CHAPTER 10 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

Section 102(c) of the National Environmental Policy Act (NEPA) specifies three requirements that an Environmental Impact Statement must evaluate. This chapter evaluates these three requirements associated with constructing and operating two or more small modular reactors (SMRs) at the Clinch River Nuclear (CRN) Site. The three requirements are evaluated in the following three sections:

1) Section 10.1: Unavoidable Adverse Environmental Impacts
2) Section 10.2: Irreversible and Irretrievable Commitments of Resources
3) Section 10.3: Relationship between Short-term Uses and Long-term Productivity of the Human Environment

The Benefit-Cost Balance normally included in Chapter 10 is addressed in the combined license application (COLA).

10.1 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

This section describes principal unavoidable adverse environmental impacts for which mitigation measures are either considered impractical, do not exist, or cannot entirely eliminate the impact. Chapter 4 describes the impacts of constructing two or more SMRs at the CRN Site and Chapter 5 describes the impacts of operating those SMRs. The unavoidable adverse impacts identified in Chapters 4 and 5 are discussed in this section. The unavoidable adverse impacts associated with constructing and operating the new underground 69- kilovolt (kV) transmission line from the CRN Site to the Bethel Valley substation also are discussed. In addition, the unavoidable adverse impacts identified for maintaining and operating the existing 500-kV and relocated 161-kV transmission lines on the CRN Site are described.

As discussed in Subsection 5.6.1, transmission line upgrades in conjunction with the CR SMR Project include reconductoring, uprating, and rebuilding some segments within the existing lines on and off the CRN Site. These upgrades, which would increase the electrical capacity of the existing transmission system, include activities such as moving features that interfere with clearance, replacing and/or modifying existing structures, installing intermediate structures, and modifying or replacing some of the existing conductors in order to increase ground clearance. As provided in Table 3.1-2, Item 16.6, the CR SMR Project has a maximum total electrical output of 800 megawatt electric (MWe), depending upon the design and number of SMR units deployed.

10.1.1 Unavoidable Adverse Environmental Impacts during Construction and Preconstruction

Construction and preconstruction impacts, and measures and controls used to reduce or eliminate such impacts, are briefly summarized in Table 4.6-1. As noted in Table 4.6-1, most of the impacts would be SMALL, because they either would not be detectable or would be minor compared to the availability or status of the affected resources. Exceptions include some land

areas such as historic properties and archaeological sites and socioeconomic areas such as employment, transportation, and aesthetic impacts. No construction-related activities result in disproportionately high and adverse environmental or health effects on minority or low income populations.

Table 10.1-1 summarizes impacts related to construction and preconstruction activities that result in a measurable loss or permanent change in resources, the mitigation and control measures available to reduce those impacts, and the remaining unavoidable adverse impacts after mitigation and control measures are applied. Preconstruction activities are not related to nuclear safety and are generally more site-wide in scope, while construction activities are more likely to be unit-specific and include activities associated with safety-related structures, systems, and components. The impact determinations in the text and in Table 10.1-1 address the combined impacts of construction and preconstruction. Many of the mitigation measures for reducing construction-related impacts are also referred to as best management practices (BMPs). The BMPs are implemented through permitting requirements and plans and procedures developed for constructing or operating the CRN Site.

As indicated in Table 10.1-1, most of the adverse impacts are either avoidable or negligible after mitigation and control measures are considered.

As discussed in Subsection 4.1.1, approximately 327 acres (ac) of the CRN Site are disturbed on a long-term basis due to construction of the SMR units and associated infrastructure. Approximately 30 ac of land off the CRN Site are occupied on a long-term basis by road and rail improvements and barge terminal refurbishment. With implementation of BMPs and compliance with applicable federal, state, and local permits and ordinances, impacts on land use of the site and vicinity from construction would be SMALL.

Subsection 4.2.1.1.1 discusses impacts of land-based construction on surface water hydrology, and Subsection 4.2.3.1 discusses impacts of construction on surface water quality. Clearing for construction and addition of paved areas results in increased stormwater runoff. However, compliance with the CRN Site's Stormwater Pollution Prevention Plan (SWPPP) and National Pollutant Discharge Elimination System (NPDES) permit for discharges of stormwater associated with construction activities ensure that the impact to surface water resources would be SMALL.

Subsection 4.2.1.1.2 discusses impacts of water-based construction on surface water hydrology, and Subsection 4.2.3.1 discusses impacts of construction on surface water quality. Limited underwater excavation associated with intake and discharge construction would result in SMALL localized changes in flow patterns along the reservoir bottom due to differences in bottom contours at the edges of the excavation zone. Underwater excavation also results in a temporary increase in turbidity and sedimentation. Impacts would be mitigated by monitoring and coordination of excavation in conformance with the Interagency Agreement between Tennessee Valley Authority (TVA), the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the Tennessee Department of Environment and

Conservation. Impacts of construction on aquatic ecology are discussed in Subsections 4.3.2.1 and 4.3.2.3. Construction of intake and discharge structures as well as installation of underground transmission lines cause temporary impacts to benthic and aquatic organisms. However, with the implementation of BMPs and the installation of appropriate engineering controls, the impacts would be SMALL.

Impacts of construction on terrestrial ecology are discussed in Subsection 4.3.1.4. Permanent loss of up to 357 ac of potential wildlife habitat and approximately 2 ac of wetlands would impact terrestrial ecology. The habitats that would be affected are common forest and early successional communities that are widespread in adjacent areas and the region and are not sensitive or critical habitats for wildlife or plants, including bats or other listed species. Therefore, impacts on terrestrial ecology would be SMALL.

As discussed in Subsection 4.4.1.1, indirect noise and vibration impacts to the public from construction-related traffic on local roads associated with preconstruction and construction activities would be SMALL to MODERATE. As discussed in Subsection 4.4.2.3, with the implementation of recommended roadway modifications, increased traffic congestion from construction workers and deliveries would result in a MODERATE and temporary impact in the vicinity of the CRN Site during the peak period of construction.

Visual impacts from construction are discussed in Subsection 4.4.2.6. For nearby residents and recreational users of the Clinch River arm of the Watts Bar Reservoir, the aesthetic impacts would be MODERATE.

As described in Subsection 4.1.3, some archaeological resources are located in areas that are impacted by construction. A final assessment and any required mitigation for historic sites are dependent on the outcome of the Phase II testing and Tennessee State Historic Preservation Officer (SHPO) consultation. With construction and preconstruction activities, although unexpected, there is the potential for inadvertent discovery of previously unknown archaeological resources or human remains. Therefore, impacts to archaeological and historic properties would be SMALL to MODERATE.

Impacts to air quality due to construction are discussed in Subsection 4.4.1.2. Preconstruction and construction activities generate temporary gaseous and particulate emissions. These emissions are mitigated under the project's construction mitigation plan. Thus, air quality impacts during the preconstruction and construction phases would be SMALL.

10.1.2 Unavoidable Adverse Environmental Operational Impacts

Table 5.10-1 summarizes operational impacts, and identifies measures and controls available to reduce or eliminate such impacts. This subsection describes unavoidable adverse impacts resulting from operation of the Clinch River (CR) SMR Project. As noted in Table 5.10-1, all operations-related impacts would be SMALL, because they would either not be detectable or would be minor compared to the availability or status of the affected resource. Table 10.1-2

summarizes operations-related impacts that result in a measurable loss or permanent change in resources, the mitigation and control measures available to reduce these impacts, and the remaining adverse impacts after mitigation and controls measures are applied. There are no operations-related activities resulting in disproportionately high and adverse environmental or health effects on minority or low income populations.

As discussed in Subsection 5.1.1.1, continued commitment of land over the operational life of the CR SMR Project includes approximately 327 ac of the CRN Site occupied by the SMR units and associated infrastructure, along with approximately 30 ac of land offsite occupied by road and rail improvements and barge terminal refurbishment. It is expected that operational activities at the CRN Site would have SMALL impacts on land use within the Site Boundary and in its vicinity. One 161-kV transmission line is to be relocated onsite. No new offsite transmission line rights-of-way (ROWs) are to be developed. Impacts on land use associated with operation and maintenance of the transmission corridors would be SMALL.

Subsection 5.2.1.2.1 discusses the impact of operations on surface water hydrology. Hydrologic alteration impacts, including water withdrawn from the Clinch River arm of the Watts Bar Reservoir for cooling tower makeup and discharged back to the reservoir, would be SMALL.

A thermal plume is generated from cooling water blowdown discharged to the Clinch River arm of the Watts Bar Reservoir. Discussions of the predicted thermal discharge plume analysis data are provided in Section 5.3.2.1. With the operation of the Melton Hill Dam bypass at 400 cubic feet per second (cfs) and compliance with the NPDES permit, the thermal plume and its effect on aquatic biota would be SMALL.

Subsection 5.2.2.1.1 discusses the impact of plant operations on surface water uses. Consumptive and evaporative water loss impacts affecting the Clinch River arm of the Watts Bar Reservoir would be SMALL.

As discussed in Subsection 5.3.3.1, discharge of an atmospheric vapor plume from linear mechanical draft cooling towers (LMDCT) can obstruct the view of the sky and cause a shadowing effect on the ground, which has a small effect on vegetation. The expected cooling tower atmospheric plume lengths by season and direction for the LMDCTs are discussed in Subsection 5.3.3.1. The potential impacts would be SMALL.

Some of the land cleared prior to construction is to be re-vegetated and allowed to enter secondary successional stages after construction is complete. Common terrestrial habitats are permanently lost in areas within facility footprints; however, these habitats are not sensitive or critical habitats for wildlife or plants, including bats or other listed species. The occurrence of extensive areas of similar habitats in the vicinity and the region indicate that this would represent a SMALL impact to terrestrial ecology.

Subsection 5.3.1.2 discusses the impact of plant operation on aquatic ecology. Relatively minor effects on fish and other aquatic organisms as a result of impingement and entrainment at the

intake and thermal and chemical effluents at the discharge would represent a SMALL impact to aquatic biota. The impact would be mitigated by compliance with EPA Section 316(b) guidelines for intake design, which would minimize impingement by limiting intake velocity and water withdrawal requirements.

As discussed in Subsection 5.3.3.1.3, modeling of the project's cooling tower demonstrated that deposition of small amounts of salt, in the form of sodium chloride (NaCl), on the surrounding vicinity created by cooling tower drift would have a SMALL impact that is unlikely to have noticeable effects on vegetation beyond a limited area adjacent to the cooling towers.

Impacts of plant operation on traffic are discussed in Subsection 5.8.2.3. With recommended road modifications implemented during construction, increased traffic would result in a SMALL impact to traffic levels in the vicinity of CRN Site over the operational period of the CR SMR Project.

As discussed in Subsection 5.8.1.4, the visual impact from the CR SMR Project and associated structures, including the cooling tower plumes, and the existing transmission line ROWs would range from SMALL to MODERATE, depending on the location of the observer and the atmospheric conditions.

Noise impacts from operation are discussed in Subsection 5.8.1.1. Noise impacts from SMR operations and maintenance and operation of the transmission line ROW would be SMALL.

Operations impacts on population and housing are discussed in Subsections 5.8.2.1.1 and 5.8.2.1.2, respectively. Operation of the SMR units is expected to require approximately 500 workers, of which about 50 percent are expected to migrate into the region. An additional 1000 workers are expected to temporarily work at the CRN Site during periodic refueling and major maintenance activities. It is assumed that all of the temporary workers are from outside of the region. The permanent projected influx of workers and their families increase the population in the geographic area of interest by approximately 0.1 percent. It is not expected that the 1000 temporary workers required for each periodic refueling event would permanently locate to the geographic area of interest. The relocation of 250 workers and their families, and the temporary presence of the refueling workers, would have a SMALL impact.

The impact of operations on utilities and services is discussed in Subsection 5.8.2.7. The operational burden would have a SMALL impact on fire protection, police and other essential community services and infrastructure.

As discussed in Subsection 5.1.3.1, potential disturbance or impacts to archaeological resources during maintenance activities would be SMALL. Such possible impacts would be mitigated through consultation with the SHPO and development of appropriate treatment measures depending on the nature of the discovery and impact.

Subsections 5.4.3 and 5.4.4 discuss the impacts of operation on radiological health. Minor radioactive emissions and direct radiation result in doses to workers and members of the public within regulatory limits and would have a SMALL impact.

Environmental effects of the contributions to the uranium fuel cycle (UFC), including land commitments for uranium mining and waste management and radiation dose impacts from the transportation of unirradiated fuel, irradiated fuel, and radioactive waste would be SMALL.

10.2 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

This section describes anticipated irreversible and irretrievable commitments of environmental resources that are used in the construction and operation of two or more SMRs at the CRN Site.

For the purposes of this analysis, the term “irreversible” applies to the commitment of environmental resources (e.g., permanent use of land) that cannot by practical means be reversed to restore the environmental resources to their former state.

In contrast, the term “irretrievable” applies to the commitment of material resources (e.g., irradiated steel, petroleum) that, once used, cannot by practical means be recycled or restored for other uses.

10.2.1 Irreversible Environmental Commitments

Irreversible environmental commitments resulting from the CR SMR Project include:

- Changes in land cover and land use
- Loss of aquatic and terrestrial habitats and biota
- Removal of some archaeological resources and potential loss of some unidentified archaeological resources
- Degradation of air and water resources
- Land disposal of equipment and materials contaminated by hazardous and low-level radioactive waste
- Commitment of underground geological resources for disposal of high-level radioactive waste and spent fuel
- Destruction of geological resources during uranium mining

10.2.1.1 Land Use

Table 4.1-1 describes the acreages that would be disturbed, either permanently or temporarily, on the CRN Site and in the Barge/Traffic Area. For construction of the reactors and other facilities on the 935-ac CRN Site, approximately 167 ac would be temporarily disturbed and 327 ac would be permanently disturbed (for a total disturbance of 494 ac). For offsite road, and

barge terminal improvements in the Barge/Traffic Area, approximately 15 ac would be temporarily disturbed and 30 ac would be permanently disturbed (for a total disturbance of 45 ac). Additionally, up to approximately 210 ac offsite would be temporarily disturbed for installation of the offsite portions of the 69-kV underground transmission line. Thus, offsite land disturbances in both the Barge/Traffic Area and the underground transmission line area would total approximately 255 ac (45 ac plus 210 ac). During facility operation, approximately 327 ac of the CRN Site is occupied by the SMR units and associated infrastructure and approximately 30 ac of land offsite is occupied on a long-term basis by road and rail improvements and barge terminal refurbishment. This land is largely unavailable for uses other than support of the construction and operation of the SMRs. Once the SMRs cease operations, and the CR SMR Project is decontaminated and decommissioned in accordance with U.S. Nuclear Regulatory Commission (NRC) requirements, the land that supports the facilities is to be returned to other industrial or nonindustrial uses. However, the land may continue to be committed to nonindustrial uses, or for other electrical generation projects or other purposes.

10.2.1.2 Aquatic and Terrestrial Biota

As discussed in Section 4.3, construction displaces or destroys some terrestrial and aquatic habitats, flora, and fauna on and near the CRN Site, with no significant effects on species or habitats, including effects on bats or other listed species. After construction is complete, areas with reversible impacts that are no longer needed for the project, are to be re-vegetated and returned to habitat, allowing some flora and fauna to recover in areas that are no longer affected by facility operations. Following decommissioning, additional habitats is to be restored on the CRN Site.

10.2.1.3 Historic Properties

As described in Subsection 4.1.3, some archaeological sites within the CRN Site cannot be avoided and will be displaced and/or destroyed by CRN Site construction. TVA has executed a Programmatic Agreement (PA) pursuant to 36 CFR 800.14(b)(3) to record the terms and conditions agreed upon to resolve potential adverse effects of the undertaking on historic and archaeological resources. The signatories to the PA are: TVA and the Tennessee SHPO. Invited concurring parties are the Eastern Band of the Cherokee Indians and the United Keetoowah Band of the Cherokee Indians in Oklahoma. A final assessment and development of the required mitigation for historic properties are dependent on the outcome of Phase II testing and Tennessee SHPO consultation in accordance with the stipulations in the PA. No significant effects on archaeological resources are anticipated. The inadvertent discovery of previously unknown archaeological resources or human remains is possible and would be addressed in accordance with the stipulations of the PA.

10.2.1.4 Air and Water Resources

During construction, fugitive dust and vehicle emissions are released to the air, and sediment is released to adjacent surface water bodies. Project operations result in the release of hazardous

and radioactive emissions to the air, along with treated hazardous and radioactive effluents to adjacent surface water. These releases of hazardous and radioactive emissions/effluents from SMRs at the CRN Site are made and monitored in accordance with duly-issued permits. The releases are in compliance with applicable regulatory standards and are not expected to significantly affect air or water resources.

10.2.1.5 Socioeconomic Resources

The CR SMR Project results in minor changes in the population, the nature and character of the local community, and the local socioeconomic structure, as detailed in Subsections 4.4.2 and 5.8.2. However, no irreversible commitments would be made to socioeconomic resources because they are to be reallocated for other purposes once the SMRs are decommissioned.

10.2.1.6 Disposal of Non-hazardous, Hazardous, and Radioactive Waste

Operation of the SMRs at the CRN Site generates radioactive, hazardous, and nonhazardous waste requiring disposal. These waste streams are to be treated at permitted facilities or disposed in permitted landfills. Land committed to the disposal of wastes would have an irreversible impact because it would be committed for that use with few other purposes.

10.2.1.7 Uranium Fuel Cycle

Table 5.7-2 presents environmental data on the UFC. These data describe the contribution of the environmental effects related to UFC activities required to support a nuclear power reactor. The permanent land commitments for the UFC (mining and waste management) would have an irreversible impact because the land would be committed for that use, and can be used for few other purposes. Energy commitments associated with fuel enrichment are also irreversible.

10.2.2 Irretrievable Environmental Commitments

Irretrievable environmental commitments resulting from the CR SMR Project may include:

- Construction and irradiated materials
- Water consumption
- Consumption of energy
- Consumption of uranium fuel

10.2.2.1 Construction and Irradiated Materials

Metals, concrete, and other materials used in the construction of the SMRs at the CRN Site become contaminated or irradiated over the life of facility operations. Much of this material cannot be reused or recycled, and is disposed of as radioactive waste during decommissioning of the facility.

Concrete, rebar, structural steel, power cable, and small and large bore piping are common materials used in new reactor construction. Estimates of these irretrievable commitments would be based on the specific reactor design selected. Because some of this material may be reused (if uncontaminated) or decontaminated for future use, the recycled portion does not constitute an irretrievable commitment of resources.

Although the amount of construction materials is large, use of such quantities in large-scale construction projects such as nuclear reactors, hydroelectric and coal-fired plants, and many large industrial facilities (e.g., refineries and manufacturing plants) would represent a relatively small incremental increase in the overall use of such materials. Even if this material is eventually disposed of, use of construction materials in such quantities would be small relative to the national or global consumption of these materials.

An additional irretrievable commitment of resources would include materials used during normal facility operations, some of which are recovered or recycled. The estimated amount of materials that are consumed during construction is provided at COLA.

10.2.2.2 Water Consumption

As stated in Subsection 3.3.1, relatively small amounts of potable water are used during construction and operation of the SMRs at the CRN Site. Some of the cooling water taken from the Clinch River arm of the Watts Bar Reservoir is consumed through the cooling towers by way of drift and evaporation. Both potable water and cooling water are eventually returned to the ecosystem through the water cycle, but they may return a long distance away, and no longer be available within the Tennessee River Basin.

10.2.2.3 Consumption of Energy Used in Constructing the Reactors

Nonrenewable energy in the form of fuels (i.e., gas, oil, and diesel) and electricity are consumed in construction and, to a much smaller extent, in the operation of the CR SMR Project. Beyond ancillary (e.g., vehicles, equipment) usage, nuclear reactors do not directly consume fossil fuels such as petroleum or coal, except to the extent that electrical power supplied for plant operations is derived from the overall TVA system, which includes coal and gas-fired generation. The total amount of energy consumed during construction or operation of the CR SMR Project is very small in comparison to the total amount consumed within the United States. On net balance, the reactor produces more energy (as measured in British Thermal Units) than is consumed in its construction and operation.

10.2.2.4 Consumption of Uranium

According to the World Nuclear Association, in June 2015, the United States had 99 operating nuclear power plants producing 98,792 MWe with five additional plants under construction producing an additional 6,018 MWe. These 104 plants require 18,692 tons of uranium. (Reference 10-1) Based on the electrical power output of existing operable reactors and

reactors currently under construction, the addition of SMRs at the CRN Site (up to 800 MWe) increases consumption of uranium in the United States by approximately 0.76 percent and increases worldwide consumption of uranium by approximately 0.18 percent. Also, as described in Subsection 5.7.1, uranium resources including domestic and international supplies along with surplus supplies from the DOE are sufficient to meet current demands. Thus, the addition of SMRs at the CRN Site by itself would not result in a significant commitment of worldwide uranium resources.

10.3 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY OF THE HUMAN ENVIRONMENT

Consistent with NEPA requirements, this section focuses on describing the relationship between the proposed action's short-term use of environmental resources versus the maintenance and enhancement of long-term environmental productivity. This section focuses on and compares the significant short-term benefit (e.g., principally generation of electricity) and uses of environmental resources which have long-term consequences on environmental productivity.

The uses of the human environment associated with the proposed action include the unavoidable adverse impacts to resources, as well as the irreversible and irretrievable commitment of resources, associated with both construction and operation of the SMRs. Impacts which would cease, or could be reversed, following plant decommissioning are considered short-term, because they would be restored to their role in supporting long-term productivity following decommissioning. These include resources such as air quality, water quality and water use, terrestrial and aquatic ecological resources, noise, visual resources, and socioeconomic resources. The long-term productivity of these resources would be restored following project decommissioning, so would not be affected. Impacts which cannot be reversed, or which would continue long past the decommissioning of the project, may be considered long-term. These include land use and impacts to historic properties. The long-term productivity of these resources may be affected by the project. Similarly, the commitment of depletable resources would be considered long-term, as they would no longer support long-term productivity following decommissioning. Finally, the long-term management of radioactive waste from operations and decommissioning, management of irradiated fuel that must be safeguarded and isolated from the biosphere for thousands of years, represent a continuing, long-term commitment of resources long after decommissioning has occurred.

The short-term use of some resources, long-term use of others, and irreversible and irretrievable commitment of depletable resources would be offset by the benefit of the production of electrical power. This benefit would be considered short-term, occurring only throughout the operational life of the SMRs. But this benefit would be much larger than the productivity of any other uses of those resources during the operational life of the SMRs. In addition to this short-term benefit, the project would continue to have long-term benefits, even following decommissioning. The production of power throughout the operational life of the SMRs would enhance regional development and economic activity, which would continue past the operational life of the SMRs. Also, following decommissioning, plant structures and

infrastructure may be turned to other productive uses which could continue to support economic activity in the area. And finally, the CR SMR Project would serve as a demonstration of SMR technology as a viable option for electric power production at other locations long after the CR SMRs have been decommissioned.

10.4 BENEFIT-COST BALANCE

The Benefit-Cost Balance is provided at COLA.

10.5 REFERENCES

Reference 10-1. World Nuclear Association, World Nuclear Power Reactors and Uranium Requirements, Website: http://www.world-nuclear.org/info/Facts-and-Figures/World-Nuclear-Power-Reactors-and-Uranium-Requirements/, June 1, 2015.

Table 10.1-1 (Sheet 1 of 5)
Unavoidable Adverse Environmental Impacts from Construction and Preconstruction

Category	Impacts	Mitigation Measures	Unavoidable Adverse Impacts
Land Use	SMALL	Clear only areas necessary for installation and security of the SMR units and associated infrastructure. Enhance awareness of construction workers to environmental BMPs. As appropriate, have environmental staff supervise activities that can alter or harm the environment. Apply erosion controls and stabilization measures, such as those provided by applicable regulations and stormwater prevention practices and procedures. As feasible, limit activities to actual construction site and access ways. To the extent feasible, re-vegetate or restore affected temporary-use areas to approximately their native state after completion of construction. Comply with requirements of applicable federal, state and local construction permits/approvals and local ordinances. Comply with requirements of all applicable TVA environmental compliance procedures and processes. Restrict ground-disturbing equipment to the existing ROW boundaries, as appropriate. Restore or re-vegetate disturbed areas, with attention to wildlife habitat or food plots. Reduce potential impacts through compliance with permitting requirements and BMPs, including use of sediment basins. Restrict maintenance access to existing roads. Implement waste minimization program to reduce the volume of debris generated. Train appropriate employees in procedures and methods for reducing waste.	Approximately 494 ac of the 935 ac CRN Site would be disturbed during construction. Approximately 255 ac would be disturbed offsite for road, rail and barge terminal improvements and for construction of the offsite portions of the underground transmission line. Landfill space would be consumed for disposal of construction debris from CR SMR Project.

Table 10.1-1 (Sheet 2 of 5)
Construction–Related Unavoidable Adverse Environmental Impacts

Category	Impact	Mitigation Measures	Unavoidable Adverse Impacts
Water Quality	SMALL	Comply with applicable regulations, permits, and plans. Apply BMPs as found in stormwater regulations and procedures. Re-vegetate construction areas in a timely manner. Install drainage controls to direct dewatering runoff. Invoke spill prevention procedures for construction activities. Use BMPs to maintain equipment and prevent spills and leaks. Train appropriate employees in methods for preventing and/or responding to spills.	Local and temporary increase in sediments in water from increased erosion and construction stormwater runoff; construction in the Clinch River arm of the Watts Bar Reservoir; and discharge of excavation dewatering product and spills. Underwater excavation would result in minor localized changes in flow patterns along the reservoir bottom due to differences in bottom contours at the edges of the excavation zone, as well as temporary suspension of sediments during excavation. Use of heavy equipment would introduce the possibility of petroleum and other chemical spills that could enter surface water.
Water Use	SMALL	Comply with applicable regulations, permits, and plans.	None
Aquatic Ecology	SMALL	Install cofferdams or similar engineering protective measures around the construction sites. Employ BMPs to minimize erosion and sedimentation. Install storm water drainage systems at large construction sites and stabilize disturbed soils.	Minimal or no unavoidable adverse impacts. Construction of the intake at reservoir's edge and the discharge in the reservoir bottom may cause a short-term loss of some benthic and aquatic organisms and temporary degradation of habitat, as well as permanent loss of limited areas of habitat at the intake and discharge structures. Installation of underground transmission line would involve crossing streams and may cause temporary disturbance of aquatic habitats in short stream segments within the ROW.

Table 10.1-1 (Sheet 3 of 5)
Construction–Related Unavoidable Adverse Environmental Impacts

Category	Impact	Mitigation Measures	Unavoidable Adverse Impacts
Terrestrial Ecology	SMALL	In disturbed areas not within the footprint of permanent facilities, re-vegetate most of the land and return it to terrestrial habitats, resulting in a reduction of ecological impacts over time. To the extent feasible, plan construction activities to take place on previously disturbed areas. Use BMPs to prevent impacts to adjacent habitats, such as from erosion and runoff of sediment. To the extent feasible, plan facility locations and construction activities to avoid wetlands. U.S. Army Corps of Engineers determines required mitigation for impacted wetlands. To the extent feasible, minimize disturbance to habitats, and schedule activities for periods when sensitive species are unlikely to be present. Limit vegetation removal and construction activities to construction sites, underground transmission line ROW, and access roads. Limit cutting of trees over 5 inches in diameter at breast height to a period between November 16 and March 31 to avoid impacts to the Federally listed Indiana bat during the non-hibernation period. As practical, use modern equipment that is designed to minimize noise. Follow procedures for minimizing noise.	Permanent loss of approximately 327 ac of habitat on the CRN Site within the footprint of the SMR units and associated infrastructure. Permanent loss of approximately 30 ac of offsite habitat within the footprint of road, rail, and barge terminal improvements. Approximately 494 ac of the 935-ac CRN Site, most of which is terrestrial habitat, would be disturbed during construction. Total of approximately 255 ac of habitat off the CRN Site would be disturbed for road, rail, and barge terminal improvements and the installation of the offsite portions of the underground transmission line. Filling of small wetland areas (total less than approximately 1 ac) within construction footprints. Approximately 0.5 ac may be impacted off the CRN Site. Mitigation would reduce impacts. Clearing of trees and other vegetation and grading could harm or displace some animals, including bats. Construction noises may cause some animals to avoid nearby habitats. This impact may occur intermittently throughout the construction phase. Birds may occasionally collide with tall construction equipment.

Table 10.1-1 (Sheet 4 of 5)
Construction–Related Unavoidable Adverse Environmental Impacts

Category	Impact	Mitigation Measures	Unavoidable Adverse Impacts
Socioeconomics	SMALL TO MODERATE	Construct the recommended roadway improvements . Use additional measures such as traffic officers during peak hours. Encourage use of vans and carpools. Post signs near construction entrances and exits to make the public aware of potentially high construction traffic areas. Train and appropriately protect employees and construction workers to reduce the risk of potential exposure to noise, dust and exhaust emissions. Make public announcements or prior notification of atypically loud construction activities. Use dust control measures (such as watering, stabilizing disturbed areas, and covering trucks). Regularly maintain construction equipment in regard to exhaust emissions and noise. Use modern equipment designed to reduce noise. Limit extreme noise-producing activities to daylight hours. Communicate with county and local school and government officials concerning the number and schedule for influx of construction workers in advance. State distribution of the 3 percent portion of TVA's in lieu tax payments reserved for counties impacted by TVA construction projects to help offset any costs associated with increasing levels of services for the construction workforce.	Increased levels of traffic that would continue through the course of the construction phase. Increased levels of temporary and localized noise, exhaust emissions, and fugitive dust associated with construction activities. Increased demand for housing, infrastructure, public services, and education resources on a short-term basis from the influx of construction workers and families.

Table 10.1-1 (Sheet 5 of 5)
Construction–Related Unavoidable Adverse Environmental Impacts

Category	Impact	Mitigation Measures	Unavoidable Adverse Impacts
Historic and Cultural Resources	SMALL TO MODERATE	Conduct Phase II site evaluations for prior to start of ground disturbing work to identify cultural resources at National Register of Historic Places (NRHP)-eligible sites that cannot be avoided and avoid all other NRHP-eligible sites. Comply with the stipulations of the Programmatic Agreement with the Tennessee SHPO. Comply with the discovery plan to assess impacts associated with the discovery of previously unknown archaeological resources or human remains, and as appropriate, stop work and contact the Tennessee SHPO. Promote awareness of construction workers on applicable cultural resource practices. Plant vegetation to screen historic sites from views of the plant as needed.	None.
Radiological	SMALL	Train construction workers in radiation safety procedures. Develop work plans that consider methods for reducing radioactive exposures to levels that are as low as reasonably achievable (ALARA). Monitor doses received by construction workers to ensure they are within regulatory limits.	Radiation exposures to construction workers that would be within regulatory limits and ALARA.
Meteorology and Air Quality	SMALL	Implement the Construction Air Permit, which includes controls such as watering, stabilizing disturbed areas, covering trucks, and minimizing idling times and the running of inactive construction equipment. Workforce emissions controls may include staggering shift hours and promoting car/van pooling.	Temporary emissions from construction equipment firing fossil fuels, fugitive dust from soils disturbance and moving of soils, and workforce motor vehicles.
Environmental Justice	SMALL	No adverse impacts that disproportionately affect minority or low-income populations. No mitigation is required.	No unavoidable adverse impacts.

Table 10.1-2 (Sheet 1 of 5)
Operational–Related Unavoidable Adverse Environmental Impacts

Category	Impact	Mitigation Measures	Unavoidable Adverse Impacts
Land Use	SMALL	The CR SMR Project is consistent with current land use plans. Approximately 240 ac of the CRN Site were disturbed during site preparation for the Clinch River Breeder Reactor Project. Approximately 467 ac of the 935-ac CRN Site and 255 ac of offsite land would be disturbed by construction activities. Re-vegetate some of the disturbed land following the end of construction. Comply with requirements of applicable federal, state and local construction permits/approvals and local ordinances. Establish waste minimization programs. There are no practical mitigation measures (beyond the no action alternative) for reducing the consumption of uranium or reducing impacts within the UFC within the scope of CR SMR Project.	Continued commitment of approximately 327 ac onsite and 30 ac offsite over the operational life of the CR SMR Project. Landfill space dedicated on a long- term basis for the disposal of nonradioactive waste. Commitment of a small percentage of the overall resources of the UFC for the entire United States nuclear power industry.
Water Quality	SMALL	Ensure discharges comply with NPDES permit and applicable water quality standards. Prepare a SWPPP to avoid/minimize releases of contaminated stormwater. Prepare an Integrated Pollution Prevention Plan (IPPP) to avoid/minimize contamination from spills. Discharge radioactive effluents in compliance with applicable regulatory standards in 10 CFR 20, Appendix B. Implement site IPPP to minimize or avoid contamination from spills. Comply with the IPPP when working on transmission lines and conducting facility maintenance activities.	Normal facility operations result in discharge of small amounts of chemicals and radioactive effluents to the Clinch River arm of the Watts Bar Reservoir. Routine/Maintenance activities at the CRN Site and along the transmission line ROWs may result in small episodic spills of petroleum or chemicals. Discharge of cooling water would result in a thermal plume to the Clinch River arm of the Watts Bar Reservoir. Thermal impacts would be within limits established in the NPDES permit.

Table 10.1-2 (Sheet 2 of 5)
Operational–Related Unavoidable Adverse Environmental Impacts

Category	Impact	Mitigation Measures	Unavoidable Adverse Impacts
Water Quality (continued)		Operate the planned Melton Hill Dam bypass at 400 cfs. Maintain the difference between plume temperature and ambient water temperature within the limits set in the NPDES permit. Use cooling towers and holding ponds to mitigate the temperature of discharges to the reservoir. Install diffuser designed to maximize thermal and chemical mixing while minimizing of discharge while minimizing scour and hydrologic modifications.	
Water Use	SMALL	No mitigation is required.	The average surface water consumptive use would be less than 1 percent of the average flow rate in the Clinch River arm of the Watts Bar Reservoir adjacent to the CRN Site.

Table 10.1-2 (Sheet 3 of 5)
Operational–Related Unavoidable Adverse Environmental Impacts

Category	Impact	Mitigation Measures	Unavoidable Adverse Impacts
Aquatic Ecology	SMALL	Prepare IPPP to avoid/ minimize contamination from spills. Comply with NPDES permit limits to ensure discharges do not adversely affect water quality, populations of aquatic organisms, or wildlife that feed on the aquatic food web. Conduct routine reservoir health monitoring to identify any adverse change in the health of aquatic life in the vicinity of the CR SMR Project. Use reservoir operation improvements, plant discharge improvements, and other means to address these impacts. The SMRs use a closed-loop cooling system that substantially reduces the loss of fish and other aquatic organisms. Compliance with EPA Section 316(b) guidelines for intake design further minimizes impingement by limiting intake velocity and water withdrawal requirements.	Routine maintenance activities may result in episodic chemical or petroleum spills near water that could affect aquatic life. Little or no unavoidable adverse impacts. Routine facility operations result in discharge of small amounts of chemical, radiological, and thermal effluents to the Clinch River arm of the Watts Bar Reservoir that could affect aquatic life over the operational life of the CR SMR Project. Little or no unavoidable adverse impacts. Entrainment or impingement at the water intake result in mortality and injury to various life stages of fish and other aquatic organisms. A relatively small proportion of eggs, larvae, or adults of relatively common species of aquatic species would be impacted by entrainment or impingement. Minor proportions of populations would be affected.
Terrestrial Ecology	SMALL	None, unless vegetation is adversely affected; then re-establish tolerant vegetation or use alternative soil cover. Bird collisions with mechanical draft cooling towers and transmission lines do not represent a major problem. No mitigation is required.	Salt (NaCl) drift would be distributed in a limited area near the cooling towers. The amount of salt deposition would be less than that expected to cause leaf or other biota damage except for a limited area adjacent to and west of the cooling towers. Little or no unavoidable adverse impacts. Birds may periodically collide with the cooling towers or the existing transmission lines. Periodic loud noises, such as maintenance at the CRN Site or along the existing transmission lines, impacts nearby wildlife over the operational life of the CR SMR Project. Little or no unavoidable adverse impacts.

Table 10.1-2 (Sheet 4 of 5)
Operational–Related Unavoidable Adverse Environmental Impacts

Category	Impact	Mitigation Measures	Unavoidable Adverse Impacts
Socioeconomics	SMALL TO MODERATE	Minimize visual impact of the structures through use of topography, design, materials, and color. Notify public in advance of planned activities. Construct transmission line in accordance with applicable regulations and codes to minimize the risk of electric shock. Post signs or fences warning people of potential danger. Encourage use of carpooling. Proper adjustment of traffic light timing. Use of traffic control police officers to direct during especially high volume traffic flows. Stagger the refueling shifts to reduce facility-related traffic on local roads. Maintain emissions within limits established in permits. No mitigation is required.	Tallest facility structures would be visible from surrounding area. Cooling tower plumes would be visible for some distance from the CRN Site. Intake and discharge structures would be visible from the Clinch River arm of the Watts Bar Reservoir. Cooling tower noise. Episodic loud noises from operation of the CR SMR Project. Intermittent noise from vehicles, generators, and public address system. No unavoidable adverse impacts from new underground transmission line, in regard to the potential to produce electric shock to people working above the line. Operation of the CR SMR Project would increase traffic on local roads during shift changes. Refueling events at the facility would also increase traffic during planned outages. No unavoidable adverse impacts for air emissions from fossil fuel combustion equipment and motor vehicles.

Table 10.1-2 (Sheet 5 of 5)
Operational–Related Unavoidable Adverse Environmental Impacts

Category	Impact	Mitigation Measures	Unavoidable Adverse Impacts
Radiological	SMALL	Train workers in radiological procedures. Work plans address safety measures and the safety program includes radiological safety procedures. Maintain releases below regulatory limits. Treat effluents according to applicable regulatory standards before being discharged into the Clinch River arm of the Watts Bar Reservoir. Reduce the impacts of irradiated reactor fuel through specific plant design features and regulatory standards. Construction and licensing of an independent spent fuel storage installation (ISFSI). Employee safety training programs and work procedures. Strict adherence to applicable regulations for storage, treatment, transportation, and ultimate disposal of this waste in a geological repository, which requires onsite and offsite long-term management. Implement waste minimization program, employee training programs, and strict adherence to work procedures and applicable regulations, as well as regulatory licensing of disposal facilities.	Small radiation doses to members of the public below NRC and EPA standards. ALARA doses to employees, adherence of the mitigation measures to applicable regulatory standards would reduce this exposure to ALARA. Non-human biota doses less than National council on Radiation and Measurements and International Atomic Energy Agency guidelines. The mitigation measures would reduce the risk of radiological impacts. However, there would be unavoidable long-term commitments of land for an ISFSI and geological repository. Long-term commitments of land for radwaste disposal.
Meteorology and Air Quality	SMALL	Comply with permit limits and regulations for installing and operating air emission sources.	Diesel generators and other fossil fuel combustion equipment would contribute to air emissions. Cooling towers would emit plumes.
Environmental Justice	SMALL	No operations-related disproportionately high and adverse environmental or health effects on minority or low-income populations. No mitigation is required.	None.