CHAPTER 2 PROPOSED ACTION

2.1 PROPOSED ACTION

The Proposed Federal Action is issuance of a Construction Permit (CP) and subsequent Operating License (OL) for a non-power reactor facility (Hermes) to test and demonstrate the key technologies, design features, and safety functions of the Kairos Power Fluoride Salt-Cooled High Temperature Reactor (KP-FHR) technology. The facility would also provide data that may be used for the validation of safety analysis tools and computational methodologies used for the designing and licensing future KP-FHR reactors.

The applicant for this CP and the OL and owner of the facility is Kairos Power LLC, (Kairos Power). Information about Kairos Power is provided with the Preliminary Safety Analysis Report (PSAR). As the owner and licensee, Kairos Power has the necessary authority and control related to the construction and operation of the facility once the CP and the OL are approved.

Kairos Power is requesting NRC review and approval of the CP application to support construction of safety-related structures, systems, and components anticipated to begin as early as mid-2023. Kairos Power is a recipient of a U.S. Department of Energy (DOE) Advanced Reactor Demonstration Program (ARDP) award for Risk Reduction funding for the KP-FHR technology with initial operations proposed to begin by mid-2026. To support this objective, the earliest start date for construction is expected to be April 2023 and the earliest projected date for completion of construction is mid-2025. The latest projected date for completion of construction is anticipated to be December 2026. The facility is expected to have a 4~~10~~-year operational license. Therefore, decommissioning activities would be expected to be initiated after the operational phase ends and is anticipated to begin in 2030~~6~~.

The construction phase of this project is estimated to require an estimated average of 212 onsite workers (425 at peak times) and a monthly average of 213 truck deliveries and four offsite shipments of construction debris. Table 2.1-1 shows estimates for materials that would be consumed. Additionally, approximately 31,800 gallons of diesel fuel (as a bounding assumption, fuel is assumed to be diesel) is assumed to be consumed on an average monthly basis. Table 2.1-2 shows the different types of construction equipment that would be used during the construction phase. These construction activities are estimated to affect an estimated 138 acres of land, of which an estimated 30 acres would be permanently disturbed for operation of the facility.

A low-pressure, molten salt coolant, i.e., Li_2BeF_4 (Flibe) and the intermediate coolant (nitrate salt) would be shipped to the site prior to startup. Flibe is estimated to be delivered in 20 shipments of 1 ton each. Nitrate salt is estimated to be delivered in 28 shipments of approximately 7 tons each.

During operations, an estimated average of 38 workers per weekday (68 full-time positions) are required for staffing. An estimated monthly average of 15 truck deliveries and four offsite waste shipments. An additional 20 shipments of Flibe (approximately one ton each) is estimated to be delivered to the facility before the end of the first two years of operation and 28 shipments per year of nitrate salt (7 tons each) for the duration of operations. Hazardous materials that would be stored onsite in small quantities include new Flibe and nitrate salt lubricating oil for rotating equipment and cleaning materials and consumables used for cleaning and maintenance. A bounding value of approximately 21,555 gallons of diesel fuel for the standby diesel generator would be contained in an onsite storage tank.

Once the facility reaches the end of its licensed life, the Operating License would be amended by the NRC and decommissioning activities would be commenced. Radioactive equipment and materials will be disposed according to local and federal laws and regulations. It is estimated that post-operational

2.3 NON-POWER REACTOR

The facility would house one Hermes reactor. The Hermes reactor is a KP-FHR with the core configuration made up of a pebble bed core, graphite moderator/reflector, and Flibe molten salt coolant. This will be a non-power test reactor with approximate dimensions of the reactor vessel being 3.4 meters in diameter and 4.7 meters in height. The facility will contain only one unit with a maximum thermal power of 35 megawatts (MW) thermal (MWth). The purpose of the reactor will be to demonstrate and test the design features and safety functions of the technology. It will be a non-power test reactor, whereby the heat generated in the core will not be used for the production of electric power. Instead, heat will be transported out of the core via the primary heat transport system (PHTS) and then dissipated into the atmosphere via the primary heat rejection system (PHRS). Figure 2.3-1 shows the process flow diagram for the reactor and heat dissipation .

The reactor vessel and internal structures will be constructed of stainless steel that conforms to the 2019 composition specification requirements of American Society of Mechanical Engineers Section III, Division 5, with a targeted service life of 4~~10~~ years. The moderator/reflector will be constructed of a nuclear grade graphite selected for its compatibility with the chemistry environment of the reactor core and would also have a targeted service life of 4~~10~~ years.

The reactor core will use 4-centimeter (cm)-diameter graphite pebbles with embedded coated TRI-structural ISOtropic (TRISO) particle fuel. The particles will be comprised of a uranium fuel kernel and three layers of carbon and ceramic based materials that prevent the release of radioactive fission products. The maximum enrichment of the uranium fuel will be 19.55 weight percent, and the required start-up fissile inventory is estimated to be no greater than 25 kilograms (kg) ^{235}U. A fraction of the pebbles in the core are moderator (graphite-only) pebbles. Fuel pebbles are extracted from the reactor while online using the pebble extraction machine, the burnup is measured, and the fuel is either returned to the reactor or removed to storage. The estimated residence time for pebbles in Hermes is about 315 days.

2.6.1.2.2 Wet Solid Wastes

Wet solid wastes would include filters and or sieves from the inert gas system (IGS), chemistry control system, and IGS oxygen and moisture absorbers. Like dry solid wastes, wet solid wastes would be packaged and prepared for onsite storage and then eventual shipment offsite.

2.6.1.2.3 Tritium Management System

The tritium management system (TMS) would provide capture of tritium (H-3) from gas streams in various plant locations to reduce environmental releases. Figure 2.6-1 identifies the tritium management system components and indicates the approximate distribution of tritium throughout the reactor system. H-3 is produced primarily by neutron irradiation of lithium in the salt coolant, such as from lithium-7 (Li-7), lithium-6 (Li-6) remaining after initial enrichment, and Li-6 produced from transmutation of beryllium-9 (Be-9). The primary system functions of the TMS include:

- H-3 separation from argon in the IGS
- H-3 separation from dry air in the PHRS cover gas
- H-3 separation from dry air in Reactor Building cells
- Final collection and disposition of H-3

The TMS would produce three solid radioactive waste streams:

- High specific activity H-3 stored as metal hydride
- High specific activity H-3 on molecular sieve
- Low specific activity tritium on molecular sieve

2.6.1.2.4 Fuel Pebble Handling and Storage System

Operation of the facility is estimated to be 4~~10~~ years and would generate approximately 38,800 spent pebbles per year. Therefore, over this duration, it is estimated that ~~388,000~~155,200 used pebbles would be produced. The Hermes reactor fuel and moderator pebbles are continually cycled through the pebble handling and storage system (PHSS) which removes pebbles from the reactor for inspection. A fuel pebble is removed permanently from circulation and placed in a storage canister if it meets pre-set standards for burnup and integrity. Fuel and moderator pebbles that are removed are replaced with new pebbles. This system requires a constant supply of new fuel pebbles. The storage canisters would be transferred to an onsite canister storage system with ~~an estimated conservative~~sufficient storage capacity ~~of 192 canisters~~ for 4 years of licensed reactor operation. Section 2.7.1 provides a description of spent fuel storage.

2.6.1.3 Gaseous Radioactive Waste System

The facility is not expected to need a gaseous radioactive waste system. Gaseous radioactive wastes generated would be primarily discharged to the Reactor Building exhaust system, in which they pass through a high efficiency particulate air filter. Releases to the atmosphere would be controlled such that the total radiation exposure to persons outside the controlled area is as low as reasonably achievable and does not exceed applicable regulations.

2.6.2 Nonradioactive and Hazardous Waste Systems

The facility would generate general types and quantities of nonradioactive and nonhazardous solid waste. No specific systems are planned other than waste management plans and policies that would control nonradioactive and nonhazardous solid wastes. Solid waste management and control measures for the facility would include waste reduction, recycling, and waste minimization practices that would be

2.7 STORAGE, TREATMENT, AND TRANSPORTATION OF RADIOACTIVE AND NONRADIOACTIVE MATERIALS

2.7.1 New and Irradiated Fuel

The Hermes reactor will use spherical fuel pebbles containing embedded TRISO particles. The fuel design is described in PSAR Section 4.2. A manufacturer has not been decided for the Hermes reactor. New fuel is anticipated to either be shipped to the facility in U.S. Department of Transportation (DOT) certified shipping containers or manufactured at a nearby manufacturing facility using high-assay low-enriched uranium (HALEU) supplied from external sources. The fuel would also be stored onsite in the shipping containers until loaded into the PHSS.

During reactor operations, the facility would receive an initial shipment of fuel and periodic shipments of fuel to support continued operations over an estimated 4~~10~~-year license period. When removed from the reactor, used TRISO fuel pebbles would be stored in canisters in a spent fuel storage area within the Reactor Building. Each canister would hold approximately 2,100 fuel pebbles. Once a canister is filled, the canister would be initially stored in a water-cooled storage pool. During this time the decay heat generation drops rapidly. The pool would also accommodate a full core off-load for temporary storage. After the initial cooling period in the pool, fuel canisters would be transferred to the larger air-cooled storage cavity. The storage capacity of the air-cooled cavity ~~would have an estimated conservative storage capacity of 192 canisters, which~~ is sufficient for 4~~10~~ years of licensed reactor operation.

If necessary, spent fuel canisters would be loaded into dry storage casks suitable for onsite storage on an exterior spent fuel storage pad. Such storage canisters have not been specifically designed for the Hermes fuel but the individual canisters are compatible with conventional dry cask overpacks. Spent fuel would ultimately be transferred from onsite storage casks to spent fuel shipping containers certified by the NRC and DOT. While a large number of transportation packages are certified by the NRC for shipping unirradiated light water reactor (LWR) fuel, irradiated LWR fuel, and radioactive waste, transportation packages would need to be certified for shipping non-LWR fuel. Without a certified design, the number of spent fuel shipments cannot be calculated, but would be bounded by the 60 annual shipments of spent fuel provided for an 880 MW-electric (MWe) reference reactor described in NRC guidance (Reference 1).

Spent fuel would eventually be transported by truck or rail to a final spent fuel repository or a regional spent fuel storage facility. Neither facility currently exists in the United States. However, the transportation distance is likely bounded by the approximate 2,100 miles from Oak Ridge, Tennessee to Beatty, Nevada. Beatty, Nevada is located just west of Yucca Mountain, the site in the United States most studied for suitability as a spent fuel repository.

2.7.2 Low-level Radioactive Waste

Operations and decommissioning would generate solid LLRW. Generally, LLRW would be stored in strong, tight industrial packages approved for transportation. Common waste containers include B-12 and B-25 steel boxes, and 55-gallon steel drums. LLRW would be transported by truck to disposal sites west of Andrews, Texas (Waste Control Specialists) or near Clive, Utah (Energy*Solutions)*. The Waste Control Specialists disposal site accepts Class A, B, and C waste and is approximately 1,300 miles from Oak Ridge. The Energy*Solutions* disposal site accepts only Class A waste and is approximately 2,000 miles from Oak Ridge. Some wastes could be managed through Energy*Solutions* Bear Creek LLRW processing facility located less than 4 miles south of the site. While the ultimate disposal route for waste processed through the Bear Creek facility is dependent on the waste type, it often ultimately gets shipped to Utah for final disposal.

Flibe is utilized in the IMS, the PHTS, and the reactor, all of which are located in the Reactor Building. Used radioactive Flibe that is removed from the IMS in liquid form during normal operations would be filled into containers where it would be allowed to cool and solidify. It is estimated that the Flibe's specific activity in curies per ton (Ci/ton) after a cooling period of 1 year would be 380 Ci/ton. No other treatment would be required. The solid Flibe is anticipated to be stored onsite until decommissioning when it would be shipped to Waste Control Specialists for Class B or C LLRW disposal. Storage areas for solidified Flibe waste would require additional radiation shielding to keep occupation radiation doses below regulatory limits an as low as reasonably achievable.

An estimated 120 drums of Flibe waste would be generated over the assumed 4~~10~~ year licensed life of the facility. The waste would require a Type B shipping cask. The capacity of a Type B cask is dependent on the shielding necessary. Assuming a minimum of six drums per cask, 120 drums would require 20 cask shipments. Alternatively, Type B drums could be used likely resulting in more drums per shipment and fewer shipments.

During operations, nitrate salts used to transfer heat from the reactor to the heat dissipation system would be pumped through the PHRS. The nitrate salts would be approximately 60 percent sodium nitrate and 40 percent potassium nitrate by weight. Used radioactive nitrate salt would be pumped into storage containers and allowed to cool prior to being shipped to Waste Control Specialists for Class B LLRW disposal or to Energy*Solutions* for Class A LLRW disposal. No other treatment would be required. Based on an estimated 200 tons of nitrate salt shipped to the site annually, an average of 10 truck shipments per year would be required to ship an equivalent amount of salt waste. Waste containers would not require radiation shielding.

The IGS would transport radioactive materials (fission products, tritium, and other radionuclides) for downstream treatment. The TMS would capture tritium from gas streams in various plant location in order to reduce environmental releases. The TMS would separate tritium from argon in the IGS, from dry air in the PHRS cover gas, and from dry air in the Reactor Building cells and collect the tritium in solid materials for final disposition as a solid LLRW. These wastes are expected to be Class B LLRW that would be stored on site in approved shipping containers until transported to Waste Control Specialist for disposal.

Tritium would not ultimately be stored in a liquid or gaseous form in the TMS. A modest amount of water may be used for analytical purposes such as tritium trapping in water bubblers and liquid scintillation counting (estimated 1 ft^3/year with dissolved tritium activity of 10 Ci [10 Ci/year total liquid water waste]). There would be a small amount of tritium ingress into other water systems, but it is not expected that water from these systems would be released as effluent from the Reactor Building.

The total number of LLRW shipments has not been calculated. However, including the number of waste nitrate slat shipments, the total number of LLRW shipments would be expected to be bounded by the 46 annual shipments of LLRW provided for an 880 MWe reference reactor described in NRC guidance (Reference 1).

2.7.3 Nonradioactive Materials

Nonradioactive Flibe is anticipated to be shipped to the site in approximately 20 initial 1-ton shipments with an additional 20 tons estimated to be shipped before the end of the first two years of operation. The Flibe would be stored in the Reactor Building. Nitrate salt would be shipped to the facility at an estimated rate of 200 tons per year in approximately 28 shipments (7 tons per shipment) and stored in the intermediate salt vessel located in the Reactor Building. As discussed in Section 2.4, the facility would also receive twelve 4,000-gallon shipments of demineralized water each month.

CHAPTER 4 IMPACTS OF PROPOSED CONSTRUCTION, OPERATIONS, AND DECOMMISSIONING

This chapter provides an analysis of the impacts of construction, operation, and decommissioning of the facility. Overall impact rankings are given to each environmental resource evaluated. Unless otherwise defined, criteria followed the guidance given in NRC Impact Rankings in 10 CFR 51 Subpart A, Appendix B, Table B-1, Footnote 3 as follows:

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

4.1 LAND USE AND VISUAL RESOURCES

This section assesses the impacts of construction and operation on land use and visual resources for the site and region. As described in Section 3.1, the land use for the site and region is analyzed using the National Land Cover Database 2016. Impacts include effects from activities associated with construction and operation, including excavation, grading, placement of fill material, temporary staging and construction laydown, construction of permanent features, and potential operational disturbances.

4.1.1 Land Use

This section discusses the land use impacts from construction and operation of the facility.

4.1.1.1 Site and Region

As described in Section 3.1, the site consists of an approximate 185 acre parcel located within the Department of Energy (DOE) East Tennessee Technology Park (ETTP) in Oak Ridge, Tennessee. The site is located on a parcel that previously housed Buildings K-31 and K-33, which were part of the K-25 complex and operated as the Oak Ridge gaseous diffusion plant (ORGDP). The region surrounding the site is defined in Subsection 3.1.1.2 as the area within a 5-mile radius of the site center point. The entire region is located within Roane, Loudon, and Morgan Counties, Tennessee.

The land use impacts to the site and near offsite areas are based on the conversion of the site from a Brownfield to an active industrial area. As described in Section 3.1, the entire site is classified as a Brownfield due to the previous disturbances associated with use of the site for the K-33 Building as part of the K-25 Gaseous Diffusion Plant for the Manhattan Project. Therefore, the site has been historically industrial in nature. While the site is currently vegetated and unused, it remains part of the ETTP which is an industrial park. As such, impacts to land use from construction and operations would be SMALL.

The source of uranium for the TRISO fuel has not been finalized. For the purposes of evaluating potential impact, this report assumes it would be sourced from an in-situ leach mine within the U.S., converted to gaseous uranium hexafluoride, and enriched to a maximum of 19.55 weight percent using commercially available centrifuge technology at an existing facility located within the U.S. While the uranium requirements, and thus land use requirements, for high-assay, low-enriched fuel could be greater than for standard low-enriched fuel, Hermes will use significantly less uranium over its lifetime than a light-water power reactor. Approximately ~~2.33~~0.93 metric tons of uranium (MTU) would be needed over the 4~~10~~-year licensed operating life compared to an average of 20 to 33 MTU per year for light-water power reactors. Therefore, the impacts on land use would be SMALL and bounded by impacts described in

Table S-3 of 10 CFR 51.51 which considers the impacts from a generic reactor requiring an average of 33 MTU per year. Optionally, enriched uranium could be sourced from international supplies, or from existing stores in the U.S., either of which option would reduce the overall environmental impacts within the U.S. compared to the assumed option.

4.1.1.2 Special Land Uses

As discussed in Subsection 3.5.4, there are two special land use areas in the region (Oak Ridge Wildlife Management Area [WMA] and Black Oak Ridge Conservation Easement [BORCE]), with neither area located onsite. Permanent and temporary impacts from construction and operation of the facility occur onsite and in near offsite areas, but not within either of these special land use areas. No direct or indirect impacts occur to special land use classification areas. Therefore, impacts to special land use classification areas would be SMALL.

4.1.1.3 Agricultural Resources and Facilities

As described in Subsection 3.3.3.2, no prime farmland or farmland of state-wide importance occurs within the site boundaries as the site is classified as a Brownfield. No other significant agricultural resources within the region of the site are located offsite in the region, as discussed in Subsection 3.1.1.2, and therefore, would not be impacted by construction and operations-related impacts. As such, direct and indirect impacts to agricultural resources and facilities from construction and operations would be SMALL.

4.1.1.4 Major Population Centers and Infrastructure

Section 3.1 summarizes the major population centers and infrastructure located within Roane, Loudon, and Morgan Counties, which include the population center of Oak Ridge. The nearest major population center is the City of Knoxville located approximately 25 miles east of the site in Knox County. Permanent and temporary impacts from construction and operations of the facility occur on-site and immediately adjacent to the boundary of the site. Therefore, construction and operations-related direct and indirect impacts on major population centers and infrastructure would be SMALL.

4.1.1.5 Impacts from Decommissioning

The facility is expected to begin operational activities in 2025 or 2026. The licensed life of the facility is expected to be 4~~10~~ years. As a result, decommissioning activities would be expected to commence in 2030~~6~~. Decommissioning activities, however, are similar to construction activities and involve heavy equipment to dismantle buildings and remove roadway and parking facilities. Resultant land uses following decommissioning are undetermined but may consist of returning the site to a Brownfield or open space. As such, direct and indirect impacts from decommissioning are anticipated to be similar to the impacts associated with construction and would be SMALL.

4.1.2 Visual Resources

The visual setting of the area affected by the construction and operation of the site is described in Subsection 3.1.2. A design simulation of the proposed facility is shown in Figure 4.1-1. The existing site is composed entirely of land used for industrial purposes. Although the site has been previously disturbed, it is currently a Brownfield and there are no existing architectural features, established structures, or natural or built barriers, screens, or buffers. Consequently, the facility would alter the on-site condition and would partially obstruct views of the existing landscape. However, the aesthetic and scenic quality of the site is already low because of the historic activities at the site and surrounding industrial areas (see Subsection 3.1.2). Approximate dimensions of the Reactor Building complex for the visual impact

below 25 tpy for all HAPs combined. As a result, the project is subject to non-Title V requirements. No air quality modeling is required for non-Title V permitting.

4.2.1.2.1 Gaseous Effluents

Air emissions of nonradiological gaseous criteria pollutants and HAPs would be emitted during the operations phase from: (1) intermittent use of diesel-powered or natural gas powered standby power generation sources such as generators or combustion gas turbines, (2) intermittent use of propane-fired heaters for the intermediate coolant located in the primary heat rejection system (PHRS) during maintenance activities, (3) diesel-powered trucks that deliver material and haul off wastes, and (4) worker commuter vehicles. Radiological air emissions would be produced in the operations phase from the primary heat rejection stack, decay heat removal system vents, Reactor Building ventilation stack, and spent fuel cooling stack.

4.2.1.2.2 Evaluation of Emission Impacts on Air Quality

Vehicle and Other Emissions

During the operations phase, vehicular air emissions occur from the commuting workforce and from routine deliveries to/from the facility. The volume of traffic generated during operations is considerably lower than that expected during construction. Additionally, the lands on the developed site are either developed surfaces (buildings, paved parking/access road) or have been landscaped. Limitation of routine vehicle usage to paved areas reduces the emissions of fugitive dust. Impacts from vehicular air emissions and fugitive dust are far less than during the construction phase. Therefore, impacts during the operations phase would be SMALL.

Release Point Characteristics

There would also be intermittent emissions from standby power generation sources such as generators or combustion gas turbines. These generators would operate less than 500 hours per year. If used exclusively for replacement or standby service and at or less than 500 hours per year, these generator units would not require a construction or operating permit, as outlined in Chapter 1200-3-9-04 (Construction and Operating Permits) of the Tennessee Air Pollution Control Regulations. In addition, the potential to emit for the generator units based on 500 hours of operation would produce insignificant emissions (less than 5 tons per year for criteria pollutants and less than 1,000 pounds per year for an individual hazardous air pollutant [HAP]), as defined in Chapter 1200-03-09 of the Tennessee Air Pollution Control Regulations; therefore, impacts would be SMALL.

Uranium Fuel Cycle

Hermes will use significantly less uranium over its lifetime than a light-water power reactor. Approximately ~~2.33~~0.93 MTU would be needed over the 4~~10~~-year licensed operating life compared to an average of 20 to 33 MTU per year for light-water power reactors. Therefore, the environmental impacts from air emissions generated during mining, enrichment, and fuel fabrication activities would be SMALL and bounded by impacts described in Table S-3 of 10 CFR 51.51 which considers the impacts from a generic LWR requiring an average of 33 MTU per year.

4.2.1.2.3 Greenhouse Gas (GHG) Emissions

Greenhouse gases trap heat in the atmosphere, absorbing and emitting radiation in the thermal infrared range. The most important of these gases are carbon dioxide (CO_2), methane, nitrous oxide, and

4.7 SOCIOECONOMICS

This subsection describes potential impacts to the socioeconomic environment, including transportation system impacts associated with the construction, operation and decommissioning of the facility. The evaluation of potential socioeconomics impacts addresses potential changes in the regional population, economy, housing availability, and public services. The evaluation of transportation system impacts addresses routes and modes that are involved with transporting materials, workers, and equipment to the site.

4.7.1 Socioeconomics Impacts

This section evaluates impacts to the population, housing, public services (e.g., water supply), public education, and tax-revenues in the region of influence (ROI), that result from constructing, operating, and decommissioning the facility. The ROI is identified as the five-county region nearest the site (Anderson, Knox, Loudon, Morgan, and Roane) as illustrated in Figure 3.7-1 (Reference 1). Potential impacts of constructing the facility are attributable to the size of the construction workforce, the expenditures needed to support the construction program, and the tax payments made to political jurisdictions. Because direct impacts are those that occur onsite, the only direct impacts are associated with the presence of the workforce at the site. All other socioeconomic impacts are considered to be indirect, as they occur offsite. The analysis presented in this subsection is based on the bounding parameters for the projected workforces for construction, operation, and decommissioning. As noted in Table 4.7-1, the peak onsite construction phase (contractor) workforce is 425 (212 off-peak) workers, and the maximum onsite operational phase workforce is 68 workers. This analysis assumes a 24-month schedule of construction-related activities. Decommissioning is estimated to start in 2030~~6~~ and would involve a peak month onsite workforce of 340 (168 average) workers.

4.7.1.1 Population Impacts

In 2019, population in the ROI was 664,125 (Reference 2). Growth projections show that the population in the ROI in 2026 would be approximately 710,778, and the population in the ROI in 2031 would be approximately 732,719 (see Table 3.7-2) (Reference 3). The analysis of population impacts considers the population growth potential due to the workforce requirements for construction, operational and decommissioning phases. Workforce estimates are based on 2016 data from the U.S. Census Bureau (USCB) County Business Patterns and Bureau of Labor Statistics (BLS) (Reference 4, Reference 5), the latest year for which this information is available.

As shown in Table 3.7-5, in 2019 the total ROI labor force was 331,121 (Reference 6). Table 4.7-1 shows the estimated number of construction workers for the major labor categories in the ROI was 24,238 in 2016. As a conservative measure, Table 4.7-1 delineates 20 percent of the construction workforce as labor available to Kairos, for an available labor pool of 4,848 workforce (Reference 5). These estimates show that substantially all of the peak requirement (425 construction workers) are present within the ROI labor. There are no estimated labor force deficiencies by occupation. Thus, the estimated ROI labor force in the construction trades is demonstrated to be abundant relative to construction workforce requirements, which greatly reduces the potential for large numbers of trade workers to relocate in the ROI. It is possible that some workforce may commute or temporarily relocate to the site from non-ROI counties, but these numbers would not be significant or cause a perceptible increase in the ROI's 2019 population of 664,125 (Reference 3). Therefore, the impact of the construction of the facility on population would be SMALL.

Table 4.7-1 shows the estimated number of operations workers for the major labor categories in the ROI was 22,358 in 2016. As a conservative measure, Table 4.7-1 delineates 10 percent of the construction

workforce as labor available to Kairos, for an available labor pool of 2,236 workforce (Reference 5). These estimates show that substantially all of the required 68 permanent operations workers are available in the ROI. It is possible that some workforce may commute or relocate to the site from non-ROI counties to pursue job opportunities, but these numbers would not be significant or cause a perceptible increase in the ROI's population of 710,778 in 2026, the year operations is expected to commence (Reference 3). Therefore, the impact of the construction of the facility on population would be SMALL.

As shown in Table 4.7-1, the estimated number of decommissioning workers for the major labor categories in the ROI was 7,531 in 2016. As a conservative measure, Table 4.7-1 delineates 20 percent of the decommissioning workforce as labor available to Kairos, for a total of 1,506 (Reference 5). These estimates show that substantially all of the required 340 decommissioning workers are available in the ROI. It is possible that some workforce may commute or relocate to the site from non-ROI counties to pursue job opportunities, but these numbers would not be significant or cause a perceptible increase in the ROI's projected population of 732,719 in 2031~~, which is five years before the estimated decommissioning in 2036~~ (Reference 3). Therefore, the impact of the construction of the facility on population would be SMALL.

4.7.1.2 Housing Impacts

Section 3.7.2.2 and Table 3.7-9 provide a summary of housing utilization sourced from 2015-2019 American Community Survey 5-Year Estimates. This data is used to evaluate the number of housing units that may be available to accommodate housing demands resulting from construction, operations and decommissioning.

In 2019, there were 31,317 vacant housing units in the ROI (see Table 3.7-9) (Reference 2). The amount of housing availability within the ROI is substantially greater than the total estimated demand for housing due to construction of the facility, which is negligible because Table 4.7-1 shows that substantially all of the peak requirement for construction, operations and decommissioning are available in the ROI labor force. Thus, workers do not need to relocate to the ROI to support construction phase peak needs, operational workforce needs or decommissioning. There is clearly an adequate supply of vacant housing to accommodate the requirements of new workers or families who may choose to relocate to the site for temporary or permanent housing (Reference 5).

The potential impacts on housing would be SMALL due to the large number of available vacant housing units in the ROI and the lack of demand related to the construction, operations and decommissioning workforce.

4.7.1.3 Public Services Impacts

Construction of the facility requires potable water to support the needs of the construction work force. During construction and operations, the City of Oak Ridge Public Works would supply water to the site, including potable water uses, fire protection uses, and typical construction uses (e.g., dust suppression and concrete mixing). The average per capita water usage in the United States is 82 gallons per day (gpd) per person including personal use, bathing, laundry and other household uses (Reference 7). At a conservatively assumed 41 gpd for each construction worker who is onsite for 8 to 12 hours per day, an average onsite workforce of 212 needs 8,692 gpd for potable and sanitary use. During peak usage, an estimated 426 construction workers would be onsite, and would need 17,425 gpd for potable and sanitary use. As discussed in Section 3.7.2.5, the City of Oak Ridge Public Works has excess water capacity of 4-6 MGD. Therefore, impacts on public water supply by the onsite construction workforce would be SMALL.

perceptible change in school enrollment. Therefore, the level of impact to the local public education system would be SMALL.

4.7.1.5 Tax Revenue Related Impacts

Tax revenues associated with the construction, operation, and decommissioning of the facility include payroll taxes on wages and salaries of the construction and operations work forces, sales and use taxes on purchases made by Kairos Power and the construction, operations and decommissioning workforces, and property taxes on owned real property and improvements. Increased tax collections are a benefit to the state, county, and municipal-level jurisdictions as well as school districts.

4.7.1.6 Personal and Corporate Income Taxes

Workforce payroll taxes (federal and state) are generated by construction, operations and decommissioning activities and purchases as well as taxes generated by workforce expenditures. State tax payments are distributed throughout the ROI and extend beyond the ROI, based on the expectation that some construction, operations and decommissioning employees reside outside of the ROI. The relocation of workers to the ROI and surrounding counties, including some expected to relocate to Tennessee from other states, results in an increase in payroll taxes paid to Tennessee.

4.7.1.7 Sales Taxes

Workers commuting to the site from within and outside of the ROI contribute sales tax revenues to the State of Tennessee and to Roane County and any other counties where they live. The vast majority of sales tax revenues from the ROI are collected by the State, as Roane sales tax rate is very low. But the ROI does experience an increase in the amount of sales taxes collected, reflecting the concentration of re-located workers. Sales tax revenues also result from direct purchases by Kairos Power for materials, equipment and services supporting the construction project, long term operations, and decommissioning. The distribution of these tax revenues is determined by the business locations of the material and service providers and likely reflects a broad area including the ROI and beyond to multiple states. The amount of sales taxes collected over a potential 410-year licensed operating period that are attributable to the facility is significant but is relatively minor when compared to the total amount of taxes collected in the ROI.

4.7.1.8 Property Taxes

The facility would be located in Roane County. As such, property taxes are paid to Roane County. These jurisdictions all provide public services that benefit Kairos Power's business and employees.

4.7.1.9 Summary of Tax Impacts

Overall tax revenues generated by construction, operation and decommissioning of the facility would be significant in absolute dollars across the lifetime of the facility. However, the overall tax revenues are relatively small in comparison to the established tax base of Roane County. The maximum increase in property tax revenues after expiration of the tax increment financing agreement is expected to be substantially less than 10 percent of the total tax revenue at the city and county levels. Therefore, total tax revenues from Kairos Power would result in SMALL positive impacts at the community level.

4.7.1.10 Other Socioeconomics Related Impacts

Socioeconomics related impacts in addition to those specifically described above include the potential for supportive business expansion and associated land use changes in Roane County as a result of the investments from Kairos Power. Land use changes due to housing needs are not expected due to the large number of existing vacant housing units. Potential land use changes include those to provide for

4.8.2.1 Layout and Location of Radioactive Material

Figure 2.2-3 depicts the physical layout of the site indicating site features, structures, and designated areas. Radioactive materials would be within the Reactor Building and the Auxiliary Systems Building with the high radiation materials limited to the Reactor Building. The Reactor Building would contain spent fuel storage facilities with a capacity sufficient for 4~~10~~ years of reactor operation. Access to the Reactor Building and the Auxiliary Systems Building would be strictly controlled and personnel entering these buildings would be participants in the occupational dose monitoring program.

4.8.2.2 Characteristics of Radiation Sources and Expected Radioactive Effluents

4.8.2.2.1 Gaseous Sources of Radiation

Gaseous radioactive effluents would be discharged primarily through the Reactor Building exhaust system. However, as stated in Subsection 2.6.1.3, there is no anticipated need for a gaseous radioactive waste system. Discharges from the Reactor Building exhaust system would pass through a HEPA filter and would be monitored prior to release. Tritium is expected to be the dominant routine gaseous radionuclide. No significant gaseous radioactive effluents are expected to be discharged through the spent fuel cooling system (SFCS), the DHRS, or the PHRS. All releases would be within the limits of 10 CFR 20 with consideration of the guidance provided in Regulatory Guide 4.20; therefore, the impacts from gaseous sources of radiation would be SMALL.

4.8.2.2.2 Liquid Sources of Radiation

The major liquid sources of radiation during operations would include the Flibe reactor coolant and the liquid nitrate salt intermediate coolant. However, when these materials have reached the end of their useful life, they are allowed to cool and solidify. Therefore, they would be managed as solid low-level radioactive waste (LLRW) during operations and decommissioning. Shielding materials, such as thick concrete walls, would be used to shield staff from large radiation exposures. Where necessary, piping used to circulate radioactive liquids would also be shielded to reduce radiation exposure rates. Exposures to these materials would be controlled to limit occupational doses with below regulatory limits provided in 10 CFR 20, Subpart C, *Occupational Dose Limits*. There would be small volumes of liquid wastes containing primarily tritium. These wastes would only be disposed of within the limits of 10 CFR 20 Table 3 (limits for releases to sewers); therefore, the impacts from liquid sources of radiation would be SMALL.

4.8.2.2.3 Fixed Sources of Radiation

During operations, solid sources of radiation that contribute to the direct dose would include fresh, circulating, and spent nuclear fuel, radioactive solid Flibe and nitrate salts, and other LLRWs, such as used moderator pebbles. During decommissioning, sources of radiation would also include the Hermes reactor and activated reactor system components and structural materials surrounding the reactor. These sources would be within the Reactor Building until they are removed for routine waste shipments or as part of facility decommissioning. Shielding materials, such as thick concrete walls, would be used to shield staff from large radiation exposures and control radiation doses to below the occupational limits provided in 10 CFR 20, Subpart C; therefore, the impacts from solid sources of radiation would be SMALL.

4.8.2.3 Baseline Radiation Levels

Background radiation levels and radiation levels in the vicinity of the site is discussed in Section 3.8. The site was once home the DOE's K-31 and K-33 gaseous diffusion plants and supporting facilities. Prior to transferring the properties for industrial development, the DOE conducted environmental baseline

Systems designed to support the safe and efficient management of these waste streams are described in Section 2.6. These waste systems would be operated in accordance with written procedures such that the final waste form would be acceptable for transportation in U.S. Department of Transportation (DOT) and/or NRC certified shipping containers. The quantities of radioactive wastes are also discussed in Section 2.6. There would be no on-site disposal of radioactive wastes during operations.

Each Hermes TRISO fuel pebble is estimated at 6 grams of uranium. At 35 MWth and 6 percent fissions per initial (heavy) metal atom (FIMA), an estimated 38,800 pebbles, or approximately 233 kilograms of uranium, will be consumed by the Hermes Reactor each year. Since the life of the Hermes Reactor is estimated to be 4~~10~~ years, a total of ~~388,000~~155,200 pebbles, or approximately ~~2,330~~931 kilograms of uranium (~~2.33~~0.93 metric tons of uranium [MTU] over 4~~10~~ years), would be consumed (this is a conservative estimate that assumes Hermes operates at full power). In contrast, the amount of spent fuel discharged from a typical light water reactor operating at low burnups is about 20 MTU per year.

Reprocessing is currently unlikely in the U.S., and an open fuel cycle is anticipated. Used TRISO fuel is assumed to be stored onsite until ultimate disposal. Management of used nuclear fuel is addressed in 10 CFR 51.23 and the associated NUREG–2157, Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel (Reference 1). NUREG–2157 concluded that the impact for at-reactor storage for each resource most of the resource areas would be small for short-term, long-term, and indefinite storage. NUREG-2157 did not address non-LWRs; to provide additional guidance to non-LWR license applications, the NRC, through Pacific Northwest National Laboratory, prepared Non-LRW Reactor Fuel Environmental Data (PNNL-29367) (Reference 2). Given degradation rates for storage systems associated with continued storage of TRISO fuel would not be significantly different than those considered for LWR storage systems, the environmental impacts for continued storage of LWRs described in NUREG–2157 are considered to bound any impacts of the Hermes fuel storage. Furthermore, the anticipated low mass of spent fuel generated during Hermes operations, approximately 0.93~~2.33~~ MTU over 4~~10~~ years, would be significantly lower than the 20 MTU per year generated from the power reactor evaluated in NUREG–2157.

Based on the quantities of waste, systems designed to manage radioactive waste streams, and waste management, impacts from all types of waste generated during operations, including impacts on the capacity of waste management facilities, would be SMALL. Impacts from waste transportation are discussed in Section 4.10.

4.9.1.3 Decommissioning

Prior to decommissioning the facility, Kairos Power would provide the NRC with a license termination plan (LTP) as described in NUREG 1757, Consolidated Decommissioning Guidance, Volumes 1 through 4. The LTP is defined in NUREG 1757 as a "detailed description of the activities a reactor licensee intends to use to assess the radiological status of its facility, to remove radioactivity attributable to licensed operations at its facility to levels that permit release of the site in accordance with NRC's regulations and termination of the license, and to demonstrate that the facility meets NRC's requirements for release. An LTP consists of several interrelated components including: (1) a site characterization; (2) identification of remaining dismantlement activities; (3) plans for site remediation; (4) detailed plans for the final radiation survey; (5) a description of the end use of the facility, if restricted; (6) an updated site-specific estimate of remaining decommissioning costs; and (7) a supplement to the environmental report, pursuant to 10 CFR 51.33, describing any new information or significant environmental change associated with the licensee's proposed termination activities (see 10 CFR 50.82)."

other sections of this ER and the direct and indirect impacts from the construction-related traffic would be SMALL.

4.10.2 Impacts from Operation

During the operation period, which includes startup activities, the facility would receive shipments of new nuclear fuel and coolant salts. When shipped to the site, the coolant salts would be nonradioactive; however, both the primary salt coolant Flibe and the intermediate (for heat transfer) nitrate salt coolant would become radioactive. There is sufficient storage capacity onsite for storage of the radioactive Flibe wastes, which would be allowed to cool, solidify, and likely held until decommissioning. As such, transportation of Flibe waste is described in Section 4.10.3. If Flibe wastes were shipped prior to decommissioning, impacts would be bound by those described in Section 4.10.2.3. Similarly, there would be sufficient onsite storage capacity for spent TRISO fuel and spent fuel transportation is also discussed in Section 4.10.3.

The following sections describe the impacts from transportation of materials to and from the facility during operations. Collectively, these impacts would be SMALL.

4.10.2.1 Transportation of Unirradiated Fuel

In the United States, low-enriched nuclear fuel for commercial light-water nuclear power plants is manufactured at either one of three facilities located in South Carolina, North Carolina, and Richland, Washington. A decision on the sourcing of fuel has not been made at this time. Fuel may be provided from either existing manufacturers or manufactured by Kairos Power at a nearby facility. For evaluation purposes it is assumed new TRISO fuel would be shipped by truck from Richland, WA. Richland, WA is the location of the furthest nuclear fuel manufacturer in the U.S. from the Kairos site.

Before startup, the facility would receive an initial shipment of fuel and then periodic shipments thereafter of fuel over the reactor's estimated 4~~10~~-year licensed operating life. The fuel loading for each 4.0 centimeter-diameter fuel pebble is estimated at 6 grams of uranium (6gU/pebble). For Hermes, at 35 MW_{th} and 6 percent fissions per initial (heavy) metal atom (FIMA), 38,800 pebbles will be consumed by the Hermes Reactor each year. Since the life of the Hermes Reactor is estimated to be 4~~10~~ years, a total of ~~388,000~~155,200 pebbles would be consumed.

Fresh fuel would likely be shipped from the manufacturer in appropriately certified containers such as Versa-Pac (VP) containers manufactured by DAHER Group, Transport Logistics International, Inc. (Reference 2). There are two VP sizes available which are certified by the DOT and configured for shipment of uranium oxides, uranium metal, uranyl nitrate crystals, and other uranium compounds such as TRISO fuel, which is specifically mentioned in the certification (Reference 3). The VP-110 is a 110-gallon drum-like package and the VP-55 is a smaller 55-gallon drum-like package. Both packages meet the specifications provided in 49 CFR 173.417 for fissile material package. If the VP-55 is used, each would contain approximately 350 fuel pebbles (Reference 2). The VP-55 has an outer diameter for approximately 23.2 inches and a height of 34.8 inches and has maximum gross weight limit of 750 pounds (Reference 3).

Fuel would be transported to the facility either periodically or once per year given the relatively small quantity involved. Approximately 111 containers of new fuel would be shipped each year consisting of 350 fuel pebbles per VP-55 (Reference 2). A standard highway shipping weight limit of 80,000 pounds gross weight and approximately 40,000 pounds cargo weight for a 40-foot container is maintained. Therefore, at 750 pounds per fuel container containing 350 fuel pebbles, approximately three trucks would be needed to transport a year's supply of fuel when operating at 35 MWth.

Unlike a conventional reactor which places new fuel into its core upon receipt, fuel pebbles would be continually fed into the reactor as spent fuel pebbles are being removed. Therefore, once containers of new fuel are received at the reactor facility, they would be placed into the fresh fuel storage area. There is sufficient on-site storage capacity for new fuel awaiting loading into the reactor at the facility.

Unirradiated fuel would be shipped on exclusive-use vehicles and fuel packages. Conveyances transporting unirradiated fuel packages must satisfy the radiation level restrictions in 49 CFR 173.441. For exclusive use shipments, the dose on contact with the package would not exceed 1 rem per hour (rem/hr) for a closed transport vehicle, 0.2 rem/hr at any point on the outer surface of the vehicle, and 0.01 rem/hr at 2 meters from the outer surface of the vehicle provided the conditions in 49 CFR 173.441(b)(1) are met. However, as evaluated in *Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants*, WASH-1238, external dose rate associated with traditional unirradiated fuel shipments containing between 0.5 and 2.0 curies of uranium in fuel casks would average about 4.0E-04 rem/hr at about 1 meter from the surface of the package and 5.0E-05 rem/hr at about 3 meters, well below the regulatory limits (Reference 4).

Transportation dose modeling of traditional LWR fuel using RADTRAN has demonstrated that the impacts from incident free transportation and transportation accidents is SMALL (Reference 5, Reference 6, Reference 7). The U.S. Department of Defense (DOD), acting through the Strategic Capabilities Office, has analyzed the transportation of high-activity low-enriched uranium TRISO fuels in VP-110 packages from Lynchburg, Virginia to Idaho using RADTRAN and also determined that the radiological risk measured as a risk of latent cancer fatality is less than 1 in 10,000 (Reference 8). Therefore, the impacts from the transportation of TRISO new fuel to the facility would be SMALL. Given uncertainty in the specific shipping modes and routes for transporting TRISO fuel to the facility, the shorter transportation distance than evaluated by DOD, the likely avoidance of major population centers, and the significant amount of past analysis of incident-free transportation of unirradiated nuclear fuel, a case-specific RADTRAN analysis was not performed for this Environmental Report.

4.10.2.2 Transportation of Spent Fuel

Spent fuel pebbles would be stored in long cylindrical storage canisters that are compatible with conventional dry cask storage overpacks. Individual canisters are 12 inches in outer diameter and over 7 feet in height. Each container would hold approximately 1,900 to 2,100 fuel pebbles. Canisters would be stored in a water pool for 30 to 50 days for initial cooling and then transferred to an air-cooled spent fuel storage bay.

Shipments of spent fuel during normal operations are not anticipated. Spent fuel would remain on site in the spent fuel storage facility which would be designed to accommodate all of the spent fuel generated during the expected 410-year licensed life of the reactor. Therefore, transportation of spent fuel is addressed as a decommissioning activity in Section 4.10.3.1 of this Environmental Report.

4.10.2.3 Transportation of Radioactive Waste

Routine LLRW would be transported off-site for disposal via truck. As provided in Table 2.6-1, radioactive waste volumes would be bounded by the estimates in WASH-1238 (Reference 4) and Kairos Power would not ship more than 3,800 ft^3 of Class B solid LLRW, primarily waste generated from tritium removal systems, and less than 400 ft^3 of Class A low-level dry active waste. These volumes would result in approximately 46 truck shipments per year. While some dry active waste may be compacted in waste drums, Kairos Power would not treat any other LLRW on site prior to transportation.

4.10.3 Impacts from Decommissioning

At the time of final reactor shutdown, the facility would initiate decommissioning and transportation of equipment, material, and waste. As noted previously, the facility would not ship spent fuel during the reactor's expected 410-year licensed operating life and would hold all spent fuel shipments until decommissioning. Therefore, the transportation of spent fuel is analyzed below.

4.10.3.1 Transportation of Spent Fuel

While there are currently no available sites to receive spent fuel, such as would be generated from operating the Hermes reactor at the facility, it is assumed that spent fuel shipments would be transported as follows:

- By truck over commercial highways
- To a facility not more than 2,100 miles away, which is the approximate distance from Oak Ridge, Tennessee to Beatty, Nevada (west of Yucca Mountain)
- In a transportation cask that is certified by the NRC and the DOT for transportation of spent TRISO fuel
- Radiation doses to members of the public and workers from incident-free transportation are bounded by the DOT conveyance dose rate limits evaluated in Section 4.10.2.5
- Not more than 60 spent fuel shipments by truck in a single year (bound by the 880 MWe reference reactor in WASH-1238)

Impacts from transportation accidents is not requested in Part 1 of ISG for NUREG-1537. However, NRC has evaluated the risks from spent fuel transport conducted in compliance with 10 CFR Part 71 regulations, *Packaging and Transportation of Radioactive Material*, in NUREG-2125, *Spent Fuel Transportation Risk Assessment*. NUREG-2125 considered radiological and nonradiological risks from routine incident-free transportation and transportation accidents. The findings and conclusions reported by the NRC are that the radiological impacts from spent fuel transportation conducted in compliance with NRC regulations are low.

In NUREG-2125, the NRC provided general insights on expected changes resulting from transporting higher burnup spent LWR fuel. The NRC stated that for incident-free transportation, there would be no effect, as the external dose rates will need to meet the same DOT requirements. The NRC also concluded that impacts to the public will be bounding for accident scenarios even considering changes in the radionuclide inventory and increases in release factors.

Therefore, the impacts from transporting spent fuel from the facility are in compliance with DOT and NRC regulations and would be SMALL.

4.10.3.2 Transportation of Radioactive Waste

The environmental impacts from the decommissioning of nuclear power plants, including the impacts from the transportation of decommissioning waste, have been analyzed by the NRC as described in NUREG-0586, *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities,* Supplement 1, Volume 1. The NRC made the generic conclusion that for all plants, the potential transportation impacts would be SMALL, with the factor determining the magnitude of transportation impacts of decommissioning including:

- Changes in waste production due to decontamination and dismantlement activities that increase the amount of waste shipped offsite
- Changes in transportation methods (rail, truck, or barge) related either to the increased amount to be shipped offsite or the type of material to be shipped

- The environmental impacts associated with in-water retrofit activities, potential dredging requirements, and impingement and entrainment would be greater than using the existing municipal system.
- The site has an expected limited licensed operational life of 4~~10~~ years and does not support the costs associated with retrofitting the existing structure.

Per conversations with the Oak Ridge Utility Services Department, the wastewater plant receiving the flows from the industrial parks on the west end of the city is currently rated for 0.6 MGD with an average flow between 0.05 and 0.07 MGD; however, peak flows have occasionally exceeded the 0.6 MGD plant capacity. The city is currently working towards reducing inflow and infiltration coming to the plant. The city is evaluating an expansion to this plant which would double the capacity; however, no specific plans are currently in place.

Since the municipal waste system currently has sufficient capacity to service the needs of the site (0.07 MGD), it has been selected as the proposed wastewater discharge option. Wastewater discharge to Poplar Creek was considered as a potential alternative, but was eliminated from further consideration due to the following:

- Existing oil water separators and discharge structures currently exist near the proposed site. However, additional upgrades may be required to include additional permitting, water treatment, and monitoring.
- The environmental impacts associated with in-water retrofit activities and added discharges to the environment would be greater than utilizing the existing municipal system.
- The facility's operational life of 4~~10~~ years does not support the costs associated with retrofitting existing structures.

5.3 REASONABLE ALTERNATIVES

This section describes how the site was developed, and potential alternatives to the proposed project, based on the guidance in Section 19.5 of the Final ISG Augmenting NUREG-1537, Part 1 and Section 19.5 of the Final ISG Augmenting NUREG-1537, Part 2. Based on the guidance in these ISG documents, this section:

- Describes the process used to develop, identify, and evaluate reasonable alternatives
- Describes reasonable alternatives considered
- Identifies the alternatives that were eliminated from further evaluation
- Considers whether alternatives may avoid or reduce adverse effects

According to the two ISG documents, reasonable alternatives may include, but are not limited to, alternative sites, alternative siting within a proposed site, modification of existing facilities, alternative technologies, and/or alternative transportation methods. The proposed project involves the demonstration and testing of new technology. Therefore, alternative technologies are not considered, and modification of an existing facility to house the proposed project is not feasible. With respect to alternative transportation methods, the proposed location of the site on a specific site within the East Tennessee Technology Park (ETTP) limits transportation options to vehicle transport using the existing road network, or rail transport using the existing onsite rail network. Based on the scope/size of components, extensive use of rail transport is not expected to be necessary, but the existing rail infrastructure would be expected to be sufficient without significant modification. Alternative routes, types of vehicles, carpooling of workers, or other transportation-related features may be considered as mitigation measures, but do not merit full analysis as alternatives. Similarly, the proposed project has been specifically sited within the former K-33 site on the ETTP to minimize potential impacts. The

- Noise from construction and operational activities, including lighting, would result in some temporary and some permanent displacement of wildlife. Some temporarily displaced wildlife species would return to any remaining suitable habitat.
- During operation, there would be the potential for birds to collide with buildings and stacks. However, collisions are unlikely, and the impact is expected to be minor.

5.5.1.1.5 Historical and Cultural Resources

- Facility construction has the potential to impact archeological sites previously identified at the site. An Archaeological Monitoring and Discovery Plan would be developed to minimize these impacts.

5.5.1.1.6 Socioeconomics

- Facility construction would result in a temporary increase in demand for housing, public education resources, police, fire, medical and social services, and parks and recreation facilities.
- Facility operation would result in a minor increase in demand for housing, public education resources, police, fire, medical and social services, parks and recreation facilities, and other public services.
- Facility construction would result in a temporary increase in local traffic due to construction workforce traffic in early morning and late afternoon and periodic construction vehicle traffic throughout the workday.
- Facility operation would result in minor increase in local traffic due to vehicle movements associated with employees and deliveries/shipments of supplies and products.

5.5.1.1.7 Environmental Justice

- No environmental justice impacts would be anticipated.

5.5.1.1.8 Human Health

- During facility operation, the public would be exposed to minor doses of radiation due to transportation of radioactive materials to and from the site, as well as direct radiation and releases of gaseous effluents from the project. Radioactive materials would be strictly controlled, and all radiological doses would comply with regulatory limits.

5.5.1.2 Other Costs

- No other environmental costs, such as lost tax revenues or decreased recreational values, have been identified.

5.5.1.3 Environmental Benefits

- The construction phase of this project is expected to create approximately 212 onsite workers (425 at peak times) and 68 full-time positions during the 4~~10~~-year operating period. Another 168 positions are expected during decommissioning. The wages earned and money spent by these workers would also stimulate the local economy.

5.5.1.3.1 Increase in Tax Payments

- The tax basis of unimproved land is determined by land value alone. Once buildings or other improvements are made, those improvements would be assessed, and both the land and the improvements would be taxed. The taxes for the site would increase substantially after project construction, benefitting Bonneville County.