and natural soils potentially containing 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 2. Of the two alternatives considered that would meet the purpose and need for Hermes 2, the proposed action would result in the fewest environmental impacts and is therefore the environmentally preferrable alternative. The proposed site at Oak Ridge, 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 EA.

5.3.1 Unavoidable Adverse Environmental Impacts

As noted in Chapter 3 of this EA, the NRC staff concluded that the environmental impacts from construction, operation, and decommissioning of Hermes 2 would be SMALL. They 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 be no adverse effects that could be offset or minimized through mitigation. The mitigation measures presented in Table 5.2 of the Hermes CP EIS (NRC 2023-TN9771) would apply to Hermes 2 as well. Table 5-2 is therefore incorporated by reference. These mitigation measures were developed for a reactor of similar size and design as the two Hermes 2 reactors, which are proposed for the same site. Although the adverse impacts for Hermes 2 could be somewhat greater than for Hermes because Hermes 2 is a two-reactor project, Chapter 3 of this EA still indicates that the direct, indirect, and cumulative impacts, including adverse impacts, would be minimal and suggests that the proposed mitigation would be similarly effective. The staff did not identify any additional relevant mitigation measures for Hermes 2 beyond those identified in Table 5.2 of the Hermes CP EIS (NRC 2023-TN9771).

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

Hermes 2 would result in short-term uses of environmental resources. “Short-term” is the time during which construction, operation, and decommissioning activities would take place. As indicated in Section 2.1 of the ER (Kairos 2023-TN9774), Kairos plans to begin construction as early as mid-2025 with an operational life of 11 years. The applicant indicates that decommissioning would commence after operations and estimates that it would begin in 2039. Applicants for licensing new reactors typically do not develop a decommissioning plan when applying for CPs and/or OLs.

As indicated in Section 3.1 of this EA, Hermes 2 would require 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 after decommissioning. Construction would require the temporary use of as much as 108 ac of additional previously used industrial land (temporary

disturbance of 138 ac), and decommissioning may again require the temporary use of all or part of the same 138 ac of land. The additional 108 ac land may be available for other uses beyond construction and decommissioning. As shown on Figure 2.1-3 of the applicant's PSAR (Kairos 2023-TN9774), the applicant has designated the entire 185 ac site as the exclusion area for Hermes 2, within which it would have to limit other land uses during operation to ensure that no significant hazards to public health and safety are possible (10 CFR Part 100-TN282). This is the same exclusion area that the applicant designated for Hermes. The Hermes 2 structures may be visible from a distance over the life of the project from nearby parks and residential areas, but they would be part of a cluster of existing and new industrial facilities (including but not limited to Hermes and Hermes 2) that are also part of the Heritage Center in the ETTP. Once the new facilities are razed as part of decommissioning, they would no longer be visible.

The discussion of the relationship between local short-term uses of the environment and maintenance and enhancement of long-term productivity presented for Hermes in Section 5.3.2 of the Hermes CP EIS (NRC 2023-TN9771) applies to Hermes 2 and is therefore incorporated by reference. Usage of resources such as water and labor and impacts related to air emissions, noise, ecological resources, cultural resources, radiological and nonradiological health and waste, and transportation would be minimal, although somewhat greater impacts could result because the Hermes 2 project involves two rather than just one test reactor.

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 EA. 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 project such as Hermes 2 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 2 also are irreversible.

The applicant states in Section 6.3 of the ER (Kairos 2023-TN9774) that the anticipated irreversible and irretrievable commitments of environmental resources used in construction and operation of Hermes 2 would be similar to those for Hermes, although would be larger because Hermes 2 consists of two reactors rather than only one. As noted in Section 5.3.3 of the Hermes CP EIS (NRC 2023-TN9771), incorporated by reference, building, operating, and decommissioning the Hermes 2 reactors at the proposed site in Oak Ridge, Tennessee, or at the alternative Eagle Rock site in Idaho would entail the irreversible and irretrievable commitment of energy, water, chemicals, fossil fuels, and other natural and human-made resources. Building Hermes 2 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-TN9774). These materials would be irretrievable unless Kairos recycles them during decommissioning (e.g., finds another facility to use such materials).

As noted for Hermes in Section 5.3.3 of the Hermes CP EIS (NRC 2023-TN9771), the reactor core of each Hermes 2 test reactor would be fueled during operation using 4 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 weight-percent. The availability of uranium ore and existing uranium stockpiles, including down-blending of highly

enriched uranium, in the United States and from foreign sources (i.e., Australia and Canada) that could be processed into fuel is sufficient to support the operation of the Hermes 2 test reactors (WNA 2022-TN7971). Thus, the irreversible and irretrievable commitment of the quantity of uranium (0.93 MT of uranium) to be used by Hermes 2 would have a negligible impact on U.S. uranium supplies. Over the anticipated 11-year operational period for Hermes 2, the applicant estimates in Section 2.6 of the ER (Kairos 2023-TN9774) that 776,000 used TRISO pebbles would be produced as waste. 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 EA, the water demands of Hermes 2 at either Oak Ridge or Eagle Rock 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 EA, a small number of birds and other wildlife could be killed or injured by collision with structures or collision with vehicles at either site. These losses would irreversibly affect wildlife populations in the surrounding area noticeably, and any affected populations can be expected to subsequently recover. As noted in Section 4.2.2 of this EA, building Hermes 2 at Eagle Rock 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 decommissioning, 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 EA, soils within all of the land subject to disturbance have been heavily disturbed by past industrial development and currently support only ruderal vegetation. Any disturbances to cultural resources at the Eagle Rock site could be irreversible.

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

Section 102(2)(H) (TN661) of NEPA 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 Hermes 2, the NRC staff did not identify any unresolved conflicts concerning alternative uses of available resources.

5.4 Recommendation

On the basis of this EA, and its determination that the environmental impacts would be SMALL for each potentially affected resource area, the NRC staff concludes that the proposed action would not have a significant effect on the quality of the human environment. Therefore, the staff has made a preliminary determination that it will not prepare an EIS and that a draft FONSI appears warranted. Further, 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 CPs to Kairos for Hermes 2. The NRC staff based its recommendation on the following:

- the NRC staff's review of Kairos's Hermes 2 ER (Kairos 2023-TN9774) and associated responses to requests for clarifying information
- the NRC staff's independent environmental review

The NRC's staff's recommendation is tentative. Before identifying a final recommendation, the staff also will consider comments received on this draft EA over a 30-day public comment period from Federal, State, local, and Tribal officials, and members of the public.

6 DRAFT FINDING OF NO SIGNIFICANT IMPACT

The proposed action before the NRC is whether to issue CPs (one for each unit) to Kairos to authorize construction of the two proposed reactors (units) making up the Hermes 2 project. The NRC has conducted an environmental review of a request for NRC issuance of CPs for the Hermes 2 project and prepared an EA. This draft FONSI incorporates by reference the EA discussed in Section 1 through Section 5 of this document. On the basis of the EA, and its determination that the environmental impacts would be SMALL for each potentially affected resource area, the NRC staff has preliminarily determined that the proposed action would not have a significant effect on the quality of the human environment. Accordingly, the NRC staff has made a preliminary determination that preparation of an EIS is not required for the proposed action and that a FONSI appears warranted.

This finding and the related environmental documents referenced throughout the EA are available for public inspection as discussed in the EA. The NRC staff's determination is tentative. Before making a final determination, the NRC staff also will consider comments received on the draft EA and draft FONSI over a 30-day public comment period from Federal, State, local, and Tribal officials, and members of the public. Once NRC makes a final determination, it will publish the final EA and FONSI or proceed to prepare an EIS.

7 REFERENCES

10 CFR Part 20. *Code of Federal Regulations*, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation." TN283.

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.

10 CFR Part 100. *Code of Federal Regulations*, Title 10, *Energy*, Part 100, "Reactor Site Criteria." TN282.

29 CFR Part 1910. *Code of Federal Regulations*, Title 29, *Labor*, Part 1910, "Occupational Safety and Health Standards." TN654.

36 CFR Part 60. *Code of Federal Regulations*, Title 36, *Parks, Forests, and Public Property*, Part 60, "National Register of Historic Places." TN1682.

36 CFR Part 800. *Code of Federal Regulations*, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties." TN513.

40 CFR Part 93. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 93, "Determining Conformity of Federal Actions to State or Federal Implementation Plans." TN2495.

40 CFR Part 1508. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 1508, "Definitions." TN428.

72 FR 57416. October 9, 2007. "Limited Work Authorizations for Nuclear Power Plants**."** *Federal Register,* Nuclear Regulatory Commission. TN260.

88 FR 63632. September 15, 2023. "Kairos Power, LLC; Hermes 2." *Federal Register*, Nuclear Regulatory Commission. TN9776.

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

AECOM. 2015. *Clinch River Site Traffic Assessment.* Final Technical Report, Greenville, South Carolina. ADAMS Accession No. ML17334A043. TN5000.

Atomic Energy Act of 1954. 42 U.S.C. § 2011 et seq. Public Law 112-239, as amended. TN663.

Cefic and ECTA (European Chemical Industry Council and European Chemical Transport Association). 2011. *Guidelines for Measuring and Managing CO2 Emission from Freight Transport Operations*. Brussels, Belgium. Accessed March 21, 2021, at https://www.ecta.com/resources/Documents/Best%20Practices%20Guidelines/guideline_for_measuring_and_managing_co2.pdf. TN6966.

CEQ (Council on Environmental Quality). 2016. Memorandum from C. Goldfuss to Heads of Federal Departments and Agencies, dated August 1, 2016, regarding "Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews." Washington, D.C. ADAMS Accession No. ML16266A244. TN4732.

Chapman, E.G., J.P. Rishel, J.M. Niemeyer, K.A. Cort, and S.E. Gulley. 2012. *Assumptions, Calculations, and Recommendations Related to a Proposed Guidance Update on Greenhouse Gases and Climate Change*. PNNL-21494, Pacific Northwest National Laboratory, Richland, Washington. ADAMS Accession No. ML12310A212. TN2644.

City of Oak Ridge. 2022. *Annual Comprehensive Financial Report City of Oak Ridge, Tennessee, For Fiscal Year Ended June 30, 2022*. Oak Ridge, Tennessee. Accessed March 1, 2024, at https://www.oakridgetn.gov/DocumentCenter/View/474/2022-City-of-Oak-Ridge-Annual-Comprehensive-Financial-Report-PDF. TN9789.

Clean Air Act. 42 U.S.C. § 7401 *et seq*. TN1141.

DOE (U.S. Department of Energy). 2011. *Environmental Assessment, Transfer of Land and Facilities within the East Tennessee Technology Park and Surrounding Area, Oak Ridge, Tennessee*. DOE/EA-1640, Final Environmental Assessment and Finding of No Significant Impact, Oak Ridge, Tennessee. ADAMS Accession No. ML18019A919. TN4888.

DOE (U.S. Department of Energy). 2015. *Covenant Deferral Request for the Proposed Title Transfer of the Former K-33 Area at the East Tennessee Technology Park, Oak Ridge, Tennessee, Final-Concurred*. DOE/OR/01-2666, Washington, D.C. ADAMS Accession No. ML22071A002. TN7964.

DOE (U.S. Department of Energy). 2016. *Environmental Assessment Property Transfer to Develop a General Aviation Airport at the East Tennessee Technology Park Heritage Center, Oak Ridge, Tennessee*. Oak Ridge, Tennessee. ADAMS Accession No. ML22123A271. TN7903.

DOE (U.S. Department of Energy). 2017. *Oak Ridge Reservation Annual Site Environmental Report 2016*. DOE/ORO/251, Oak Ridge, Tennessee. ADAMS Accession No. ML18019B167. TN5081.

DOE (U.S. Department of Energy). 2017. State of Tennessee, County of Roane, Quitclaim Deed. BK/PG: 1627/57-72, 17006727. Oak Ridge, Tennessee. ADAMS Accession No. ML22059A771. TN8206.

DOE (U.S. Department of Energy). 2017. State of Tennessee, County of Roane, Quitclaim Deed. BK/PG: 1627/73-89, 17006728. Oak Ridge, Tennessee. ADAMS Accession No. ML22060A114. TN8207.

DOE (U.S. Department of Energy). 2021. *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*. DOE/OR/01-2749&D1/A2/R2, Washington, D.C. ADAMS Accession No. ML22106A003. TN7913.

DOE (U.S. Department of Energy). 2021. *Oak Ridge Reservation Annual Site Environmental Report 2020*. DOE/CSC-2514, Oak Ridge, Tennessee. September. ADAMS Accession No. ML22106A004. Available at https://doeic.science.energy.gov/aser/aser2020/REPORT%20FULL%202020%20ASER%20FINAL.pdf. TN7915.

DOE (U.S. Department of Energy). 2022. "East Tennessee Technology Park." Available at https://www.energy.gov/orem/cleanup-sites/east-tennessee-technology-park. TN7897.

DOE (U.S. Department of Energy). 2023. "Centrus Produces Nation's First Amounts of HALEU." Washington, D.C. Accessed March 1, 2024, at https://www.energy.gov/ne/articles/centrus-produces-nations-first-amounts-haleu#:~:text=Advanced%20centrifuge%20cascade%20in%20Piketon,by%20many%20advanced%20reactor%20technologies. TN9791.

DOE (U.S. Department of Energy). 2023. *Record of Decision for Groundwater in the K-31/K-33 Area at the East Tennessee Technology Park,* Oak Ridge, Tennessee. DOE/OR/01-2950&D1, Washington, D.C. TN9801.

DOE (U.S. Department of Energy). 2024. "DOE/EIS-0559: Draft Environmental Impact Statement, High-Assay Low-Enriched Uranium (HALEU) Availability Program Activities in Support of Commercial Production of HALEU Fuel." DOE/EIS-0559, Washington, D.C. Accessed March 24, 2024, at https://www.energy.gov/nepa/articles/doeeis-0559-draft-environmental-impact-statement. TN9826.

DOE (U.S. Department of Energy). 2024. "HALEU Availability Program." Washington, D.C. Accessed March 1, 2024, at https://www.energy.gov/ne/haleu-availability-program. TN9790.

DOI (U.S. Department of the Interior). 2022. Memorandum from K. Kirby, NPS, to T. Dozier, NRC, dated April 12, 2022, regarding "NPS Scoping Comments on Kairos Test Reactor." Denver, Colorado. ADAMS Accession No. ML22169A009. TN7957.

Endangered Species Act of 1973. 16 U.S.C. § 1531 *et seq.* TN1010.

EPA (U.S. Environmental Protection Agency). 2012. "Clean Energy: Calculations and References." Washington, D.C. ADAMS Accession No. ML12292A648. TN2643.

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.

EPA (U.S. Environmental Protection Agency). 2023. “Emissions & Generation Resource Integrated Database (eGRID).” Washington, D.C. Accessed October 4, 2023, at https://www.epa.gov/egrid. TN9079.

EPA (U.S. Environmental Protection Agency). 2023. “Greenhouse Gases Equivalencies Calculator - Calculations and References.” Washington, D.C. Accessed October 4, 2023, at https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references. TN9080.

EPRI (Electric Power Research Institute). 2015. *Advanced Nuclear Technology: Site Selection and Evaluation Criteria for New Nuclear Power Generation Facilities (Siting Guide).* Palo Alto, California. TN5285.

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

Fiscal Responsibility Act of 2023. 2 U.S.C. § 900 Note. Public Law 118-5. TN9775.

FWS (U.S. Fish and Wildlife Service). 2023. “Species Profile for Whooping Crane (Grus americana).” ECOS-Environmental Conservation Online System, Fort Collins, Colorado. Accessed September 6, 2023, at https://ecos.fws.gov/ecp/species/758. TN8854.

GSA (U.S. General Services Administration). 2023. “HALEU Deconversion Services RFP.” Washington, D.C. Accessed March 1, 2024, at https://sam.gov/opp/bfa371842550469bb22d718d5a06b715/view. TN9792.

GSA (U.S. General Services Administration). 2023. “HALEU Enrichment Acquisition RFP.” Washington, D.C. Accessed March 1, 2024, at https://sam.gov/opp/11ff0842638849558f2ae917975b1f28/view. TN9793.

IPCC (Intergovernmental Panel on Climate Change). 2012. *Renewable Energy Sources and Climate Change Mitigation—Special Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom. TN2648.

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. “Kairos Power Signs Agreement to Produce Fuel for Hermes at Los Alamos National Laboratory.” Alameda, California. Accessed March 5, 2024, at https://kairospower.com/external_updates/kairos-power-signs-agreement-to-produce-fuel-for-hermes-at-los-alamos-national-laboratory/. TN9796.

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.

Kairos Power, LLC. 2022. Letter from P. Hastings, Vice President, to NRC Document Control Desk, dated April 27, 2022, regarding “Kairos Power LLC Transmittal of Changes to Hermes Environmental Report Resulting from NRC Environmental Review Audit.” KP-NRC-2204-011, Alameda, California. ADAMS Accession No. ML22117A218. TN7912.

Kairos Power, LLC. 2023. Letter from P. Hastings, Vice President, Regulatory Affairs and Quality, to NRC Document Control Desk, dated July 14, 2023, regarding “Kairos Power LLC, Submittal of the Construction Permit Application for the Hermes 2 Kairos Power Fluoride Salt-Cooled, High Temperature Non-Power Reactor.” KP-NRC-2307-002, Alameda, California. ADAMS Accession No. ML23195A121. TN9774.

Kairos Power, LLC. 2023. Letter from P. Hastings, Vice President, Regulatory Affairs and Quality, to NRC Document Control Desk, dated March 30, 2023, regarding “Kairos Power LLC, Submittal of the Environmental Report for the Kairos Power Fluoride Salt-Cooled, High Temperature Non-Power Reactor (Hermes), Revision 1.” KP-NRC-2303-003, Alameda, California. ADAMS Accession No. ML23089A386. TN8172.

Kairos Power, LLC. 2023. Letter from P. Hastings, Vice President, Regulatory Affairs and Quality to NRC Document Control Desk, dated May 31, 2023, regarding “Kairos Power LLC, Submittal of the Preliminary Safety Analysis Report for the Kairos Power Fluoride Salt-Cooled, High Temperature Non-Power Reactor (Hermes), Revision 3.” KP-NRC-2305-002, Alameda, California. ADAMS Accession No. ML23151A743. TN8398.

Kairos Power, LLC. 2024. Letter from P. Hastings, Vice President, Regulatory Affairs and Quality, to NRC Document Control Desk, dated March 4, 2024, regarding, “Kairos Power LLC Transmittal of Reponses to NRC Requests for Confirmatory Information for the Review of the Hermes 2 Environmental Report.” Alameda, California. ADAMS Accession No. ML24065A100. TN9866.

Napier, B.A. 2020. *Non-LWR Fuel Cycle Environmental Data*. PNNL-29367, Revision 2, Richland, Washington. ADAMS Accession No. ML20267A217. TN6443.

National Environmental Policy Act of 1969 (NEPA), as amended. 42 U.S.C. § 4321 *et seq.* TN661.

National Historic Preservation Act. 54 U.S.C. § 300101 *et seq*. TN4157.

National Research Council. 2010. *The Power of Renewables: Opportunities and Challenges for China and the United States*. The National Academies Press, Washington, D.C. Available at https://doi.org/10.17226/12987. TN9827.

NRC (U.S. Nuclear Regulatory Commission). 1975. *Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants, Supplement 1.* NUREG–75/038, Washington, D.C. ADAMS Accession No. ML14091A176. TN216.

NRC (U.S. Nuclear Regulatory Commission). 1991. *Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors (Generic Letter 89-01, Supplement No. 1).* NUREG-1301, Washington, D.C. ADAMS Accession No. ML091050061. TN5758.

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

NRC (U.S. Nuclear Regulatory Commission). 2002. *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Supplement 1: Regarding the Decommissioning of Nuclear Power Reactors, Main Report - Final Report*. NUREG-0586, Supplement 1, Volume 1 and 2, Washington, D.C. ADAMS Accession Nos. ML023470304, ML023470323, ML023500187, ML023500211, ML023500223. TN7254.

NRC (U.S. Nuclear Regulatory Commission). 2006. *Consolidated Decommissioning Guidance: Decommissioning Process for Materials Licensee*s. NUREG-1757, Volume 1, Revision 2, Washington, D.C. ADAMS Accession No. ML063000243. TN6599.

NRC (U.S. Nuclear Regulatory Commission). 2009. "Memorandum and Order in the Matter of Duke Energy Carolinas, LLC (Combined License Application for William States Lee III Nuclear Station, Units 1 and 2) and Tennessee Valley Authority (Bellefonte Nuclear Power Plant, Units 3 and 4)." CLI-09-21, Rockville, Maryland. ADAMS Accession No. ML093070690. TN6406.

NRC (U.S. Nuclear Regulatory Commission). 2012. *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*. Washington, D.C. ADAMS Accession No. ML12156A069. TN5527.

NRC (U.S. Nuclear Regulatory Commission). 2012. *Final Interim Staff Guidance Augmenting NUREG–1537, 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*. Washington, D.C. ADAMS Accession No. ML12156A075. TN5528.

NRC (U.S. Nuclear Regulatory Commission). 2013. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Revision 1, Washington, D.C. ADAMS Package Accession No. ML13107A023. TN2654.

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.

NRC (U.S. Nuclear Regulatory Commission). 2014. *Interim Staff Guidance on Environmental Issues Associated with New Reactors.* COL/ESP–ISG–026, Washington, D.C. ADAMS Accession No. ML14092A402. TN3767.

NRC (U.S. Nuclear Regulatory Commission). 2014. *Spent Fuel Transportation Risk Assessment, Final Report*. NUREG–2125, Washington, D.C. ADAMS Accession No. ML14031A323. TN3231.

NRC (U.S. Nuclear Regulatory Commission). 2018. *Preparation of Environmental Reports for Nuclear Power Stations*. Regulatory Guide 4.2, Revision 3, Washington, D.C. ADAMS Accession No. ML18071A400. TN6006.

NRC (U.S. Nuclear Regulatory Commission). 2019. *Environmental Impact Statement for an Early Site Permit (ESP) at the Clinch River Nuclear Site*. NUREG-2226, Washington, D.C. ADAMS Package Accession No. ML19087A266. TN6136.

NRC (U.S. Nuclear Regulatory Commission). 2022. C*onsolidated Decommissioning Guidance, Characterization, Survey, and Determination of Radiological Criteria, Final Report*. NUREG-1757, Volume 2, Revision 2, Washington, D.C. July. ADAMS Accession No. ML22194A859. TN8031.

NRC (U.S. Nuclear Regulatory Commission). 2023. Letter from M. Orenak, Project Manager Advanced Reactor Licensing Branch 1 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 September 11, 2023, regarding “Acceptance for Docketing of the Hermes 2 Test Reactor Facility Construction Permit Application Submitted by Kairos Power LLC.” Washington, D.C. ADAMS Accession No. ML23233A167. TN9777.

NRC (U.S. Nuclear Regulatory Commission). 2023. Email from T. Dozier, Project Manager, to P. Doub and K. Erwin, dated March 5, 2023, regarding “Information related to Government to Government Consultations - Section 106 of the National Historic Preservation Act.” Washington, D.C. ADAMS Accession No. ML23064A002. TN8208.

NRC (U.S. Nuclear Regulatory Commission). 2023. *Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor, Final Report*. NUREG-2263, Washington, D.C. ADAMS Accession No. ML23214A269. TN9771.

NRC (U.S. Nuclear Regulatory Commission). 2024. Letter from J.P. Doub, Environmental Project Management Branch 3 Division of Rulemaking, Environmental, and Financial Support Office of Nuclear Material Safety and Safeguards, to E.P. McIntyre, Jr., Executive Director and State Historic Preservation Officer Tennessee Historical Commission State Historic Preservation Office, dated January 31, 2024, regarding "Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Number: 50-611 AND 50-612)." Washington, D.C. ADAMS Accession No. ML24008A148. TN9778.

NRC (U.S. Nuclear Regulatory Commission). 2024. Letter from J.P. Doub, Environmental Project Management Branch 3 Division of Rulemaking, Environmental, and Financial Support Office of Nuclear Material Safety and Safeguards, to R. Nelson, Executive Director Advisory Council on Historic Preservation, dated January 31, 2024, regarding "Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Number: 50-611 AND 50-612)." Washington, D.C. ADAMS Accession No. ML24008A099. TN9779.

NRC (U.S. Nuclear Regulatory Commission). 2024. Letter from J.P. Doub, Environmental Project Management Branch 3 Division of Rulemaking, Environmental, and Financial Support Office of Nuclear Material Safety and Safeguards, to N.S. Nicholas, Superintendent Manhattan Project National Historical Power, dated January 31, 2024, regarding "Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Number: 50-611 AND 50-612)." Washington, D.C. ADAMS Accession No. ML24009A174 . TN9780.

NRC (U.S. Nuclear Regulatory Commission). 2024. Letter from J.P. Doub, Environmental Project Management Branch 3 Division of Rulemaking, Environmental, and Financial Support Office of Nuclear Material Safety and Safeguards, to Honorable John Raymond Johnson, Governor Absentee Shawnee Tribe; Honorable Ben Barnes, Chief Shawnee Tribe; Honorable Chuck Hoskin, Jr., Principal Chief Cherokee Nation; Honorable David Hill, Principal Chief Muscogee Nation; Honorable Glenna J. Wallace, Chief Eastern Shawnee Tribe of Oklahoma; Honorable Joe Bunch, Chief United Keetoowah Band of Cherokee Indians; Honorable Jonathan Cernek, Chairman Coushatta Tribe of Louisiana; Honorable Lewis J. Johnson, Chief Seminole Nation of Oklahoma; Honorable Marcellus W. Osceola, Jr., Chairman Seminole Tribe of Florida; Honorable Michell Hicks, Principal Chief Eastern Band of Cherokee Indians; Honorable Rick Sylestine, Chairman Alabama-Coushatta Tribe of Texas; Honorable Ryan K. Morrow, Town King Thlopthlocco Tribal Town; Honorable Stephanie A. Bryan, Chairwoman Poarch Band of Creek Indians; Honorable Stephanie Yahola, Mekko Kialegee Tribal Town; Honorable Wilson Yargee, Chief Alabama-Quassarte Tribal Town; and Libby Rogers, Principal Chief Jena Band of Choctaw Indians, dated February 2, 2024, regarding "Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Number: 50-611 AND 50-612)." Washington, D.C. ADAMS Accession No. ML24009A107. TN9781.

NRC (U.S. Nuclear Regulatory Commission). 2024. *Summary Report on the Environmental Audit of Kairos Hermes 2 Test Reactor Construction Permit Application*. Washington, D.C. ADAMS Accession No. ML24100A042. TN9899.

ORR (Oak Ridge Reservation). 2023. *Oak Ridge Reservation Annual Site Environmental Report 2022*. DOE-SC-OSO/RM-2023-01, U.S. Department of Energy, Oak Ridge Tennessee. Available at https://doeic.science.energy.gov/aser/aser2022/index.html. TN9739.

Packer, D.B, C.A. Zetlin, and J.J. Vitaliano. 2003. *Essential Fish Habitat Source Document: Clearnose Skate,* Raja eglanteria*, Life History and Habitat Characteristics*. NOAA Technical Memorandum NMFS-NE-174, Woods Hole, Massachusetts. ADAMS Accession No. ML072080214. TN2822.

RCT (Roane County Tennessee). 2020. *Budget, Fiscal Year 2020-2021, Roane County, Tennessee*. Kingston, Tennessee. Accessed March 1, 2024, at https://roanecountytn.gov/wp-content/uploads/2023/06/Budget-Book-2021-Final.pdf. TN9788.

RCT (Roane County Tennessee). 2024. "Assessor of Property." Kingston, Tennessee. Accessed February 29, 2024, at https://roanecountytn.gov/assessor-of-property/. TN9785.

Resource Conservation and Recovery Act of 1976. 42 U.S.C § 6901 *et seq*. Public Law 94-580, 90 Stat. 2795. TN1281.

T.C.A. § 11-6-107 et seq. Tennessee Code Annotated, Title 11, Natural Resources and Recreation, Chapter 6, "Archaeology." TN7938.

TRB (Transportation Research Board). 2000. *Highway Capacity Manual*. HCM2000, Washington, D.C. Available at: https://sjnavarro.files.wordpress.com/2008/08/highway_capacital_manual.pdf. TN9065.

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.

USCB (U.S. Census Bureau). 2020. "Decennial Census, Urban and Rural, Table P2, DEC 118th Congressional District Summary File, 2020. Loudon, Morgan, Knox, Anderson, and Roane, Counties, Tennessee." Washington, D.C. Accessed February 29, 2024, at https://data.census.gov/table/DECENNIALCD1182020.P2?q=P2&g=040XX00US47_050XX00US47001,47093,47105,47129,47145. TN9782.

USCB (U.S. Census Bureau). 2022. "American Community Survey, Table DP03, ACS 5-Year Estimates Data Profiles, 2022, Loudon, Morgan, Knox, Anderson, and Roane, Counties, Tennessee." Washington, D.C. Accessed February 29, 2024, at https://data.census.gov/table/ACSDP5Y2021.DP03?q=DP03&g=040XX00US47_050XX00US47001,47093,47105,47129,47145. TN9783.

USCB (U.S. Census Bureau). 2022. “American Community Survey, Table DP04, ACS 5-Year Estimates Data Profiles, Selected Housing Characteristics, 2022, Loudon, Morgan, Knox, Anderson, and Roane, Counties, Tennessee.” Washington, D.C. Accessed on February 29, 2024, at https://data.census.gov/table/ACSDP5Y2021.DP04?q=DP04&g=040XX00US47_050XX00US47001,47093,47105,47129,47145. TN9784.

USGCRP (U.S. Global Change Research Program). 2014. *Climate Change Impacts in the United States: The Third National Climate Assessment*. J.M. Melillo, T.C. Richmond, and G.W. Yohe (eds.). U.S. Government Printing Office, Washington, D.C. ADAMS Accession No. ML14129A233. TN3472.

USGCRP (U.S. Global Change Research Program). 2017. *Climate Science Special Report: Fourth National Climate Assessment*. Volume I. Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.). Washington, D.C. ADAMS Accession No. ML19008A410. doi: 10.7930/J0J964J6. TN5848.

USGCRP (U.S. Global Change Research Program). 2018. *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment*. Volume II. D.R. Reidmiller, C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.). Washington, D.C. ADAMS Accession No. ML19008A414. doi: 10.7930/NCA4.2018. TN5847.

USGCRP (U.S. Global Change Research Program). 2023. *The Fifth National Climate Assessment*. A.R. Crimmins, C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. Washington, D.C. Available at https://doi.org/10.7930/NCA5.2023. TN9762.

USGCRP (U.S. Global Change Research Program). 2024. “Atlas of the 5th National Climate Assessment.” Washington, D.C. Accessed March 5, 2024, at https://atlas.globalchange.gov/. TN9798.

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.

WNA (World Nuclear Association). 2022. “Supply of Uranium.” London, United Kingdom. Available, at https://world-nuclear.org/information-library/nuclear-fuel-cycle/uranium-resources/supply-of-uranium.aspx. TN7971.

APPENDIX A

LIST OF PREPARERS

Members of the U.S. Nuclear Regulatory Commission; Office of Nuclear Material Safety and Safeguards; Division of Rulemaking, Environmental, and Financial Support; Environmental Center of Expertise prepared this draft environmental assessment. Staff from other U.S. Nuclear Regulatory Commission branches and from Pacific Northwest National Laboratory provided supplemental technical support and technical editing/production. Table A-1 below identifies each contributor's name and affiliation, summary of education and experience, and description of function or expertise contributed to the document.

Table A-1 List of Preparers

Name & Affiliation	Education/Experience	Function or Expertise
Anderson, David PNNL	MS Forest Resources BS Forest Resources 31 years of relevant experience	Socioeconomics Environmental Justice
Barnhurst, Daniel NRC	MS Geology BS Environmental Geology 17 years of relevant experience	Branch Chief (February 2024-Present)
Carlon, Teresa PNNL	BS Information Technology 26 years of relevant experience	Reference Coordinator
Counts, Cary PNNL	MS Environmental Engineering BS Ceramic Engineering 50 years of relevant experience	Technical Editor
Doub, Peyton NRC	MS Plant Physiology BS Plant Sciences (Botany) Professional Wetland Scientist Certified Environmental Professional Duke NEPA Certificate 36 years of relevant experience	Project Manager Acting Branch Chief (Nov 2023-January 2024) Introduction Proposed Action Land Use and Visual Resources Biological Evaluation Cumulative Impacts Alternatives Conclusions Peer Review: Ecology
Dozier, Tami NRC	MS Civil Engineering/Water Resources BS Civil Engineering Duke NEPA Certificate 23 years of relevant experience	Project Management Support
Erwin, Kenneth NRC	MS Nuclear Engineering BS Nuclear Engineering 21 years of relevant experience	Branch Chief (through Oct 2023)
Ghosh, Saikat PNNL	PhD Chemical Engineering MS Environmental Engineering 15 years of relevant experience	Air Emissions Green House Gas Emissions
Giacinto, Joseph NRC	MS Hydrology BS Geology (Geophysics) Professional Geologist Duke NEPA Certificate 26 years of relevant experience	Peer Review: Geology Water Resources

Table A-1 List of Preparers (Continued)

Name & Affiliation	Education/Experience	Function or Expertise
Glowacki, Brian NRC	BS Environmental Engineering 3 years of relevant experience	Geology Water Resources Ecology Nonradiological Waste Nonradiological Human Health
Goldstein, Beau NRC	MA Anthropology BA Anthropology Registered Professional Archaeologist 25 years of relevant experience	Cultural Resources
Kautzky, Kevin PNNL	BS English 21 years of relevant experience	PNNL Deputy Team Lead References
McFarland, Douglas PNNL	MS Cultural Resource Management BS Anthropology Registered Professional Archaeologist 26 years of relevant experience	Cultural Resources
Meyer, Philip PNNL	PhD Civil Engineering MS Civil Engineering BS Physics 25 years of relevant experience	Climate Change
Montgomery, Sadie PNNL	BS Mathematics 10 years of relevant experience	Comment Database
Nagel, Madelyn NRC	BA Environmental Science & Policy BA Political Science 2 years of relevant experience	Air Quality Climate Change
Palmrose, Donald NRC	PhD Nuclear Engineering MS Nuclear Engineering BS Nuclear Engineering Duke NEPA Certificate 38 years of relevant experience	Peer Review: Radiological Health Postulated Accidents Uranium Fuel Cycle Radiological Waste Transportation of Rad. Material
Richmond, Mary NRC	BA Biological Sciences MS Environmental Engineering 35 years of relevant experience	Project Management Support Peer Review: Introduction Proposed Action Land Use and Visual Resources Cumulative Impacts
Wessel, Caitlin PNNL	PhD Marine Science MS Coastal, Marine, and Wetland Science BS Biology 11 years of relevant experience	PNNL Team Lead
Willingham, Laura NRC	BS Environmental Sciences 18 years of relevant experience	Peer Review: Air Quality Climate Change
Zeng, Lin PNNL	PhD Environmental Science & Engineering BE Civil Engineering 10 years of relevant experience	Socioeconomics Environmental Justice

Key: BA = Bachelor of Arts; BE = Bachelor of Engineering; BS = Bachelor of Science; MA = Master of Arts; MS = Master of Science; NEPA = National Environmental Policy Act; NRC = U.S. Nuclear Regulatory Commission; PhD = Doctor of Philosophy; PNNL = Pacific Northwest National Laboratory.

APPENDIX B

AGENCIES, ORGANIZATIONS, TRIBES, AND INDIVIDUALS CONTACTED

The U.S. Nuclear Regulatory Commission (NRC) is providing electronic copies of the draft Kairos Hermes 2 Test Reactor Construction Permit Environmental Assessment to the agencies, organizations, Tribes, and individuals listed n Table B-1. The NRC will also send copies to citizens that provide comments and contact information during the 30-day comment period following publication of the draft environmental assessment. 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 Assessment Will Be 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 rnelson@achp.gov
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
Daniel Elbert	U.S. Fish and Wildlife Service	U.S. Fish and Wildlife Service Tennessee Ecological Services Field Office 446 Neal Street Cookeville, TN 38501-4027 daniel_elbert@fws.gov
Kris Kirby	National Park Service: Manhattan Project National Historical Park	12795 West Alameda Parkway P.O. Box 25287 Denver, CO 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 Mariza.Gonzalez@tn.gov
Jennifer Tribble	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 Jennifer.Tribble@tn.gov
Dave Adler	U.S. Department of Energy	david.adler@orem.doe.gov

Table B-1 List of Agencies, Organizations, Tribes, and Persons to Whom Copies of this Environmental Assessment Will Be Sent (Continued)

Name	Affiliation	Contact Information
	Tribes	
John Raymond Johnson, Governor	Absentee Shawnee Tribe	2025 S. Gordon Cooper Drive Shawnee, OK 74801
Rick Sylestine, Chairman	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
Michell Hicks, 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
Stephanie Yahola, Mekko	Kialegee Tribal Town	P.O. Box 332 Wetumka, OK 74883
David Hill, Principal Chief	Muscogee (Creek) Nation	P.O. Box 580 Okmulgee, OK 74447
Lewis J. Johnson, 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 74464
Jonathan Cernek, Chairman	Coushatta Tribe of Louisiana	P.O. Box 818 Elton, LA 70532
Libby Rogers, Principal Chief	Jena Band of Choctaw Indians	P.O. Box 14 Jena, LA 71432
Stephanie A. Bryan, Chairwoman	Poarch Band of Creek Indians	5811 Jack Springs Road Atmore, AL 36502
	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
Peter Hastings	Kairos Power, LLC	hastings@kairospower.com
Heather Hoff	Mothers for Nuclear	heather@mothersfornuclear.org
Martin O'Neill	Nuclear Energy Institute	mjo@nei.org

Table B-1 List of Agencies, Organizations, Tribes, and Persons to Whom Copies of this Environmental Assessment Will Be Sent (Continued)

Name	Affiliation	Contact Information
Kati Austgen	Nuclear Energy Institute	kra@nei.org
Alan Ahn	Third Way	aahn@thirdway.org
D.A. Smith	D.A. Smith Nuclear Matters dasmith@apocworldwide.com	D.A. Smith Nuclear Matters dasmith@apocworldwide.com
Danielle Emche	Nuclear Innovation Alliance demche@nuclearinnovationalliance.org	Danielle Emche Nuclear Innovation Alliance demche@nuclearinnovationalliance.org
Natalie Houghtalen	Clear Path	houghtalen@clearpath.org
Christine Michaels	Oak Ridge Chamber of Commerce	Oak Ridge Chamber of Commerce 1400 Oak Ridge Turnpike Oak Ridge, TN 37830 president@orcc.org
Wade Creswell	Wade Creswell Roane County Executive	200 East Race Street, Suite 1 P.O. Box 643 Kingston, TN 37763 wade.creswell@roanecountytn.gov
Brad Parish	Advanced Technologies & Laboratories	bparish@atlintl.com
Rani Franovich	Nuclear ROSE Consulting, LLC	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 2 Test Reactors. 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.

July 14, 2023	Letter to NRC from Peter Hastings, Kairos Power, submitting the Construction Permit Application for Hermes 2 (Accession No. ML23195A122)
September 11, 2023	Letter from NRC to Peter Hastings, Kairos Power, Acceptance for Docketing of the Hermes 2 Test Reactor Facility Construction Permit Application Submitted by Kairos Power LLC (Accession No. ML23233A167)
September 15, 2023	Federal Register Notice – Acceptance for docketing of the Kairos Power LLC Hermes 2 Test Reactor Construction Permit Application (88 FR 63632) (Accession Number ML23237B465)
October 11, 2023	Letter from NRC to Peter Hastings, Kairos Power, Hermes 2 Construction Permit Application Review Schedule and Resource Estimate (Accession Number ML23269A176)
November 22, 2023	Federal Register Notice – Kairos Power LLC Hermes 2 Construction Permit Application; Opportunity to Request a Hearing and Petition for Leave to Intervene (88 FR 81439) (Accession Number ML23311A195)
January 5, 2024	Kairos Power, LLC-Hermes 2-Environmental Report Audit Plan (Accession Number ML23353A069)
January 31, 2024	Letter from NRC to Reid Nelson, Advisory Council on Historic Preservation, Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Accession No. ML24008A099)
January 31, 2024	Letter from NRC to E. Patrick McIntyre, Executive Director and State Historic Preservation Officer, Tennessee Historical Commission, Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Accession No. ML24008A148)

January 31, 2024	Letter from NRC to Niki S. Nicholas, Superintendent, Manhattan Project National Historical Park, Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Numbers 50-611 and 50-612) (ML24009A179)
February 2, 2024	Letter from NRC to Hon. Wilson Yargee, Chief, Alabama-Quassarte Tribal Town, Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Numbers 50-611 and 50-612) (Accession No. ML24032A199)
February 2, 2024	Letter from NRC to Hon. Ban Barnes, Shawnee Tribe, Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Numbers 50-611 and 50-612) (Accession No. ML24032A186)
February 2, 2024	Letter from NRC to Hon. Chuck Hoskin, Jr., Principal Chief, Cherokee Nation, Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Numbers 50-611 and 50-612) (Accession No. ML24032A187) (Accession No. ML24032A187)
February 2, 2024	Letter from NRC to David Hill of Muscogee Nation, Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Numbers 50-611 and 50-612) (Accession No. ML24032A188)
February 2, 2024	Letter from NRC to Hon. Glenna J. Wallace, Chief, Eastern Shawnee Tribe of Oklahoma, Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Numbers 50-611 and 50-612) (Accession No. ML24032A189)
February 2, 2024	Letter from NRC to Hon. Joe Bunch, Chief, United Keetoowah Band of Cherokee Indians, Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Numbers 50-611 and 50-612) (Accession No. ML24032A190)
February 2, 2024	Letter from NRC to Hon. John Raymond Johnson, Governor, Absentee Shawnee Tribe, Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Numbers 50-611 and 50-612) (Accession No. ML24009A112)

February 2, 2024	Letter from NRC to Hon. Jonathan Cernek, Chairman, Coushatta Tribe of Louisiana, Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Numbers 50-611 and 50-612) (Accession No. ML24032A191)
February 2, 2024	Letter from NRC to Hon. Lewis J. Johnson, Chief, Seminole Nation of Oklahoma, Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Numbers 50-611 and 50-612) (Accession No. ML24032A192)
February 2, 2024	Letter from NRC to Libby Rogers, Principal Chief, Jena Band of Choctaw Indians, Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Numbers 50-611 and 50-612) (Accession No. ML24032A200)
February 2, 2024	Letter from NRC to Hon. Marcellus W. Osceola, Jr., Chairman, Seminole Tribe of Florida, Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Numbers 50-611 and 50-612) (Accession No. ML24032A193)
February 2, 2024	Letter from NRC to Hon. Michell Hicks, Principal Chief, Eastern Band of Cherokee Indians, Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Numbers 50-611 and 50-612) (Accession No. ML24032A194)
February 2, 2024	Letter from NRC to Hon. Rick Sylestine, Chairman, Alabama-Coushatta Tribe of Texas, Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Numbers 50-611 and 50-612) (Accession No. ML24032A195)
February 2, 2024	Letter from NRC to Hon. Ryan K. Morrow, Town King, Thlopthlocco Tribal Town, Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Numbers 50-611 and 50-612) (Accession No. ML24032A196)
February 2, 2024	Letter from NRC to Hon. Stephanie A. Bryan, Chairwoman, Poarch Band of Creek Indians, Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Numbers 50-611 and 50-612) (Accession No. ML24032A197)

February 2, 2024	Letter from NRC to Stephanie Yahola, Mekko, Kialegee Tribal Town, Request to Initiate Section 106 Consultation for Kairos Power Proposed Non-Power Test Reactors (Hermes 2) Construction Permit Review in Roane County, Tennessee (Docket Numbers 50-611 and 50-612) (Accession No. ML24032A198)
March 20, 2024	Letter from Wendy Berhman, Superintendent, Manhattan Project National Historical Park to Peyton Doub of NRC, Comments in response to letter dated January 31, 2024. (Accession No. ML24109A060)

APPENDIX D

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

D.1 Required Environmental-Related Authorizations, Permits, and Certifications

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 the Hermes 2 project at the proposed site in Oak Ridge, Tennessee.

Section 1.4 of the environmental report (Kairos 2023-TN9774) indicates that the regulatory compliance requirements for Hermes 2 would the same as for the Hermes test reactor, for which the U.S. Nuclear Regulatory Commission recently completed an environmental impact statement (NRC 2023-TN9771) and issued a construction permit. Table D-1 was adapted from Appendix D of the Hermes CP environmental impact statement (NRC 2023-TN9771).

D.2 References

Kairos Power, LLC. 2023. Letter from P. Hastings, Vice President, Regulatory Affairs and Quality, to NRC Document Control Desk, dated July 14, 2023, regarding “Kairos Power LLC, Submittal of the Construction Permit Application for the Hermes 2 Kairos Power Fluoride Salt-Cooled, High Temperature Non-Power Reactor.” KP-NRC-2307-002, Alameda, California. ADAMS Accession No. ML23195A121. TN9774.

NRC (U.S. Nuclear Regulatory Commission). 2023. *Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor, Final Report*. NUREG-2263, Washington, D.C. ADAMS Accession No. ML23214A269. TN9771.

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
U.S. Nuclear Regulatory Commission	10 CFR 50.57	Operating License	Operation of the facilities
U.S. Nuclear Regulatory Commission	10 CFR Part 40	Source Material License	Possession, use, and transfer of special nuclear material
U.S. Nuclear Regulatory Commission	10 CFR Part 30	By-Product Material License	Production, possession, and transfer of radioactive by-product material
U.S. Nuclear Regulatory Commission	10 CFR Part 70	Special Nuclear Material License	Receipt, possession, use, and transfer of special nuclear material
U.S. Nuclear Regulatory Commission	National Environmental Policy Act (NEPA) 10 CFR Part 51	Environmental Assessment 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	Acknowledgment of Notification of Hazardous Waste Activity	Generation of hazardous waste
U.S. Environmental Protection Agency	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
Tennessee Department of Environment and Conservation (TDEC)		Air Pollution Control Operation Permit	Operation of an air pollution emission source that is not specifically exempted
Tennessee Department of Environment and Conservation (TDEC)	Federal Clean Water Act	Construction Storm Water Discharge Permit	Discharge of stormwater runoff from the construction site
Tennessee Department of Environment and Conservation (TDEC)		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
Tennessee Department of Transportation (TDOT)		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.
City of Oak Ridge		Storm Water Plan approval (may be included in Site Plan Approval)	Administrative approval of grading and drainage plans
City of Oak Ridge		Erosion Control Permit (may be included in Site Plan Approval)	Administrative approval of erosion control plans
City of Oak Ridge		Building Permit	Construction of buildings
City of Oak Ridge		Plumbing Plan Approval	Installation of plumbing systems

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

Agency	Authority	Requirement	Activity Covered
City of Oak Ridge		Heating, Ventilation, and Air Conditioning Plan approval	Installation of heating, ventilation, and air conditioning systems
City of Oak Ridge		Occupancy Permit	Occupancy of completed buildings
City of Oak Ridge		Conditional use Permit	Construction of multiple buildings on the same site
City of Oak Ridge		Sanitary Sewer and Water Supply Facility Approvals	Administrative approval of construction, installation, and operation of connections to the municipal sewer and water supply systems
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 ESTIMATES FOR A REFERENCE 1,000 MWE REACTOR AND THE HERMES 2 TEST REACTOR

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. The GHG emission estimates include direct emissions from the nuclear facility 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 megawatts 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.[1] This report discusses the calculation of GHG emission estimates for the reference 1,000 MWe reactor.

The estimated emissions from equipment used to build a nuclear power plant listed in Table E-1 are based on hours of equipment use estimated for a single nuclear power plant at a site requiring a moderate amount of terrain modification (UniStar 2007-TN1564).

Table E-1 Greenhouse Gas Emissions from Equipment Used in Building and Decommissioning (metric tons [MT] CO_2(e))

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_2(e).

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 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).

[1] 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 (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.

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[2] (CO_2(e)) 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 traveled by each workforce and the factors used to convert total miles to metric tons of CO_2(e). 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 mi/gal (9.1 km/L) of gasoline (FHWA 2012-TN2645). Conversion from gallons of gasoline burned to CO_2(e) is based on U.S. Environmental Protection Agency emission factors (EPA 2012-TN2643).

Table E-2 Workforce Greenhouse Gas Footprint Estimates

Parameter	Construction Workforce	Operational Workforce	Decommissioning Workforce	SAFe STORage 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 (miles)(a)	102,000,000	321,000,000	20,000,000	23,000,000
Average Vehicle Fuel Efficiency(b) (miles per gallon)	21.6	21.6	21.6	21.6
Total Fuel Burned(a) (gallons)	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_2(e))	0.977	0.977	0.977	0.977
Total GHG Emitted(a) (MT CO_2(e))	43,000	136,000	8,000	10,000

Key: CO_2 = carbon dioxide; CO_2(e) = carbon dioxide equivalent; GHG = greenhouse gas; MT = metric ton.
(a) Values have been rounded.
(b) Source: FHWA 2012-TN2645.
(c) Source: EPA 2012-TN2643

[2] 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.

Title 10 of the *Code of Federal Regulations* 51.51(a) (10 CFR 51.51(a) TN250) states that every environmental report (ER)[3] 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 nuclear power plant 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 (^{235}U) with an average burnup of 40,000 megawatt days/MT for 40 years, then it will require about 1,043 tons of enriched uranium for fuel. To produce 1 ton of 5 percent enriched uranium with 0.25 percent ^{235}U in the depleted uranium stream requires extraction of 10.3 tons of natural uranium and 7,923 separative work units, or SWUs (Napier 2020-TN6443). The 1,043 tons of uranium enriched to 5 percent ^{235}U required over the 40-year life of the 1,000 MWe plant would then require 8,264,000 SWUs. Because a centrifuge enrichment facility requires about 50 kWh per SWU (WNA 2020-TN6661), a total of 413,200 MWh is needed to produce 40 years' worth of uranium enriched to 5 percent ^{235}U 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 lb/MWh,[4] 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_2(e) being emitted into the atmosphere per year because of the process heat requirements of the uranium fuel cycle.[5] For a 40-year operational life, this is 298,000 MT of CO_2(e). This amount is in addition to the CO_2(e) emissions from the enrichment process.

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

[4] 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 pounds per kilowatt-hour (lb/kWh). The value for southeastern New Mexico has been applied here (EPA 2023-TN9079).

[5] The conversion is 0.0551 (metric tons CO_2/thousand scf) (EPA 2023-TN9080).

The NRC staff estimated GHG emissions related to plant operations from the typical usage of various onsite diesel generators (UniStar 2007-TN1564). Carbon monoxide emission estimates were derived assuming an average of 600 hours (h) of emergency diesel generator operation per year (four generators, each operating 150 h/yr) and 200 h of station blackout diesel generator operation per year (two generators, each operating 100 h/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 CH_4 and N_2O (Chapman et al. 2012-TN2644).

The number of shipments and shipping distances for transport of fresh nuclear fuel, 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 lb (23 MT) and rail casks weigh 100 t (91 Mt). For this analysis, emission rates of CO_2 are calculated as 64.7 g/t-mi (44.2 g/MT-km) for trucks and 32.2 g/T-mi (22 g/MT-km) for rail (Cefic and European Chemical Transport Association 2011-TN6966). For the calculation, it was also assumed that return trips with empty casks double the total miles traveled by truck or rail. Table E-3 presents estimated annual CO_2(e) 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_2(e) 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: Co_2(e) = carbon dioxide equivalent; mi = mile' MWe = megawatt electric.
(a) Source: NRC 1975-TN216, Table S-5.
(b) Results are rounded to the nearest 1,000 MT CO_2(e).

The total GHG emissions for fuel and waste transportation was approximately 352 MT per reference reactor-year as presented in 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_2(e) 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_2(e), with a 7-year building phase, 40 years of operation, and 10 years of active decommissioning.[6] These source categories of the GHG emissions footprint are summarized in Table E-4.

[6] Under NRC 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 earth-moving 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).

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

Source	Activity Duration (yr)[(a)]	Total Emissions (MT CO_2(e))
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
SAFe STORage workforce	40	10,000
TOTAL[(b)]		990,000

Key: CO_2(e) = carbon dioxide equivalent; MT = metric tons; yr = year.
(a) Nuclear power plant life -cycle for estimating greenhouse gas is assumed to be 97 years which includes building, operating, and decommissioning.
(b) Results are rounded to the nearest 1,000 MT CO_2(e).

The uranium fuel cycle component of the footprint is the largest portion of the overall 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.

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 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 g of CO_2(e)/kWh, with 25th percentile, 50th percentile, and 75th percentile values of 8 g CO_2(e)/kWh, 16 g CO_2(e)/kWh, and 45 g CO_2(e)/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 nuclear power plant. The NRC staff's life-cycle GHG estimate of approximately 990,000 MT CO_2(e) for the reference 1,000 MWe reactor is equal to about 3.5 g CO_2(e)/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 calculation of GHG emissions for the proposed Hermes 2 facility assumes that two 35 megawatt thermal (MWt) advanced reactors would be installed. Assuming that GHG emission estimates for operation and extended SAFe STORage for the proposed Hermes 2 reactors, could generally be scaled based on the plant's output, the estimates for these stages would be scaled down to 1.3 percent of the totals for the reference reactor calculated above.

Because two units would be installed, additional scaling by a factor of two 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.

The 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 percent. 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 percent is assumed to be bounding for the two test reactors. Under this assumption, the staff estimated GHG emissions for uranium fuel cycle activities and fuel and waste transport associated for the proposed Hermes 2 test reactors as 2.6 percent (1.3×2) of the totals presented for the reference 3,415 MWt (1,000 MWe) reference reactor. The assumed activity durations and total GHG emissions for these activities for the reference reactor and for the Hermes 2 test reactors are shown in Table E-5.

Table E-5 Life-Cycle Assumptions and GHG Emissions for Hermes 2

	3,415 MWt Reference Reactor		Two 35 MWt Hermes 2 reactors		
Source	Activity Duration (yr)[(a)]	Total Emissions (MT CO_2(e))	Scaling factor	Activity Duration (yr)[(b)]	Total Emissions (MT CO_2(e))
Construction equipment	7	39,000	0.5	3	8,357
Construction workforce	7	43,000	0.5	3	9,214
Plant operations	40	181,000	0.026	11	1,294
Operations workforce	40	136,000	0.026	11	972
Uranium fuel cycle	40	540,000	0.026	11	3,861
Fuel and waste transportation	40	14,000	0.026	11	100
Decommissioning equipment	10	19,000	0.5	10	9,500
Decommissioning workforce	10	8,000	0.5	10	4,000
SAFe STORage workforce	40	10,000	0.026	40	260
TOTAL[(c)]		990,000			38,000

Key: CO_2(e) = carbon dioxide equivalent; MT = metric tons; MWt = megawatt thermal; yr = year.
(a) Nuclear power plant life-cycle for estimating GHG is assumed to be 97 years which includes construction (7 years), operations (40 years), and decommissioning (50 years).
(b) Nuclear power plant life-cycle for estimating GHG is assumed to be 64 years which includes construction (3 years), operations (11 years), and decommissioning (50 years).
(c) Results are rounded to the nearest 1,000 MT CO_2e

The NRC staff calculated that the GHG emissions for the proposed Hermes 2 test reactors to be approximately 38,000 MT CO_2(e) using the assumptions discussed above to scale the emissions from the reference 1,000 MWe reactor. A scaling factor of 0.026 is calculated from the ratio of power outputs between the reference 3,415 MWt reactor accounting for 0.8 capacity factor.

$$\text{Scaling Factor} = 35\ \text{MWt} \times 2\ /(3{,}415\ \text{MWt}\ \times 0.8) = 0.026$$

Yearly GHG emissions from the reference 3,415 MWt reactor is scaled down and then multiplied by the number of years of construction, operation or decommissioning as shown below:

Hermes CO_2e Emissions

$$= 3{,}415 \text{ MWt Reactor } CO_2(e) \times \text{Scaling Factor} \times \frac{\text{Years of Activity for 35 MWt reactor}}{\text{Years of Activity for 3,415 MWt reactor}}$$

A 3-year of construction period and an 11-year operation period were assumed for the Hermes 2 reactors. The period of decommissioning and SAFe STORage activities were kept the same as that for the reference reactor due to uncertainty with future post closure waste management activities. The staff calculated that the GHG emissions for the Hermes 2 test reactors to be 37,600 MT $CO_2(e)$. Comparing the entire life cycle estimated GHG emissions from construction, operation, uranium fuel cycle, transportation of fuel and waste, and decommissioning activities to 2019 total gross annual U.S. energy sector emissions, the project's GHG emissions would be about 0.0007 percent of the 2019 GHG emissions from the U.S. energy sector.

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.

Cefic and ECTA (European Chemical Industry Council and European Chemical Transport Association). 2011. *Guidelines for Measuring and Managing CO2 Emission from Freight Transport Operations*. Brussels, Belgium. Accessed March 21, 2021, at https://www.ecta.com/resources/Documents/Best%20Practices%20Guidelines/guideline_for_measuring_and_managing_co2.pdf. TN6966.

Chapman, E.G., J.P. Rishel, J.M. Niemeyer, K.A. Cort, and S.E. Gulley. 2012. *Assumptions, Calculations, and Recommendations Related to a Proposed Guidance Update on Greenhouse Gases and Climate Change*. PNNL-21494, Pacific Northwest National Laboratory, Richland, Washington. ADAMS Accession No. ML12310A212. TN2644.

EPA (U.S. Environmental Protection Agency). 2012. "Clean Energy: Calculations and References." Washington, D.C. ADAMS Accession No. ML12292A648. TN2643.

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.

EPA (U.S. Environmental Protection Agency). 2023. “Emissions & Generation Resource Integrated Database (eGRID).” Washington, D.C. Accessed October 4, 2023, at https://www.epa.gov/egrid. TN9079.

EPA (U.S. Environmental Protection Agency). 2023. “Greenhouse Gases Equivalencies Calculator - Calculations and References.” Washington, D.C. Accessed October 4, 2023, at https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references. TN9080.

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

IPCC (Intergovernmental Panel on Climate Change). 2012. *Renewable Energy Sources and Climate Change Mitigation—Special Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom. TN2648.

Napier, B.A. 2020. *Non-LWR Fuel Cycle Environmental Data*. PNNL-29367, Revision 2, Richland, Washington. ADAMS Accession No. ML20267A217. TN6443.

NRC (U.S. Nuclear Regulatory Commission). 1975. *Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants, Supplement 1.* NUREG–75/038, Washington, D.C. ADAMS Accession No. ML14091A176. TN216.

NRC (U.S. Nuclear Regulatory Commission). 2002. “Final Generic Environmental Impact Statement of Decommissioning of Nuclear Facilities (NUREG-0586).” 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

PAST, PRESENT, AND REASONABLY FORESEEABLE PROJECTS AND OTHER ACTIONS CONSIDERED IN THE CUMULATIVE EFFECTS ANALYSIS

In determining the cumulative environmental impacts associated with the construction, operation, and decommissioning of Hermes 2, the combination of the past, present, and reasonably foreseeable actions or projects presented in Section 4.13 of the Hermes Environmental Report (ER) (Kairos 2023-TN8172) were evaluated, with the exception that the potential effects of the Hermes facility were also considered in the Hermes 2 evaluation. Table F-1 reproduces, in part, Table 4.13-1 from the Hermes ER (Kairos 2023-TN 8172) used in the cumulative impact evaluation.

Table F-1 Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Cumulative Effects Analysis

Project Name	Summary of Project	Location (from Reactor building)	Status	Potentially Affected Resource(s)
Federal Facilities				
Proposed Clinch River Nuclear Site	Two or more small modular reactors to be built by TVA	3.5 mi south-southeast	Proposed NRC issued ESP-006 on December 19, 2019	Land use and visual resources, air quality and noise, water resources, ecological resources, transportation, socioeconomics
East Tennessee Technology Park	Clean up and redevelopment of the former Manhattan Project Site	Adjacent across Poplar Creek	In progress	Land use and visual resources, air quality, transportation, socioeconomics, noise, water resources, human health
Sludge Processing Mock Test Facility	Construction of a TRU sludge waste processing facility	Approximately 5.3 mi east	Construction underway; expected completion 2022	Water resources, air quality, land use, waste management
Uranium Processing Facility at Y-12	New building in Y-12 complex	Approximately 8.4 mi northeast	Construction began 2018; expected to continue through 2025	Water resources, air quality and noise, waste management, human health

Table F-1 Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Cumulative Effects Analysis (Continued)

Project Name	Summary of Project	Location (from Reactor building)	Status	Potentially Affected Resource(s)
Outfall 200 Mercury Treatment Facility at Y-12	Construction of two mercury treatment facilities in separate areas connected by a pipeline	Approximately 9 mi northeast	Construction began 2017 and scheduled to begin operations in mid-2020s	Water quality, air quality and noise, human health, waste management
New Y-12 Steam Plant	Natural gas power generation for Y-12 operations.	Approximately 9 mi northeast	Operational since 2010	Air quality
Y-12 Shipping and Receiving (on-site verification)	Non-hazardous shipping and receiving facility	West and adjacent <1,000 ft	Operational	Transportation
K-1251 Barge Facility	Barge docking facility approximately 1 ac in size.	2 mi southeast	Operational	Transportation
Roane Regional Business and Technology Park	Business and industrial park with sites for development	Approximately 5 mi southeast	Operational since 2001	Land use and visual resources, water resources, air quality, socioeconomics, transportation
ORNL	DOE Nuclear and High-Tech Research Facility	Approximately 5 mi east	Operational since 1943	Water resources, air quality
ORNL - Spallation Neutron Source	Accelerator-based neutron pulse for R&D. Includes upgrades and second target station construction completion 2025.	Approximately 5.8 mi east	Operational since 2006	Air quality, water resources, human health, waste management
ORNL - High Flux Isotope Reactor	Critical reaction providing a stable beam of neutrons for R&D.	Approximately 5.75 mi east	Operational since 1965. Decommission anticipated after 2060.	Air quality, water resources, human health, waste management
White Oak Dam	Manhattan Project impoundment on White Oak Creek with 25 ac settling pond. Formed to reduce radioactive waste runoff into Clinch River, must be remediated by 2036.	Approximately 5 mi southeast	Operational since 1943	Water resources, human health

Table F-1 Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Cumulative Effects Analysis (Continued)

Project Name	Summary of Project	Location (from Reactor building)	Status	Potentially Affected Resource(s)
Environmental Management Waste Management Facility on ORR	Proposed new landfill for disposal of radioactive, hazardous, and toxic wastes in Oak Ridge because current landfill will soon reach full capacity	Approximately 5.3 mi northeast (current location is 6.8 mi northeast)	Proposed	Water resources, air quality, socioeconomics, human health, waste management
Industries and Manufacturing Facilities				
Kairos Power Fuel Fabrication Facility	Fabrication of TRISO-coated uranium oxycarbide (UCO) kernels in a graphite matrix	Near or on K-31 site	Potential	Land use and visual resources, air quality and noise, geologic resources, water resources, socioeconomics, transportation, human health, waste management
Ultra Safe Nuclear Corporation Pilot Fuel Manufacturing Facility	Fabrication of TRISO coated UCO kernels in a graphite matrix	Approximately 0.8 mi southeast	Operational since 2022	Land use and visual resources, noise, socioeconomics, transportation
TRISO-X Fuel Fabrication Facility	Fabrication of TRISO coated UCO kernels in a graphite matrix	Approximately 2.4 mi northeast	Proposed	Land use and visual resources, air quality, socioeconomics, human health, transportation
Coquí Pharma	Planned Medical Isotope Production Facility	Duct Island; Approximately 0.75 mi south	Proposed	Land use and visual resources, air quality and noise, water resources, socioeconomics, human health
Tellico West Industrial Park	Development of industrial site for Tellico Reservoir Development Agency	25.4 mi southeast	Proposed	Air quality, socioeconomics

Table F-1 Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Cumulative Effects Analysis (Continued)

Project Name	Summary of Project	Location (from Reactor building)	Status	Potentially Affected Resource(s)
Energy*Solutions*, LLC Bear Creek Facility	Processing and packaging of radioactive material for permanent disposal	Approximately 2.1 mi southeast	Operational	Air quality, water resources, human health, waste management
Horizon Center Industrial Park	Industrial park available for development	Approximately 2.3 mi northeast	Various lots sold and available	Land use and visual resources, air quality, water resources, socioeconomics, transportation, noise
Heritage Center Industrial Park	Industrial park available for development; includes Hermes site and Coquí Pharma project site on Duct Island	Onsite and extending south and east	Various sites pending sale, leased, sold, or fully serviced	Land use and visual resources, air quality and noise, water resources, socioeconomics, transportation, noise
Transportation Projects				
TDOT Projects	Bridge Replacement, I-40 over Clinch River in Kingston	Approximately 7.5 mi southwest	Pre-planning, no data	Transportation, socioeconomics
TDOT Projects with proposed letting dates	Total projects in five-county region of interest: 108, includes bridge repair/replacement, resurfacing, maintenance, and repair	Various within the region of interest	Planned or in progress	Transportation, socioeconomics
Construction of a General Aviation Airport Future Oak Ridge Airport	Development of a general aviation airport	Approximately 1.1 mi east	Have not broken ground yet; construction could start in 2021.	Land use and visual resources, air quality and noise, water resources, socioeconomics, transportation
Utility Projects				
City of Oak Ridge Water Treatment Plant	Upgrade aging drinking water treatment plant/ infrastructure (WIFIA grant)	Approximately 9.6 mi northeast	Construction to begin upon award of WIFIA grant	Air quality, water resources, socioeconomics

Table F-1 Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Cumulative Effects Analysis (Continued)

Project Name	Summary of Project	Location (from Reactor building)	Status	Potentially Affected Resource(s)
New Construction				
The Preserve at Clinch River	New home construction, subarea G	Approximately 2 mi south	Operational since 2002	Land use and visual resources, water resources, air quality, socioeconomic
Kingston Point	New residential, recreational, and commercial development	Approximately 9 mi southwest	proposed	Land use and visual resources, socioeconomics
Energy Projects				
Nuclear				
Sequoyah Nuclear Plant, Units 1 and 2	Power Generation	Approximately 62.5 mi southwest	Operational since 1981 and 1982, respectively	Air quality, human health
Watts Bar Nuclear Plant, Units 1 and 2	Power Generation	Approximately 31.75 mi southwest	Operational since 1996 and 2016, respectively	Air quality, human health
Coal-Fired				
Bull Run Fossil Plant	Net capability 870 MWe	Bull Run Creek; approximately 15 mi northeast	Operational since 1967; will be retired in Dec 2023 with decommissioning taking 5-6 years	Air quality, human health
Kingston Fossil Plant	Net capability 1,379 MWe	Watts Bar Reservoir; approximately 7 mi west	Operational since 1955	Air quality, human health
Oher Actions/Projects				
Roane County High School	Combine Harriman, Rockwood, and Roane County High Schools into a new combined high school to be located adjacent to Roane State Community College.	Approximately 12 mi southwest	Planning	Land use and visual resources, transportation, socioeconomics

Key: ac = acre; DOE = Department of Energy; mi = mile; MWe = megawatts electric; NRC = U.S. Nuclear Regulatory Commission; ORNL = Oak Ridge National Laboratory; ORR = Oak Ridge Reservation; R&D = research and development; ROI = region of interest; TDOT = Tennessee Department of Transportation; TRISO = tri-structural isotropic; TRU = transuranic; TVA = Tennessee Valley Authority; UCO = uranium oxycarbide; WIFIA = Water Infrastructure Finance and Innovation Act.
Source: Reproduced in part from Table 4.13-1 from the Hermes ER (Kairos 2023-TN 8172)

NRC FORM 335 (12-2010) NRCMD 3.7

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

1. REPORT NUMBER
(Assigned by NRC, Add Vol., Supp., Rev., and Addendum Numbers, if any.)

ML24103A002

2. TITLE AND SUBTITLE

Environmental Assessment and Finding of No Significant Impact for the Construction Permits for the Kairos Hermes 2 Test Reactors
Draft Report for Comment

3. DATE REPORT PUBLISHED

MONTH	YEAR
April	2024

4. FIN OR GRANT NUMBER

5. AUTHOR(S)

See Appendix A

6. TYPE OF REPORT

Technical

7. PERIOD COVERED (Inclusive Dates)

8. PERFORMING ORGANIZATION - NAME AND ADDRESS (If NRC, provide Division, Office or Region, U. S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address.)

Division of Rulemaking, Environmental, and Financial Support
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

9. SPONSORING ORGANIZATION - NAME AND ADDRESS (If NRC, type "Same as above", if contractor, provide NRC Division, Office or Region, U. S. Nuclear Regulatory Commission, and mailing address.)

Same as above

10. SUPPLEMENTARY NOTES

Dockets 50-0611 and 50-0612

11. ABSTRACT (200 words or less)

This draft environmental assessment (EA) describes the environmental review conducted by U.S. Nuclear Regulatory Commission (NRC) staff for an application by Kairos Power, LLC (Kairos) for construction permits under Title 10 of the Code of Federal Regulations Part 50, allowing construction of two non-power test reactors termed Hermes 2 on a 185-acre site in Oak Ridge, Tennessee. Hermes 2 would be built on the same site as Hermes, another non-power test reactor for which Kairos has already received a construction permit from the NRC. As with Hermes, Kairos plans to build and operate Hermes 2 to demonstrate key elements of the Kairos Power Fluoride Salt-Cooled, High Temperature Reactor technology for possible future commercial deployment. Each Hermes 2 reactor would be of similar size and design as the Hermes reactor but would include specific design differences. The draft EA follows procedures in 10 CFR 51.30, “Environmental assessment,” and 10 CFR 51.31, “Determinations based on environmental assessment,” which are NRC’s regulations for preparing EAs to implement the National Environmental Policy Act of 1969. The NRC staff concludes that the potential direct, indirect, and cumulative environmental impacts from Hermes 2 would not be significant and has determined that a draft Finding of No Significant Impact appears warranted.

12. KEY WORDS/DESCRIPTORS (List words or phrases that will assist researchers in locating the report.)

Kairos Hermes 2 Test Reactors
Kairos Power Hermes 2 Non-Power Test Reactor
Draft Environmental Assessment
National Environmental Policy Act, NEPA

13. AVAILABILITY STATEMENT

unlimited

14. SECURITY CLASSIFICATION

(This Page)

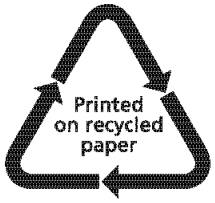
unclassified

(This Report)

unclassified

15. NUMBER OF PAGES

16. PRICE



Federal Recycling Program

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

OFFICIAL BUSINESS

ML24103A002

Environmental Assessment and Finding of No Significant Impact for the Construction Permits for the Kairos Hermes 2 Test Reactors
Draft Report for Comment

April 2024