5.8 SOCIOECONOMIC IMPACTS

The following subsections describe the potential socioeconomic impacts from operating the Clinch River (CR) Small Modular Reactor (SMR) Project. Subsection 5.8.1 describes physical impacts of CR SMR Project operation to the Clinch River Nuclear (CRN) Site and vicinity. Subsection 5.8.2 describes social and economic impacts on the region. Subsection 5.8.3 describes environmental justice impacts as a result of CR SMR Project operation.

5.8.1 Physical Impacts of Station Operation

This subsection assesses the potential physical impact due to operation of the CR SMR Project on the nearby communities or residents. Potential impacts include noise, odors, exhausts, thermal emissions, and visual intrusions. Tennessee Valley Authority (TVA) complies with federal, state and local environmental regulations applicable to these potential effects to reduce the potential for adverse impacts to the CRN Site and vicinity.

There are no residences located within the CRN Site. The majority of land located north and east in the vicinity of the CRN Site is federal land and is part of the ORR. The remaining area surrounding the CRN Site is predominantly rural and characterized by isolated residences, farmland, and wooded tracts. The locations of surrounding communities within the vicinity are described in Section 2.1. Population distribution is described in Subsection 2.5.1.

An estimated 500 operations workers are needed for operation of the CR SMR Project at full power at the CRN Site, as presented in Table 3.1-2, Item 16.3.1. The impacts from these workers on the local and regional area are discussed in Subsection 5.8.2.

5.8.1.1 Noise

The U.S. Department of Housing and Urban Development has established noise impact guidelines for residential areas based on day-night average sound levels (DNL) (Title 24 of the Code of Federal Regulations [51.103). Neither the State of Tennessee nor Roane County has developed noise regulations that specify acceptable community noise levels. When feasible, TVA uses the U.S. Environmental Protection Agency (EPA) guideline of 55 A-weighted decibel (dBA) DNL as a design goal if the nearest receptor is residential. For industrial and commercial areas, TVA uses a 60 dBA equivalent noise level as a design goal at the property line. (Reference 5.8-1) As described in Section 2.8, the DNL is the sound level average over a 24-hour (hr) period used to define the level of average noise exposure to a community during that 24-hr period. As part of the DNL sound level calculation, an additional 10 dB is added to nighttime (10:00 PM to 7:00 AM) sound levels to account for the increased sensitivity of the community to nighttime noise. When the background DNL is 60 dBA or less, TVA uses the Federal Interagency Committee on Noise recommendation that a 3 dB increase in DNL indicates a possible impact and necessitates further analysis (Reference 5.8-2).

As stated in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants,* Rev. 1, in general, noise levels below a DNL of 65 dBA outside a residence are considered to be acceptable. Therefore, DNLs up to 65 dBA are considered to be SMALL impacts in this Environmental Report.

Onsite Noise

Noise sources from the operation of the CR SMR Project include heating, ventilation, and air conditioning systems; vents; transformers; electrical equipment; switchyard equipment and transmission lines; water pumps; material-handling equipment; motors; public address systems; cooling towers; generators; and trucks and vehicular traffic. Tests of emergency warning sirens are conducted periodically, with advance notification to the public. Many noise sources are confined indoors, underground, or are used infrequently.

The main source of continuous noise is associated with the mechanical draft cooling towers. The cooling towers operate at less than 70 dBA at a distance of 1000 feet (ft), as presented in Table 3.1-2, Item 3.3.10.

As described in Section 2.2, the Site vicinity is largely rural residential and agricultural land in an area of alternating ridges and valleys. Ambient noise levels at the CRN Site are described in Section 2.8. Noise from the CR SMR Project is attenuated through distance and abated by natural features such as forests and ridges.

To assess the noise impacts on the surrounding environment, receptor sites were selected including the nearest residences, churches, schools, cemeteries, and the nearest public facilities. All of the identified sensitive receptors are located more than 1000 ft from the estimated position of the cooling towers at the CR SMR Project. The nearest offsite residence is located approximately 1900 ft southwest from the edge of the cooling tower block across the Clinch River arm of the Watts Bar Reservoir from the CRN Site. NUREG-1437, Rev. 1 indicates that noise levels below 65 dBA are considered acceptable outside a residence. It also notes that cooling towers emit noise of a broadband nature, which masks other noises such as transformers at most sites. Noise produced by the cooling towers is attenuated with distance and intervening vegetation. Because noise levels from the cooling towers are less than 70 dBA at 1000 ft from the towers (Table 3.1-2, Item 3.3.10) and the nearest residence is almost twice that distance, noise levels at the nearest residence are attenuated to 65 dBA or less. Therefore noise impact would be SMALL and mitigation would not be warranted.

Transmission Line Noise

High-voltage transmission lines can emit noise when the electric field strength surrounding the lines is greater than the breakdown threshold of the encapsulating air, creating an energy discharge. This discharge is known as corona discharge, and is affected by ambient weather conditions such as wind, precipitation, air density, and humidity and energized surface irregularities. Corona results in audible noise, radio, and television interference, energy losses,

and the production of ozone and oxides of nitrogen. The noise created from corona discharge can result in a noise which can be heard near the base of the transmission lines. Noise from corona discharge along the transmission line is low (well below the 65 dBA threshold) and does not pose a noise-induced risk to the surrounding community (NUREG-1437, Rev. 1). Corona discharge is not an issue with underground lines except at aboveground components such as substations (Reference 5.8-3).

The 500-kilovolt (kV) and 161-kV lines that serve the CR SMR Project are already operating and it is expected that the noise levels they produce would continue to be acceptable. It is expected that the underground transmission line planned for construction would not generate audible noise. Therefore, there are no anticipated increases to the current ambient noise levels associated with the operation of the transmission system, and the effect of the CR SMR Project on noise would be SMALL.

5.8.1.2 Air Quality

The Clean Air Act of 1977, which was last amended in 1990, requires EPA to establish ambient concentration thresholds for certain compounds based upon the identifiable effects the compounds may have on the public health and welfare. Subsequently, EPA promulgated regulations in Title 40 of the Code of Federal Regulation (40 CFR) 50 (subsections 50.4 – 50.13 and 50.15 – 50.18) that set National Ambient Air Quality Standards (NAAQS) for criteria compounds: sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter with a diameter less than 10 microns (PM_{10}), particulate matter with a diameter less than 2.5 micros ($PM_{2.5}$), lead (Pb), and ozone. As described in Subsection 2.7.2, the CRN Site is in attainment for air permitting purposes. The portion on Roane County in which the CRN Site is located is in attainment for all air pollutants. However, neighboring counties (Anderson, Blount, Knox, and Loudon) and part of Roane County (not including the CRN Site) are designated nonattainment for $PM_{2.5}$. (Reference 5.8-4; Reference 5.8-5)

Generation of electricity associated with the operation of two or more SMRs would not be a source of criteria pollutants or air toxics emissions. Supporting equipment such as cooling towers, emergency diesel generators, auxiliary boilers, standby power gas turbines, and other combustion sources emit criteria pollutants and air toxics. Currently a specific SMR technology and supporting equipment have not been selected, so detailed emissions data from supporting equipment are not available. However, supporting equipment for the surrogate plant, as defined in the plant parameter envelope (PPE) presented in Tables 3.1-1 and 3.1-2, has been assumed for this evaluation. It is expected that supporting equipment would generate minor levels of emissions, because any equipment firing fossil fuels is used intermittently and the CR SMR Project includes required controls to minimize emissions. Preliminary annual estimates for criteria pollutant emissions from SMR-supporting fossil fuel fired equipment are presented in Table 5.8-1.

Table 5.8-1 shows that current expected maximum annual emissions, for any individual pollutant, would be under 38 tons per year (TPY) for the fossil fuel fired units. This level is well

below the Prevention of Significant Deterioration (PSD) major source threshold of 250 TPY for any pollutant defined in 40 CFR 52.21. These emissions estimates, along with emissions from other pollutant sources, are evaluated in more detail once the CR SMR Project final SMR design has been selected. In addition, because the project is not located in a nonattainment area for any pollutant, the CR SMR project is not subject to review under Nonattainment New Source Review (NSR).

Once the SMR design is selected and emissions are defined, the Tennessee Department of Environmental Conservation (TDEC), Division of Air Pollution Control will be consulted regarding air permitting requirements. Air permitting, as necessary under both federal and state regulations, will be completed to demonstrate compliance with applicable air rules. The air permitting process involves ensuring that air emissions sources are operated consistent with manufacturer's specifications and emissions are mitigated by the application of air pollution control equipment and best emissions control practices as required under state and federal regulations. In addition, all air-related construction and operating permits will be obtained and potential impacts to sensitive areas addressed as necessary under state and federal air laws.

Once the project design has been selected, air quality modeling will be conducted as required to demonstrate project emissions will not result in exceedances of the NAAQS. Modeling, as required, will be conducted using current EPA models and modeling methodology. Power generation is also associated with emissions of greenhouse gases (GHGs). The primary GHGs include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). SMRs are not sources of GHGs, although supporting equipment emits some GHGs. The Nuclear Energy Institute (NEI) reports that "independent studies have assessed nuclear energy's life cycle emissions and found them to be comparable to wind, solar, geothermal and hydroelectric generation" (Reference 5.8-6). Supporting this conclusion:

- NEI cites that in 2012, the U.S. Department of Energy's (DOE) National Renewable Energy Laboratory concluded: "Collectively, life cycle assessment literature shows that nuclear power is similar to other renewables and much lower than fossil fuel in total life-cycle GHG emissions." (Reference 5.8-6)
- NEI cites a World Nuclear Association 2011 study that noted: (1) "greenhouse gas emissions of nuclear power plants are among the lowest of any electricity generation method and on a lifecycle basis are comparable to wind, hydroelectric, and biomass," (2) "lifecycle emissions of natural gas are 15 times greater than nuclear," and (3) "lifecycle emissions of coal generation are 30 times greater than nuclear." (Reference 5.8-6)

NEI has compiled a comparison of Life-Cycle CO_2 equivalent (weighted CO_2, CH_4, and N_2O) emissions (in tons per gigawatt-hour) for different energy sources; these are presented in Table 5.8-2. Findings demonstrate that CO_2 equivalent emissions from nuclear power are significantly below those of the most common sources of energy. (Reference 5.8-7)

GHG emissions may also be subject to PSD review. For a new source to be major for GHG emissions under the PSD regulations, the source must first be major for another regulated pollutant (other than GHG) and have the potential to emit more than 75,000 TPY of CO_2 equivalent air emissions. Applicable GHG rules and regulations (40 CFR 52.21(b)(49)(iv)(a)) will be addressed during the CR SMR Project's air permitting as required.

The CR SMR Project would generate indirect source emissions from motor vehicles during facility operation. Typically the primary emissions of concern are GHG (CO_2 equivalent), CO, PM, nitrogen oxide (NO_x) and volatile organic compounds (VOCs). Emissions of NO_x and VOCs are precursor pollutants in the formation of ozone. As with other air related sources, motor vehicle emissions and required air quality modeling would be addressed during the air permitting process with the TDEC. Air quality modeling, if required for a comparison of project impacts to ambient air quality standards, would be based on air emissions factors developed using the EPA Motor Vehicle Emission Simulator emissions model. In the event the air permitting process indicated that measures were necessary to reduce ambient air concentrations, the project would employ the appropriate mitigation measures.

During SMR operation, motor vehicle activity would be associated with the facility's work force and truck deliveries to the CRN Site. Once the facility is operating, mitigation measures as necessary may include staggered shift times, requiring delivery vehicles to shut down engines during off-loading, restricting idling times of onsite vehicles, use of electric and hybrid vehicles, and supporting and promoting van/carpooling and other commuter programs. Motor vehicle emissions are not expected to create significant impacts but will be addressed, along with mitigation measures, as required under federal and state regulations during the air permitting process. Air impacts from motor vehicle activity during facility operations are expected to be SMALL because: (1) mitigation measures would be implemented to reduce vehicular emissions, (2) Section 5.8.2.3 indicates that with recommended transportation improvements, LOS at the local intersections would be adequate to mitigate vehicle queuing and improve flow through these intersections, (3) emissions from the work force are not continuous throughout the day and are primarily limited to the hours during which shift changes occur, and (4) the project is currently located in attainment areas for CO, PM, NO_x, and O_3 which are the primary pollutants of concern for motor vehicles.

Based on preliminary design information of the CR SMR project and attainment status of Roane and surrounding counties, the CR SMR project's air related geographic area of interest for criteria pollutants is expected to fall within Roane County and the surrounding counties of Loudon, Knox, Anderson, and Morgan. Once an SMR design is selected, air quality modeling under the Tennessee air permitting process would detail the project's air quality geographic area of interest in the context of other nearby sources. Because the project's supporting equipment, which emits criteria pollutants, would be operated infrequently and for limited periods of time, it is expected the project's modeling impact area would be within 10 miles (mi). The area out to 10 mi would include Roane County and portions of Loudon, Knox, Anderson and Morgan Counties. Also, even though the project area is in attainment of all criteria

pollutants, the surrounding nonattainment areas may need to be considered during air permitting. The surrounding counties of Loudon, Knox and Anderson, along with Census Block Group 47-145-0307-2 in Roane County are nonattainment for $PM_{2.5}$. Once the project design is selected and vendor data are provided to support more detailed air quality analysis, the geographic area of interest would be refined if necessary.

Because climate change is global in nature and currently focuses on the policies established by national governing agencies, the project's geographic area of interest for GHG would need to be considered in the context of United States policy and national GHG emissions. Further, individual states are developing GHG regulations, thus consideration of GHG emissions under state regulations may in all likelihood also be necessary. Therefore for GHG emissions, the project's operations geographic area of interest is national (United States) in scale. Because GHG emissions and associated impacts require a global perspective, small incremental changes from individual projects must be evaluated collectively. This is beyond the scope of an individual project and is therefore addressed by the United States under the authority of the EPA at the national scale.

Supporting equipment used during operation, including cooling towers and various fossil fuel combustion sources, is expected to generate minor levels of criteria pollutants and air toxics emissions. However, the effects on air quality from these sources would be minor because they would be used intermittently and emissions would be minimized by using required controls. In addition, air permitting will be completed to demonstrate compliance with applicable air rules. CO_2 equivalent emissions are expected to be low in comparison to most other energy technologies, particularly the most common technologies used. Accordingly, air quality impacts from operation of the CR SMR Project would be SMALL for the surrounding communities and the nearest residents.

5.8.1.3 Thermal Emissions

The CR SMR Project's cooling towers use water from the Clinch River arm of the Watts Bar Reservoir to cool facility water. In the process, thermal plumes are released to both the ambient air and back to the Clinch River arm of the Watts Bar Reservoir.

As described in Section 3.4, the CRN SMR Project's cooling system includes mechanical draft cooling towers for the transfer and dissipation of heat from the facility's cooling water to the atmosphere. Releases to the atmosphere from cooling towers include a visible vapor plume released from the towers, which is formed as water vapor condenses in cooler ambient air. The visible vapor plume presents no threat to the environment. Small water droplets, referred to as drift, associated with the tower's circulating water and which contain dissolved solids, are also emitted and escape with the exhaust air. Drift deposition is generally greatest close to the towers. The principal concern associated with cooling tower drift is the downwind deposition of salts. Significant salt deposition can adversely affect sensitive plants and animal communities and change water and soil chemistry. Although final SMR design has not been selected, the CR SMR Project includes efficient drift eliminators to minimize drift emissions.

Computer modeling of the CR SMR Project's mechanical draft cooling towers used the Electric Power Research Institute's Seasonal and Annual Cooling Tower Impact (SACTI) model for evaluating potential impacts to the CRN Site and its immediate surroundings. Thermal discharges to the atmosphere from the facility's cooling towers are detailed in Subsection 5.3.3.1. Based on these results, there would be no fogging or icing at any distance from the cooling towers and additional water deposition would have a negligible effect on precipitation and humidity. The SACTI calculations indicate that the effects of salt deposition from cooling tower operation would be limited to the area within 600 meters (m) of the cooling towers, with the maximum deposition rate occurring 100 m to the west. Therefore, the effects of cooling tower operation on local residents and the public in the surrounding area from precipitation, humidity, fogging or icing, and salt deposition would be SMALL. The predicted frequencies of plume shadowing, or shading of the ground, beyond the CRN Site are low, and the impacts to the surrounding area would be SMALL. The visual effects of visible plumes generated by the cooling towers, as calculated by the SACTI model, are addressed in Subsection 5.8.1.4.

As shown in Figure 3.1-1, the CR SMR Project includes a holding pond to mix the cooling tower blowdown and discharge streams from miscellaneous demineralized water users and miscellaneous raw water users. Treated liquid radwaste is discharged downstream of the holding pond. The holding pond is used for discharge mixing so that the discharge from the facility into the Clinch River arm of the Watts Bar Reservoir is homogeneous in temperature and composition. Use of the holding pond is not intended for purposes of heat removal from the facility discharge, or for management of discharge flow rates, and cooling effects of the pond are not given credit in the hydrothermal analysis. The purpose of the pond is for discharge flow mixing only. However, this mixing acts to further reduce temperatures and moderate flow rates, making this is a conservative modeling assumption for purposes of the hydrothermal analysis. Assuming the holding pond was to function under a worst case scenario as a cooling pond, guidance provided in NUREG-1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan,* states that the:

- Plume will exist as ground level fog, but will evaporate within 300 m or lift to become stratus for wind speeds greater than 2.2 m per second
- Plume will exist as fog over the pond, lifting to become stratus for winds less than or equal to 2.2 m per second

An analysis of nearby areas of importance shows the closest area of importance is Interstate 40, which is located 0.6 mi (900 m) from the nearest border of the CRN Site. Because this area is greater than 300 m from the holding pond, potential worst case scenario impacts from the holding pond would be minor to non-existent.

Operational impacts of thermal discharges to surface water are discussed in Subsection 5.2.2.2. As described in Subsection 3.4.1, the Cooling Water System for the facility uses circulating makeup water from the Clinch River arm of the Watts Bar Reservoir as the mechanism for cooling the main condenser. The circulating makeup water is pumped into the mechanical draft

cooling towers, and from there it is circulated in and out of the main condenser. A portion of the water evaporates or is lost as drift from the cooling towers. The remainder of the water becomes blowdown from the mechanical draft cooling towers. The blowdown passes through a holding pond on its way to a discharge on the reservoir. This discharge results in a thermal plume in the receiving waterbody.

Discharges from the SMRs are permitted under the TDEC National Pollutant Discharge Elimination System (NPDES) program, which regulates the discharge of pollutants into waters of the state. Under NPDES regulations, waste heat is regarded as thermal pollution and is regulated in the same way as chemical pollutants. As discussed in Subsection 5.3.2.1, modeling was performed to evaluate the thermal effects on surface water of the discharge from the SMRs at both a local and a regional scale. The results show that with a minimum steady flow of 400 cubic feet per second through the planned Melton Hill Dam bypass, thermal impacts in the Clinch River arm of the Watts Bar Reservoir are manageable within state NPDES regulatory limits at a distance of approximately 50 ft from the diffuser under steady state conditions. To allow for worst-case conditions with unsteady flows in the reservoir and operation of the CR SMR Project under PPE conditions, a circular mixing zone of 150 ft is sufficient.

Because the discharge is managed in accordance with requirements of the TDEC NPDES permit, and the modeling indicates compliance with the thermal water quality criteria, physical effects of the thermal discharge are considered to be negligible. Accordingly, impacts to the public and recreational users of the Clinch River arm of the Watts Bar Reservoir would be SMALL.

5.8.1.4 Visual Intrusions

The existing visual resources near the CRN Site are described in Subsection 2.5.2.5.1. Visual and aesthetic effects associated with a project occur as a result of the introduction of a structure or facility that is not consistent with the existing viewshed. Consequently, the character of an existing site is an important factor in evaluating potential effects of an introduced facility on the visual resource. The overall aesthetic character of the CRN Site is good, with natural and scenic views relatively uninterrupted by man-made objects. Because the areas immediately surrounding the CRN Site are bound by water features, forests, and ridge lines, direct visual access to the CR SMR Project is limited primarily to onsite workers, residents living along the Clinch River arm of the Watts Bar Reservoir across from the CRN Site, and recreators using the reservoir.

Most of the structures associated with the CR SMR Project are not expected to be visible to the general public. Section 3.1 describes the CR SMR Project layout and the external appearance of the proposed facility. The tallest power block structure is 160 ft above finished grade and the mechanical draft cooling towers are 65 ft above finished grade (Table 3.1-2, Items 1.1.1 and 3.3.8, respectively). Renderings were made, using baseline photographs and the CR SMR Project PPE, in order to estimate possible visual impacts once construction is complete. The

renderings show the tallest facility structure visible from each location as well as the cooling tower plumes.

Figure 5.8-1 presents a map showing the Key Observation Points (KOPs) from which the CR SMR Project would be visible. Baseline photographs were collected at each KOP and renderings were developed to show the potential appearance of the CR SMR Project from these viewpoints. Figures 5.8-2 through 5.8-29 show the baseline photographs and the renderings with the tallest facility structures visible, the annual average plume, and the winter plume.

The SACTI model results predict that the visible plume, on an annual basis, would not go beyond 300 m from the towers more than 3 percent of the time for any wind direction. (The maximum annual frequency at 300 m is 2.97 percent of the time for the east direction from the cooling towers.) About 50 percent of the time, the plume centerline is at 150 to 160 m above the ground. The annual plume visualization was drawn so that the centerline of the plume transitions from the top of the cooling tower up to 150 m above the ground, out to a distance of 300 m downwind of the towers. The SACTI model generates a visible plume length for every hour modeled (day and night, and for conditions of good visibility and poor visibility). Longer plumes generally occur with colder temperatures and when the atmosphere is more saturated. Colder temperatures generally occur more frequently during nighttime hours when the plume would not be highly visible, while saturated atmospheric conditions can be accompanied by fog or rain where a visible plume would likely be obscured. Thus the SACTI model is likely to provide conservative results.

Using the 3 percent visible plume length criteria for any direction, the spring, summer, and fall are well reflected by the average annual numbers. As noted above, the SACTI model's annual predicted visible plume length does not exceed 300 m more than 3 percent of the time for any direction. For spring and fall, the 3 percent visible plume lengths are also at 300 m and for summer, the 3 percent visible plume length is at 200 m. The 50-percent centerline plume height during spring, summer, and fall ranges from around 140 m to 170 m, while the annual 50-percent centerline plume height is 150 m. Thus, the annual SACTI plume data provide a good estimate for the spring, summer, and fall seasons.

For winter, using the same 3 percent plume length criteria, visible plumes extend to 1700 m for the east-northeast, east, east-southeast, and southeast directions (for these directions the visible plume frequency was greater than 3 percent to 1700 m). For all other directions in winter, the 3 percent visible plume length is predicted at 300 m, as for the annual case. The 50-percent centerline plume height for winter is 200 m, somewhat higher than the annual case. As plume visibility may be considerably more noticeable during winter, both average annual plumes and winter plumes are rendered.

In all instances, the plumes are presented perpendicular to the observer.

The photo at KOP 5 (Figure 5.8-2) was taken from the northeast, across the Clinch River from the CRN Site. The view is of a country road with an agricultural field, a small building and a

power line. The CRN Site itself is not visible in the photo as the trees screen the view. Rendering 1 (Figure 5.8-3) shows the CRN facility in place. It is seen as two large square blocks extending above the tree line. It is not visually intrusive, however, because the height of the trees is similar and the facility is in the distance. Rendering 2 (Figure 5.8-4) shows the CRN facility during operations with the modeled average annual plume. The plume is not large, but it is hovering above the towers, which draws attention to them. The CRN facility looks larger because of the association with the plume. The visual intrusion is small, however, and if it were a cloudy day, the plume and the facility would not be as obvious from this location. Rendering 3 (Figure 5.8-5) shows the CRN facility during operations in the winter, when the plume would be most obvious. As with the average plume, the eye is drawn towards the CRN facility towers and they are more significant. However, because the plume appears to be dispersing and blowing in the wind, the larger size makes it look like natural clouds. Overall, depending on the atmospheric conditions, the CRN facility would present a SMALL visual intrusion from KOP 5.

The photo at KOP 7 (Figure 5.8-6) was taken from the northwest of the CRN Site, also across the Clinch River. The photo shows an open area with trees in the middle ground and hills in the background. The view is of a rural natural setting with appealing character. Rendering 1 (Figure 5.8-7) shows the CRN facility in the distance. It has essentially replaced the top of the hill in the background of the photo. The CRN facility is barely visible from this location and does not interfere with the general aesthetics of the scene. Rendering 2 (Figure 5.8-8) shows the CRN facility during operations with the average annual plume in place. Due to the partial tree screen in this location, the plume does not draw as much attention to the towers as in KOP 5, which is more open. This view is reminiscent of natural clouds as most of the sky is not exposed to the viewer. Rendering 3 (Figure 5.8-9) shows the CRN facility during operations in the winter season. This view is basically a more dramatic version of the previous rendering, with the scenery appearing to be a more cloudy day. It is a slight juxtaposition, however, and if the observer were to stop and contemplate this scene, they would register the industrial complex located in the distance behind the forest. This could become disturbing or annoying, depending on the length of the observer's visit. There are only a few residences in this area, most of which would be screened by trees; most views would simply have a cloudy spot on the horizon where the plume is located. As there is an existing tree screen and few residences in this location, the visual intrusions created by the operation of the CRN facility would be SMALL.

The photo at KOP 8 (Figure 5.8-10) was taken from the southeast, approximately 1 mi from the center point of the CRN Site. It is similar to the photo at KOP 5 (Figure 5.8-2) with an agricultural field in the foreground with trees and hills in the background. The power lines overhead and the transmission line right-of-way (ROW) form the focal point of the photo. Rendering 1 (Figure 5.8-11) shows the CRN facility at the end of the transmission line ROW. It is so far distant that it is difficult to identify as a structure. Rendering 2 (Figure 5.8-12) shows the CRN facility with the average annual plume. The plume, as in the two previous photo locations (5 and 7), makes the CRN facility much more visually obvious, especially in an otherwise clear sky. Rendering 3 (Figure 5.8-13) shows the CRN facility with the winter plume. This view is actually less intrusive than the average plume view, because the winter plume appears as

naturally occurring clouds would. In general, due to the distance of the CRN facility from the viewer, visual intrusions at this location would be SMALL.

The photo at KOP 16 (Figure 5.8-14) was taken from the southwest, directly across the Clinch River from the CRN Site. It is an open area with few trees along the river bank. Rendering 1 (Figure 5.8-15) shows the CRN facility clearly visible in the middle ground. It overtops the trees on the far river bank and injects an industrial aspect into the rural, natural landscape. From this viewpoint, the CRN facility is the most imposing. However, it is still screened partially by the trees and the surrounding hills in the distance are similarly visually sized. Rendering 2 (Figure 5.8-16) shows the CRN facility in this location with the average annual plume. The plume makes the facility more visible from this location, increasing the industrial aspect of the scene. Rendering 3 (Figure 5.8-17) shows the CRN facility with the winter plume. The view resembles a cloudy day, although there may only be clouds in this one area. The observer may be confused by the image, or would notice the CRN facility more, as the plume is only in the vicinity of the facility. Due to the size of the facility and plume from this location, visual intrusions would be considered MODERATE.

The photo at KOP 19 (Figure 5.8-18) was taken from the north-northwest, from the surface of the Clinch River, approximately 1 mi from the center of the CRN Site. The CRN facility is barely visible in Rendering 1 (Figure 5.8-19), located in the middle ground, just visible above the treetops. Rendering 2 (Figure 5.8-20) shows the CRN facility with the average annual plume and Rendering 3 (Figure 5.8-21) shows the facility with the winter plume. The plumes draw the eye to the CRN facility, making it more noticeable than without. The facility itself is still almost invisible, however, and on a cloudy day it would likely go unnoticed from this location. On a clear day though, the plume presents an industrial view in an otherwise calming and natural scene. Due to the plume, the visual intrusions from this location would be MODERATE on clear days and SMALL on cloudy days.

The photo at KOP 22 (Figure 5.8-22) was taken from the northeast, approximately 1.5 mi from the center of the CRN Site. Rendering 1 (Figure 5.8-23) shows the CRN facility in the distance. It is dwarfed by the large hill on the left, and is not visually dominant from this viewpoint. Renderings 2 and 3 (Figures 5.8-24 and -25) show the CRN facility with the average annual plume and winter plume, respectively. This view is similar to the previous photo (KOP 19) and associated renderings. Therefore, visual intrusions would be MODERATE on clear days and SMALL on cloudy days at this location as well.

The photo at KOP 40 (Figure 5.8-26) was taken from the northwest, approximately 1.5 mi away, on the Clinch River. Rendering 1 (Figure 5.8-27) shows the CRN facility on the far right, as a minor visual intrusion just above the trees in the distance. The two plume renderings (Figures 5.8-28 and -29) reveal a similar appearance as most of the other renderings. Both the average annual plume and the winter plume serve to draw attention to the CRN facility in the distance, increasing the level of visual intrusion at this location. The annual plume is more visible than the winter plume at this spot, however, due to the distance and the dispersion of the larger plume.

Due to the distance from the observer, the surrounding natural landscape, and the large expanse of sky visible from this location, the visual intrusion from the operation of the CRN facility would be SMALL.

Overall, the renderings show that the CRN facility would be well screened by the riparian trees from most locations. The surrounding hills also help to soften the industrial aspects of the view because they are larger than the facility and make it seem smaller and less imposing. From a distance of approximately 2 mi, the CRN facility would not be visible at all from most viewpoints. The average annual plume and the winter plume, however, draw the observer's attention to the CRN facility, inserting an industrial aspect to a mostly natural landscape. The plume impacts would be larger on a clear, cloudless day than on an overcast day. Therefore, due to the plume, the visual intrusion due to operation of the CR facility would range from SMALL to MODERATE, depending on the location of the observer and the atmospheric conditions.

5.8.2 Social and Economic Impacts of Station Operation

This subsection evaluates the potential demographic, economic, infrastructure, and community impacts associated with operation of two or more SMRs at the CRN Site. The evaluation assesses potential impacts associated with operation of the CR SMR Project, including routine capital expenditures needed to support operations and the size of the operations workforce. The analysis is based on the PPE, which is discussed in Section 3.1 and provided in Tables 3.1-1 and 3.1-2.

5.8.2.1 Population and Housing

This analysis of population and housing is based on an operations workforce of 500 workers, which represents the total number of operational employees for operation of the CR SMR Project at full power, as presented in Table 3.1-2, Item 16.3.1. An additional 1000 workers would temporarily work at the CRN Site during periodic refueling and major maintenance activities, as presented in Table 3.1-2, Item 16.3.2.

As discussed in Subsection 3.10.3, it is anticipated that approximately 250 operations workers would already reside within the 50-mi region of the CRN Site. The remaining 250 workers would relocate into the region. It is conservatively assumed that 100 percent of this in-migrating workforce would relocate within the geographic area of interest. All of the 1000 temporary workers required for the scheduled refueling outages are assumed to be from outside the region. It is assumed they would temporarily reside in the geographic area of interest.

5.8.2.1.1 <u>Population</u>

In 2010, the population within the 50-mi radius of the CRN Site was 1,158,026 and is projected to grow to 1,305,189 by 2021 (Tables 2.5.1-2 and 2.5.1-5). The four-county geographic area of interest, including Anderson, Knox, Loudon, and Roane Counties, had a population of 610,092 in 2010 and a projected population of 682,278 in 2020 and 807,594 in 2040 (Table 2.5.1-6).

It is assumed that each operations worker that relocates into the geographic area of interest would bring a family. The average household size in Tennessee is 2.48 (Reference 5.8-8). Therefore, an in-migrating workforce of 250 would increase the population of the geographic area of interest by 620 people, or 0.1 percent of the geographic area of interest population in 2010. It is assumed that the residential distribution of the in-migrating operations workforce would resemble the residential distribution of the DOE Oak Ridge workforce. Of the 11,433 employees at the DOE Oak Ridge facilities that reside within the geographic area of interest, 27 percent reside in Anderson County, 50 percent in Knox County, 6 percent in Loudon County, and 17 percent in Roane County. Therefore, of the total population increase due to the operations workforce, it is assumed that 166 people (27 percent of 620) would settle in Anderson County, 310 people in Knox County, 37 people in Loudon County, and 107 people in Roane County. These numbers constitute 0.2 percent, 0.1 percent, 0.1 percent, and 0.2 percent of the 2010 populations of Anderson, Knox, Loudon, and Roane Counties, respectively.

Scheduled refueling is performed every 2 years for each SMR unit, as presented in Table 3.1-2, Item 18.0.4. It is conservatively assumed that the 1000 temporary workers required for each periodic refueling outage work at the CRN Site for 30 to 60 days. This is based on the mean duration of refueling outages for pressurized water reactors of 37 days and the maximum of 54 days (Reference 5.8-9). Based on the infrequent nature and limited length of time for refueling outages, it is assumed that the temporary refueling workers would not permanently relocate to the geographic area of interest and would not bring families.

As described in Subsection 4.4.2.1, the CR SMR Project includes construction of multiple SMRs that would be brought into operation sequentially; therefore, there would be a period of time when one or more SMRs is operating while other SMR(s) are being constructed. The duration of this overlap between preconstruction/construction and operation would be expected to take between three and five years. During that overlap period, the combined project workforce would include the construction workforce (3300 workers) plus the operation workforce (366 workers) for an estimated total onsite workforce of 3666 workers. As presented in Subsection 4.4.2.1, an in-migrating construction workforce of 1115 would increase the population in the geographic area of interest by 2765 people, or 0.5 percent of the geographic area of interest population in 2010. During the overlap period between preconstruction/construction and operation, the population in the geographic area of interest would increase by 3385 people (2765 associated with construction and 620 associated with operation). This combined population increase constitutes 0.6 percent of the 2010 population of the geographic area of interest.

The operations workers and their families would represent a small increase to the population of the four counties within the geographic area of interest (0.1 percent) and the combined population increase associated with in-migrating workers during the overlap period between preconstruction/construction and operation would also represent a small increase (0.6 percent). The temporary refueling workers would not be associated with a permanent increase in the geographic area of interest population. Therefore, based on a population increase of less than 1

percent in the geographic area of interest, the potential impacts on population for the CR SMR Project would be SMALL.

5.8.2.1.2 Housing

Subsection 2.5.2.6 and Table 2.5.2-10 summarize availability of housing in the year 2010 in the geographic area of interest. This information was used as a basis for estimating the number of housing units that may be available for CR SMR Project operations workers. Generally, the counties with larger populations (in particular Knox County) have more available vacant housing.

NUREG-1437, Revision 1 presents criteria for the assessment of housing impacts based on the discernible changes in the housing availability, prices, and changes in housing construction or conversions. These criteria are:

- SMALL: small and not easily discernible change in housing availability; increases in rental rates or housing values equal to or slightly exceeding the statewide inflation rate; and no extraordinary construction or conversion of housing

- MODERATE: discernible but short-lived reduction in housing availability; rental rates or housing values rise slightly faster than statewide inflation rate with prices realigning as new housing added or project-related demand diminished; and minor or temporary conversions of non-living space to living space

- LARGE: very limited housing availability; rental rates and housing values increase well above normal inflation rate for state; and substantial conversions of housing units as well as overbuilding of new housing units.

There is currently enough housing to accommodate all the expected in-migrating families in Knox County alone. Knox County, with the greatest number of housing units in the geographic area of interest, had 17,700 vacant units in 2010, with 6777 for rent and 3747 for sale. In the geographic area of interest as a whole, there were a total of 26,403 vacant housing units, with 8984 for rent and 5120 for sale in 2010. It is likely adequate housing would be available within the geographic area of interest at the time the in-migrating operations workforce would move into the area. If all of the new in-migrating workers move to the geographic area of interest, 620 operations workers and family members would seek permanent housing in the four counties. It is also probable that workers on short-term assignments, such as refueling operations, would utilize temporary housing in the form of hotels, seasonal homes, and recreational vehicle parks and campgrounds. As described in Subsection 2.5.2.6, there are over 8100 hotel rooms in the Knoxville area and another 1185 rooms in Anderson, Loudon, and Roane Counties. According to the 2010 Census, the geographic area of interest has 2329 seasonal housing units. Also, there are approximately 1302 temporary housing sites at recreational facilities in the geographic area of interest (Table 2.5.2-12). Also, refueling outage workers could utilize temporary housing in the surrounding region, beyond the four counties in the geographic area of interest. During

the overlap between preconstruction/construction and operation, 3385 people would potentially seek permanent and temporary housing within the geographic area of interest.

The in-migrating operations workforce of 250 workers and overlap period workforce of 1365 (1115 construction + 250 operations) are small compared to the 26,403 vacant housing units within the geographic area of interest. Also the 1000 temporary workers required for the scheduled refueling outages, assumed to be from outside the region, could be accommodated in approximately 3600 seasonal and temporary housing units and 9200 hotel rooms within the geographic area of interest. Based on the large number of available vacant housing units in the geographic area of interest and the relatively small requirements for the in-migrating operations and overlap period workforces and the temporary refueling outage workforce, the potential impacts on housing would be SMALL.

5.8.2.2 Employment and Income

Subsection 2.5.2.1 and Tables 2.5.2-1 through 2.5.2-8 summarize current employment characteristics and income levels in the geographic area of interest. Employment of the operations workforce and routine capital expenditures needed to support CR SMR Project operations over the period of operation would have economic impacts on the surrounding region.

NUREG-1437, Revision 1 presents criteria for the assessment of economic impacts based on operation-related employment as a percentage of total employment for the relevant study area. These criteria are:

- SMALL: if operations employment accounts for less than 5 percent of total study area employment
- MODERATE: if operations employment accounts for 5 to 10 percent of total study area employment
- LARGE: if operations employment accounts for more than 10 percent of total study area employment.

The 500 operations workers assumed for the SMR Project account for 0.1 percent of the total workforce (based on 2011 employment levels) within the four counties in the geographic area of interest, and the 1000 temporary refueling outage workers represent 0.2 percent of the total workforce. During the overlap period between preconstruction/construction and operation, the total workforce of 3666 represents 1 percent of the total workforce.

The U.S. Department of Commerce Bureau of Economic Analysis, Economics and Statistics Division, calculates multipliers for industry jobs and earnings within a specific region. The economic model they use is called the Regional Input-Output Modeling System (RIMS II).

RIMS II multipliers were obtained for the geographic area of interest consisting of Anderson, Knox, Loudon, and Roane Counties. The RIMS II direct effect employment multiplier for jobs in the utilities industry is 2.2149. Thus, for every newly created operations job at the CR SMR Project, an estimated additional 1.2149 jobs would be created in the region. (Reference 5.8-10) Based on the Bureau of Economic Analysis multiplier and an operations workforce of 500, the CR SMR Project would create approximately 607 indirect jobs within the geographic area of interest during the period of operation. The combined total of 1107 direct operations jobs plus indirect jobs represents approximately 0.3 percent of the geographic area of interest workforce.

It is assumed that most indirect jobs would be service related and it is expected that those jobs would be filled by the existing workforce within the geographic area of interest. As of 2011, there were approximately 24,000 unemployed persons in the geographic area of interest (Table 2.5.2-2). The 607 indirect jobs created by the CR SMR Project during the operations phase represent approximately 2.5 percent of the existing unemployed workforce.

For every dollar earned by an operations worker, an additional 0.5423 dollars is added to the regional economy based on the Bureau of Economic Analysis Utilities industry direct-effect earnings multiplier for the geographic area of interest (Reference 5.8-10).

It is assumed that the additional 1000 temporary workers required for each periodic refueling outage reside temporarily in the geographic area of interest during the 30- to 60-day outage period. Therefore, they would affect the local economy to a lesser extent than the permanent operations workforce.

As described in Subsection 4.4.2.2, the combined total of 3300 direct construction jobs plus 2450 indirect jobs would result in an increase of 5750 jobs, representing approximately 1.5 percent of the geographic area of interest workforce. During the overlap period between preconstruction/construction and operation, the combined direct plus indirect total of 6857 jobs (5750 construction-related + 1107 operation-related) represents approximately 1.7 percent of the geographic area of interest workforce.

The employment of the operations workforce and temporary refueling outage workers over the CR SMR Project period of operation, as well as employment during the overlap period between preconstruction/construction and operations, would have positive economic effects on the geographic area of interest and surrounding region. The CR SMR Project would introduce millions of dollars into the regional economy, creating indirect jobs that can help reduce unemployment and add business opportunities for housing and service-related industries. Operational activities at the facility would result in additional positive economic effects in the region related to expenditures for goods and services. Considering that operations-related employment (direct operations jobs plus indirect jobs) and overlap period-related employment each represents less than 5 percent of the workforce in the geographic area of interest, there would be a SMALL beneficial impact of CR SMR Project operations on the economy.

5.8.2.3 Transportation

Figure 2.5.2-1 identifies federal highways and state roads that provide access to the geographic area of interest. Operations workers would typically access the CRN Site via Tennessee State Highway (TN) 58 and Bear Creek Road. As shown in Figure 3.1-2, driveway access to and from the CRN Site is from Bear Creek Road.

As discussed in Subsection 2.5.2.2.3, capacity analyses of the four intersections most likely to be affected by the construction and operation of the CR SMR Project were performed in 2013 as part of the traffic assessment for the CRN Site (Reference 5.8-11). The intersections analyzed are TN 58 at Bear Creek Road ramp, TN 58 at TN 327, TN 95 at Bear Creek Road, and Bear Creek Road at Bear Creek Road ramp.

NUREG-1437, Revision 1 presents criteria for the assessment of transportation impacts based on the effect of operations traffic on the level of service (LOS) for roadways within the relevant study area. These criteria are:

- SMALL: LOS A and B are associated with small impacts because the operation of individual users is not substantially affected by the presence of other users; no delays occur and no improvements are needed

- MODERATE: LOS C and D are associated with moderate impacts because the operation of individual users begins to be severely restricted by other users; upgrading of roads or additional control systems may be required

- LARGE: LOS E and F are associated with large impacts because the use of the roadway is at or above capacity level, causing traffic delays and a potential increase in accident rates; major renovations of existing roads or additional roads may be needed.

Traffic generation estimates were determined for several scenarios, including for the peak year 2024 during the overlap period between preconstruction/construction and operation, which was assumed to have a construction workforce of 3300 (maximum number onsite during a 24-hr period) and an operations workforce of 366. Capacity analyses were performed for the AM and PM peak hours for all the study intersections. Under existing roadway conditions, Bear Creek Road as a two-lane section (between Bear Creek Road ramp and Proposed Site Entrance) was projected to operate at level of service (LOS) F (i.e., low variable speeds, heavily congested) in AM peak and the PM peak hours. Based on this traffic analysis, roadway improvements were recommended to mitigate adverse impacts to LOS as a result of increased traffic volume; these recommended improvements are summarized in Subsection 4.4.2.3. It is assumed that those improvements would provide an acceptable operation for the peak year 2024, which would have the largest combination of construction and operations traffic volumes.

It is assumed that approximately 75 percent of the operations workers work the 1st shift (7:00 AM to 3:00 PM), 5 percent the 2nd shift (3:00 PM to 11:00 PM), and 5 percent the 3rd shift (11:00

PM to 7:00 AM). The remaining 15 percent, including 5 percent in training and 10 percent on annual sick leave, were not included in the daily traffic generation estimates. Based on this breakdown of shift workers, during the long-term operations phase approximately 375 employees arrive at the CRN Site around 7:00 AM. Assuming one person per vehicle, this represents 375 vehicles. If the local roadways were in their current configuration, this influx of traffic could create an adverse impact to transportation in the immediate CR SMR Project area. (Reference 5.8-11) However, the peak operations workforce at the completion of the CR SMR Project would be well below the peak overlap workforce evaluated in the traffic assessment for the CRN Site. Therefore, although operations traffic could slightly increase the commute time along Bear Creek Road for persons working at the Clinch River Industrial Park, the roadway improvements recommended to accommodate the peak overlap period would also accommodate the operations staff traffic once the CR SMR Project is complete.

Similarly, traffic accidents and related injuries and fatalities associated with operations at the CRN Site are anticipated to increase slightly over current conditions, but not as much as during construction. The analysis for traffic accidents during the peak overlap period is discussed in Subsection 4.4.2.3. The roadway improvements recommended to accommodate the peak overlap traffic are anticipated to be sufficient mitigation to minimize traffic accidents associated with CRN Site operations.

During refueling operations, an increased number of vehicles would be travelling on the local roads. Using the same shift breakdown as described for the operations workers, an estimated 750 additional outage worker vehicles arrive at the CRN Site around 7:00 AM. The total of operations and outage worker vehicles (1125) is less than the year 2024 total of construction and operations workers used in the traffic analysis (3666). Therefore, it is anticipated that the LOS at each of the intersections studied in the traffic assessment would be adequate, because the intersections would have been upgraded to handle the higher construction traffic volumes.

The mitigation measures used to offset the construction impacts on local roads, as described in Subsection 4.4.2.3, are sufficient to offset operational impacts to LOS for these roads. Considering that the road improvements are designed to accommodate the much larger construction workforce, the improved LOS resulting from the mitigation measures would have a beneficial impact on operations of those intersections and roads. Therefore, impacts to local roads would be beneficial and SMALL.

The volume of equipment delivered by rail and barge during operation of the CR SMR Project and during the overlap period is expected be similar to the volume of large components transported during construction. Therefore, the impact on local railroads and on barge traffic on the Clinch River arm of the Watts Bar Reservoir would be SMALL.

The estimated geographic area of interest population increase associated with operation of two or more SMRs at the CRN Site is approximately 620 workers and family, and 3385 people (2765 associated with construction and 620 associated with operation) for the overlap period between construction/preconstruction and operation. This could slightly increase public

transportation usage, which would have a SMALL impact on public transportation facilities in the geographic area of interest.

5.8.2.4 Tax Revenues to Local Jurisdictions

NUREG-1437, Revision 1 presents criteria for the assessment of impacts on local tax receipts based on the magnitude of potential new tax payments, or payments in lieu of taxes, in relation to total revenues in the host community. These criteria are:

- SMALL: if the new tax payments constitute less than 10 percent of total revenues for local taxing jurisdictions
- MODERATE: if the new tax payments constitute 10 to 20 percent of total revenues for local taxing jurisdictions
- LARGE: if the new tax payments constitute more than 20 percent of total revenues for local taxing jurisdictions.

Several types of taxes are generated by operational activities and by workforce expenditures. These include sales and use taxes on employee purchases and personal property tax associated with employees. In addition, TVA makes tax equivalent payments. As described in Subsection 4.4.2.4, Anderson, Knox, Loudon, and Roane Counties are the tax districts that are assumed to be most directly affected by the CR SMR Project.

Sales and use taxes would be generated in the geographic area of interest and region through retail expenditures of the operations and refueling outage workforce and the preconstruction/construction and operations overlap period workforce. Property tax revenues would be generated by the increased economic activity involving the operations and overlap period workforce. Revenues such as residential property taxes, real estate transfer fees, and motor vehicle taxes are collected by or on behalf of the state government. These funds are then distributed to the jurisdictions, including schools and public services.

As discussed in Subsection 2.5.2.3, TVA makes tax equivalent payments to eight states under Section 13 of the TVA Act of 1933, including the State of Tennessee. TVA pays 5 percent of its gross proceeds from the sale of power (with certain exclusions) to states and counties where its power operations are carried out (the State of Tennessee and Roane County for the CR SMR Project). Payments to each state are determined based upon the proportion of TVA power property and power sales, in each state, compared to TVA's total power property and power sales, respectively. TVA’s tax equivalent payments to the four counties in the geographic area of interest are presented in Table 2.5.2-11 and total revenues in those counties are provided in Table 2.5.2-7. Fiscal Year (FY) 2013-2014 is the most recent year for which data on TVA tax equivalent payments and total county revenues are both available. The percentage of total county revenues represented by the TVA tax equivalent payment (i.e., TVA payment divided by total county revenues) for FY 2013-2014 are:

- Anderson County, 1.0 percent ($1.1 million/$109.6 million)
- Knox County, 0.4 percent ($3.4 million/$846.9 million)
- Loudon County, 1.6 percent ($1.1 million/$67.3 million)
- Roane County, 1.8 percent ($1.6 million/$91.3 million)

Although the amount of sales and property taxes as well as TVA tax equivalent payments would be large in absolute terms, they would be small when compared to the total amount of taxes collected within the geographic area of interest.

Given the structure by which the TVA makes tax equivalent payments, the general distribution structure of funding by the State of Tennessee, as well as the increase in sales and property taxes, the new tax payments are expected to represent less than 10 percent of total revenues and potential impact of taxes within the geographic area of interest and region would be SMALL and beneficial.

5.8.2.5 Land Use

In NUREG-1437, Revision 1, the NRC defines levels of significance for identifying impacts to offsite land use related to refurbishment of an existing nuclear facility. The analysis is based on population changes caused by refurbishment activities. These significance levels are applicable to the analysis of the impacts associated with operating a new nuclear power plant. NRC concluded that the impacts to offsite land use during refurbishment at nuclear plants are considered:

- SMALL: if population growth results in very little new residential or commercial development compared with existing conditions and if the limited development results only in minimal changes in an area's basic land-use pattern
- MODERATE: if plant-related population growth results in considerable new residential or commercial development and the development results in some changes in an area's basic land-use pattern
- LARGE: if population growth results in large-scale new residential or commercial development and the development results in major changes in an area's basic land-use pattern

NRC identified key predictors of population-induced land use changes as:

- SMALL: if plant-related population growth is less than 5 percent of the study area's total population, especially if the study area has established patterns of residential and commercial development, a population density of at least 60 persons per square mile, and at least one urban area with a population of 100,000 or more within 50 mi

- MODERATE: if plant-related population growth is between 5 and 20 percent of the study area's total population, especially if the study area has established patterns of residential and commercial development, a population density of 30 to 60 persons per square mile, and one urban area within 50 mi

- LARGE: if plant-related population growth is greater than 20 percent of the study area's total population and population density is less than 30 persons per square mile

Subsection 4.4.2.5 describes impacts to offsite land use due to the influx of 2765 construction workers and family members. As stated in Subsection 4.4.2.5, according to U.S. Nuclear Regulatory Commission (NRC) guidelines, population-induced land use changes would be SMALL because the construction-related population increase would be 0.5 percent of the geographic area of interest population, the area has an established pattern of residential and commercial development, a population density of greater than 60 people per square mile, and at least one urban area with a population of 100,000 or more within 50 mi (178,874 in Knoxville, Tennessee). As discussed in Subsection 5.8.2.1, an in-migrating operations workforce of 250 workers and their family members would increase the population of the geographic area of interest by 620 people, or 0.1 percent of the geographic area of interest population in 2010. Population increases during the overlap period between preconstruction/construction and operations would represent an increase of 0.6 percent of the geographic area of interest population. Accordingly, the population-induced land use changes associated with the smaller operations-related population and the population during the overlap period would be minor, and the impacts on land use would be SMALL.

As discussed in Subsection 5.8.2.1, population increases due to the operations workforce constitute 0.2 percent, 0.07 percent, 0.08 percent, and 0.2 percent of the 2010 populations of Anderson, Knox, Loudon, and Roane counties, respectively. The population density is greater than 60 people per square mile in each county: 222.8 in Anderson County, 850.5 in Knox County, 211.8 in Loudon County, and 150.2 in Roane County. Accordingly, population-induced land use changes would also be SMALL if the counties within the geographic area of interest are considered individually.

A temporary influx of approximately 1000 workers during refueling operations are not expected to cause impacts to offsite land use because these temporary employees are assumed to utilize temporary housing in the form of hotels, seasonal homes, and recreational vehicle parks and campgrounds.

Overall, because CR SMR Project-related population growth would be less than 5 percent, according to NRC guidelines the population-induced impacts to offsite land use patterns would be SMALL.

5.8.2.6 Recreation

NUREG-1437, Revision 1 presents criteria for assessing the impacts of nuclear power plants on recreation and tourism based on level of demand for recreational facilities. The criteria are:

- SMALL: if current facilities are adequate to handle local levels of demand
- MODERATE: if facilities are overcrowded during peak demand times
- LARGE: if additional recreation areas are needed to meet ongoing demands.

The existing visual resources and recreational opportunities near the CRN Site are described in Subsection 2.5.2.5.1. A number of public and private recreational facilities and a range of outdoor activities are located in the vicinity of the CRN Site, as described in Subsection 2.5.2.5.2, and in the region, as discussed in Subsection 2.5.1.3. Recreational opportunities in the immediate vicinity of the CRN Site include outdoor activities such as fishing and boating (including on the Clinch River arm of the Watts Bar Reservoir), hunting, hiking, and camping. Recreational areas within the CRN Site vicinity and region could potentially be impacted by the increased population of operations workers and their families and the increased competition for transient housing during refueling outages. Workers who relocate to the geographic area of interest are expected to utilize recreational areas and facilities to a similar degree as the permanent population of the geographic area of interest. Because many of the recreational opportunities of the region are outdoor activities without associated maximum capacities, it is difficult to accurately estimate utilization by the permanent population. As discussed on Subsection 5.8.2.1, an in-migrating workforce of 250 would increase the population in the geographic area of interest by 620 people, or 0.1 percent based on the 2010 population of 610,092 and an in-migrating workforce of 1365 would increase the population by 3385 people or 0.6 percent. Sufficient recreational facilities are available to accommodate the associated increase in usage. Therefore, impacts to recreation resources during CR SMR Project operation would be SMALL. Based on the regional supply of transient housing, including 2329 seasonal units and 1302 temporary housing sites at recreational facilities in the geographic area of interest, the impact on recreational facilities due to increased competition for transient housing during refueling outages also would be SMALL.

5.8.2.7 Community Infrastructure and Services

NUREG-1437, Revision 1 has consolidated the evaluation of public utilities, public safety, and education within the community services and education issue area. (Education is addressed in Subsection 5.8.2.8.) The criteria identified for community services are:

- SMALL: if little or no change occurs in the community's ability to respond to the level of demand and there is no need to add capital facilities or additional personnel

- MODERATE: if overtaxing of facilities during peak demand periods occurs or some permanent additions to public safety forces or new capital equipment purchases are needed

- LARGE: if existing service levels are substantially degraded and additional capacity, personnel, or equipment is needed.

Demands from operational activities as well as from associated population increases were considered when evaluating the effects of operation of the CR SMR Project on infrastructure and services. During the period of operation, an estimated 250 workers would migrate into the geographic area of interest accompanied by 370 family members, for a population increase of 620, and the total permanent onsite operations workforce would be an estimated 500 workers. An additional 1000 temporary workers would be on site during the periodic refueling operations. During the overlap period, an estimated 1365 workers would in-migrate accompanied by 2020 family members, for a total population increase of 3385.

Water Supply Facilities

Potential impacts to potable water supplies would result from additional demands on water supply facilities associated with operation-related water needs and the increase in the local population (in-migrating operations workers). The source of water for the potable and sanitary water systems at the CRN Site is municipal water from the City of Oak Ridge Public Works Department, which obtains its raw water from the surface water in the Melton Hill Reservoir. As discussed in Subsection 4.4.2.7, the U.S. Geological Survey (USGS) estimates that the average person uses 80 to 100 gallons per day (gpd) of water at home, including bathing, laundry, and outdoor watering. Using the presumption that the operations workers are present on site for 8 hr per day, it is assumed that a conservative estimate of 50 gpd of potable water per worker would be required. The peak operations workforce of 500 operations workers and 1000 outage workers would require a maximum of 75,000 gpd, or 0.08 million gallons per day (mgd), of potable water. During the overlap period, the peak overlap workforce of 3666 (3300 construction workers and 366 operations workers) would require a maximum of 183,300 gpd, or 0.18 mgd. As shown in Table 2.5.2-15, the utility has a maximum potable water capacity of 9.9 mgd and an average daily consumption of 7.7 mgd, for an excess capacity of 2.2 mgd. The onsite maximum potable water usage during operations of 0.08 mgd represents less than 4 percent of excess capacity and the maximum of 0.18 mgd during the peak overlap workforce represents less than 9 percent of excess capacity. Therefore, operational impacts to water supply facilities and the temporary overlap period impacts would be SMALL.

The impacts to the water supply systems within the geographic area of interest from the operations-related population increase can be estimated by calculating the amount of potable water that is required by these individuals. Table 2.5.2-15 contains details regarding the more than 20 public water suppliers in the four counties of the geographic area of interest, including their maximum daily capacity and current demand. Most of these water supply systems are

operating well below capacity. As stated earlier, the USGS estimates that the average person uses 80 to 100 gpd of water at home. This represents an increased demand of approximately 62,000 gpd (during operations) and 338,500 gpd (overlap period). Because all of the local utilities are operating below capacity and the in-migrating workforce would be spread out among four counties, an increase of 620 persons (operations) or 3385 persons (overlap period) in the geographic area of interest would not adversely affect the local utilities' capacity to supply potable water to their customers. Therefore, impacts to public water supply systems in the geographic area of interest would be SMALL.

The 1000 refueling outage workers are conservatively assumed to reside within the geographic area of interest during periodic refueling activities. The associated increase in potable water demand would be temporary and spread over several water supply systems. Most of these water supply systems are operating well below capacity. Therefore, impacts to public water supply systems in the geographic area of interest would be SMALL during refueling activities.

Wastewater Treatment Facilities

Similar to potable water supplies, potential impacts to wastewater treatment facilities would result from onsite operation-related needs and the increase in the local population associated with in-migrating operations workers. Wastewater generated during operation of the CR SMR Project is discharged to the City of Oak Ridge Rarity Ridge sanitary treatment facility. As previously described, the average person in the United States uses 80 to 100 gpd of water at home, including such activities as dishwashing, laundry, and outdoor watering. During operations, a peak operations workforce of 500 operations workers and 1000 temporary outage workers are on site on any particular day. Assuming that half of their water consumption occurs at the CRN Site results in 40 to 50 gpd of wastewater per worker, and a maximum of 75,000 gpd or 0.08 mgd of wastewater produced on site during peak operations. During the overlap period, a maximum of 183,300 gpd or 0.18 mgd of wastewater would be produced on site. As shown on Table 2.5.2-16, the City of Oak Ridge Rarity Ridge facility has a maximum treatment capacity of 0.6 mgd and an average daily utilization of 0.1 mgd, for an excess capacity of 0.5 mgd. The onsite wastewater production of 0.08 mgd represents approximately 15 percent of excess capacity and the wastewater production of 0.18 mgd represents approximately 36 percent of excess capacity. Although the temporary demand during the overlap period would be noticeable, it would not overtax existing facilities and there would be no capital purchases required to increase treatment capacity. Accordingly, the operations-related impact to wastewater treatment facilities would be SMALL.

Table 2.5.2-16 lists the wastewater treatment facilities in the geographic area of interest, their maximum daily capacity, and wastewater flows processed daily. The increase to the geographic area of interest population of an estimated 620 operation-related residents and 3385 overlap period-related residents would increase demand for wastewater treatment. Because the in-migrating population is not expected to settle in one area exclusively, this increased demand would be distributed among several facilities in the four counties. All of the wastewater

treatment facilities in the geographic area of interest are operating below capacity, and would be able to absorb the increased demand without adversely affecting the current customers. Therefore, based on the current excess capacities of the existing wastewater treatment facilities in the geographic area of interest, impacts to wastewater treatment facilities would be SMALL.

The 1000 refueling outage workers are conservatively assumed to reside within the geographic area of interest during periodic refueling activities. The associated increase in wastewater treatment demand would be temporary and distributed over several water supply systems. Most of these water supply systems are operating well below capacity. Therefore, impacts to public water supply systems in the geographic area of interest would be SMALL during refueling activities.

Police Services

The number of sworn law enforcement officers and the resident-to-officer ratio for the four counties and the larger cities in the geographic area of interest are given in Table 2.5.2-17. The recommended ratio of officers to residents is between 1 and 4 officers to 1000 residents, or a police officer-to-resident ratio between 1:250 and 1:1000 (Reference 5.8-12). Table 2.5.2-17 shows that the cities within the geographic area of interest are within this ratio range and the counties are at or slightly above 1:1000. As previously stated, during the period of operation an estimated 620 workers and family members and during the overlap period an estimated 3385 workers and family members would migrate into the geographic area of interest. It is expected that most of these workers would reside in the larger cities in the area, including Knoxville, Oak Ridge, Clinton, Harriman, Kingston, and Lenoir City, Tennessee. These cities would be able to absorb the additional residents without the necessity of hiring more police officers because their police forces are already larger than the size required to achieve the recommended ratio of officers to residents. Table 5.8-3 shows distribution of the operations workforce among the four counties within the geographic area of interest and the resulting increased total populations by county. These population increases would increase the police-to-resident ratios slightly. The percent increase in ratio attributed to operation would be 0.2 percent in Anderson, Loudon, and Roane counties and no change in Knox County. During the overlap period, an increase in ratio attributed to construction would also occur, including 1.0, 0.9, 0.4, and 1.0 percent in Anderson, Knox, Loudon, and Roane Counties, respectively (as described in Subsection 4.4.2.7). Based on the percentage increase in police-to-resident ratios, the impact of in-migrating operation-related population to police services would be SMALL.

The 1000 refueling outage workers are conservatively assumed to reside within the geographic area of interest during periodic refueling activities. The associated population increase would be temporary and spread over the geographic area of interest. Therefore, impacts to police services in the geographic area of interest would be SMALL during refueling activities.

Fire Protection Services

The existing levels of fire protection services in the geographic area of interest are close to the national average, as described in Subsection 2.5.2.7.3. Firefighter-to-resident ratios range from 1:205 in Roane County to 1:715 in Knox County. During operations, the City of Oak Ridge Fire Department provides primary fire and emergency medical services to the CRN Site. The first responder is the station located at the East Tennessee Technology Park, approximately 3.2 mi north of the CRN Site. Table 5.8-4 shows distribution of the operations workforce among the four counties within the geographic area of interest and the effect of the larger populations. These population increases would increase the firefighter-to-resident ratios slightly. The percent increase in ratio attributed to operations would be 0.3 and 0.5 percent in Anderson and Roane counties, respectively, and no change in Knox and Loudon counties. During the overlap period, the additional percent increase in ratio attributed to construction would be 1.0, 0.9, 0.4, and 1.0 percent in Anderson, Knox, Loudon, and Roane Counties, respectively (as described in Subsection 4.4.2.7). Therefore, the potential impacts of the in-migrating residents to fire protection services during operation would be SMALL.

The 1000 refueling outage workers are conservatively assumed to reside within the geographic area of interest during periodic refueling activities. The associated population increase would be temporary and spread over the geographic area of interest. Therefore, impacts to fire protection services in the geographic area of interest would be SMALL during refueling activities.

Medical Services

The available medical services in the geographic area of interest, including health care facilities and nursing homes, are described in Subsection 2.5.2.7.3 and Tables 2.5.2-18 and 2.5.2-19. During operation of the CR SMR Project, onsite medical personnel would be expected to treat minor injuries to workers. More extensive injuries would be treated at one of the medical centers in the vicinity of the CRN Site. The influx of operations workers, temporary refueling outage workers, and overlap period construction and operation workers to the geographic area of interest would not disrupt the existing medical services available in the area. An addition of approximately 620 operation-related residents would increase the geographic area of interest population by 0.1 percent and an addition of 3385 overlap period construction and operations workers would increase the population by 0.6 percent, which would not adversely affect existing medical services. Therefore, impacts to medical services would be SMALL.

5.8.2.8 Education

NUREG-1437, Revision 1 presents criteria for the assessment of education impacts based on the baseline conditions of the potentially affected school system (e.g., whether it is below, at, or exceeding maximum allowed student/teacher ratio). These criteria are:

- SMALL: project-related enrollment increases of 3 percent or less; no change in the school systems' abilities to provide educational services and no additional teaching staff or classroom space is needed
- MODERATE: project-related enrollment increases of 4 to 8 percent; school system must increase its teaching staff or classroom space
- LARGE: project-related enrollment increases above 8 percent; current institutions not adequate to accommodate the influx of students or project-related demand can be met only if additional resources are acquired.

Schools and student populations are discussed in Subsection 2.5.2.8. In the 2010 US Census Bureau estimates, 17.1 percent of the population of Tennessee was 5 to 17 years old (i.e., school age) and students accounted for 15.1 to 16.3 percent of total county populations in the four-counties within the geographic area of interest. It is assumed that an estimated 250 operations workers would come from outside the 50-mi region. This would result in a population increase of 620 based on an average household size in Tennessee of 2.48 persons. Using the highest county figure of 16.3 percent for student population, an estimated 101 school-aged children would relocate within the geographic area of interest.

As described in Subsection 5.8.2.1, it is assumed that 27 percent of the in-migrating operations workforce resides in Anderson County, 50 percent in Knox County, 6 percent in Loudon County, and 17 percent in Roane County. Table 5.8-5 applies the population distribution percentage assumptions to the number of school-aged children in the in-migrating operations workforce population to estimate the number of operations-related school-aged children in each of the four counties. Knox County would experience the largest increase in school-age population of 51 students. This represents less than 0.1 percent of the current public school population of 58,800. Roane County, with an additional 17 students, would experience the largest relative increase at 0.2 percent. Public school teacher-to-student ratios in the geographic area of interest are 1:14 in Anderson County and 1:16 in Knox, Loudon, and Roane counties (Reference 5.8-13). The increase in number of students would not change the teacher-to-student ratios (Table 5.8-5). During the overlap period between construction and operation, the population in the four-county geographic area of interest would increase by 3385 persons, including an estimated 552 school-aged children. This represents an increase of 0.6 percent in current public school enrollment. Project-related school enrollment increases would be less than 3 percent and increased revenues from property taxes and sales taxes on purchases as a result of workforce expenditures would help offset the additional education-related costs. Therefore, impacts to education within the geographic area of interest would be SMALL.

5.8.3 Environmental Justice Impacts

Executive Order 12898 (59 FR 7629) directs federal executive agencies to consider environmental justice under the National Environmental Policy Act. This Executive Order ensures that minority and/or low-income populations do not bear a disproportionate share of adverse health or environmental consequences of a proposed project, which in this instance is operation of two or more SMRs at the CRN Site. (Reference 5.8-14)

Subsection 2.5.4 describes the evaluation process used to identify minority and low-income populations living within the region that meet the conditions associated with the NRC guidance. Census blocks, block groups, and relative distances of minorities and low-income populations around the CRN Site are identified in Table 2.5.4-1 and Figures 2.5.4-1 and 2.5.4-2.

As shown in Figure 2.5.4-1, the spatial distribution of block groups with minority populations in the region is clustered in the City of Knoxville in Knox County, Tennessee and the City of Alcoa in Blount County, Tennessee. No block groups in Roane County (in which the CRN Site is located) or in Anderson County contain minority populations as defined in Subsection 2.5.4.2. As discussed in Subsection 2.5.4.2, the identified aggregate minority population closest to the CRN Site is located approximately 20 mi to the east in Blount County, Tennessee. The closest Hispanic minority population is located in Loudon County, Tennessee, approximately 9 mi southeast of the CRN Site.

As shown in Figure 2.5.4-2, the majority of the low-income population in the geographic area of interest is in the City of Knoxville, in Knox County, Tennessee. There is one low-income population block group within Roane County, Tennessee and one within Anderson County, Tennessee. As discussed in Subsection 2.5.4.3, the closest low-income population block group is located in Loudon County, Tennessee, approximately 7 mi southeast of the CRN Site. As shown on Figures 2.5.4-1 and 2.5.4-2, there is some overlap between the locations of minority and low-income population groups.

As discussed in Subsection 2.5.4.4, no other populations or groups (e.g., subsistence populations) were identified that represent environmental justice populations in the region. Two locations of potential significance to minority communities were identified, however. The Wheat Community Burial Ground is a mid-19th century African American cemetery located approximately 1 mi northwest of the northern boundary of the CRN Site on the east side of TN 58. The community of Scarboro, a small predominantly African American community established in 1950, is located in Anderson County approximately 0.5 mi from the Oak Ridge Reservation Y-12 plant.

5.8.3.1 Potential Physical Impacts

For the purpose of this environmental justice assessment, physical impacts under consideration due to CR SMR Project operation include potential effects on land use, water, and ecology. Ecological resources are a concern in the event that any minority or low-income populations in

the area are dependent on fishing or farming for subsistence. Potential impacts on land use are described in detail in Section 5.1. Impacts on water are described in Section 5.2. Ecological and public health impacts in regard to the cooling system, radiation exposure pathways, and the transmission system are described within Sections 5.3, 5.4, and 5.6, respectively.

The CR SMR Project includes structures and facilities located within the CRN Site boundaries as well as on nearby and adjacent offsite areas. Offsite facilities include the 69-kV underground transmission line, railroad siding, and barge landing area, all located within property owned by the federal government and managed by the DOE or TVA and not in proximity to any residences. In addition, the Clinch River arm of the Watts Bar Reservoir is used to supply source water for the circulating water system for the SMR units.

As described in Section 5.1, the impacts on the surrounding public from any land use impacts as a result of CR SMR Project operation would be SMALL to MODERATE, including effects on land use in the vicinity of the CRN Site, transmission corridors and roadways, and historic properties. Because the effects are SMALL and because of the spatial distribution of minorities and low-income population in the region, the potential for disproportionate land use impacts on minority and low-income populations would be SMALL to MODERATE.

As described in Section 5.2, the impacts on the surrounding public from any water related impacts as a result of CR SMR Project operation would be SMALL, including hydrology, water use, and water quality. Because the effects would be SMALL and because of the spatial distribution of minorities and low-income population in the region, the potential for disproportionate water related impacts on minority and low-income populations would be SMALL

As described in Section 5.3, 5.4, and 5.6, the impacts on the surrounding public from any ecological and public health impacts as a result of CR SMR Project operation would be SMALL. Ecological and public health impacts were evaluated for cooling system effects on surface water and the atmosphere, radiological effects on humans and non-human biota, and transmission line effects on members of the public and terrestrial and aquatic ecosystems.. Because the effects would be SMALL and because of the spatial distribution of minorities and low-income population in the region, the potential for disproportionate ecological impacts on minority and low-income populations would be SMALL.

Based on the evaluations of land use impacts, water-related impacts, and ecological and public health impacts presented in Sections 5.1, 5.2, and 5.3, 5.4, and 5.6, physical impacts on the surrounding public from CR SMR Project operations would be SMALL. Based on the SMALL impacts overall, combined with the distribution patterns of minority and low-income populations, the potential for disproportionate impacts to minority and low-income populations would be SMALL.

5.8.3.2 Potential Socioeconomic Impacts

The socioeconomic resource categories with the greatest potential to affect minorities and low-income populations are transportation and housing. The impacts associated with the remaining socioeconomic resource categories (i.e., noise and air quality, land use, social and public services, economy, tax revenues, and recreation) would be SMALL, regardless of their spatial distribution relative to the CRN Site, and some have beneficial effects.

As described in Subsection 5.8.2.3, the mitigation measures used to offset the effects of construction traffic would also accommodate operations traffic; therefore, impacts to local roads during operation would be SMALL. Operations workers typically access the CRN Site via TN 58 and Bear Creek Road. Few houses are located along these access roads in the areas likely to be impacted by operation traffic. None of the minority or low-income census blocks are located along either TN 58 or Bear Creek Road. Although the Wheat Community Burial Ground is located off of TN 58, construction traffic would not impede access to the cemetery. No relocations of traffic to local offsite roads as a result of operation of the CR SMR Project are anticipated. Therefore, minority and low-income populations and locations of potential significance to minority populations would not be adversely impacted by operation traffic or disproportionately affected.

The impact of CR SMR Project operation, including periodic refueling activities, on the housing market in the CRN Site vicinity is expected to be small due to the large number of available vacant housing units and the relatively small requirements for the in-migrating operations workforce. However, due to the increased demand for housing in the region, rental housing costs could increase and potentially displace low-income renters. Considering the available number of housing units and assuming operations workers are not likely to need low-income housing, minority and low-income populations, including the Scarboro community, would not be adversely impacted or disproportionately affected by the operation-related demand for housing.

Positive socioeconomic impacts associated with operation are described in Subsection 5.8.2. These include increased employment opportunities, possible income increases, and generation of additional tax revenues, which are directly and indirectly related to CR SMR Project operations. These beneficial impacts also would be realized by minority and low-income populations.

The possibility that uniquely vulnerable minority or low-income communities, such as subsistence populations, might be located near the CRN Site was also evaluated. As discussed in Subsection 2.5.4.4, inquiries were made to local agencies, such as planning departments and social services agencies, academic institutions, and local businesses. None of the persons contacted identified any unique economic, social, or human health circumstances and lifestyle practices through which the minority and low-income populations could be disproportionately adversely affected by the CR SMR Project.

Based on the evaluation of potential socioeconomic effects of operation, impacts would be SMALL. Given the small impacts overall, combined with the distribution patterns of minority and low-income populations, the potential for adverse socioeconomic impacts that could disproportionately affect minority or low-income populations in the region would be SMALL.

5.8.4 References

Reference 5.8-1. AECOM, "Final Clinch River Site Ambient Noise Assessment Technical Report - Revision 1," Tennessee Valley Authority, April, 2014.

Reference 5.8-2. Federal Interagency Committee on Noise, "Federal Agency Review of Selected Airport Noise Analysis Issues," August, 1992.

Reference 5.8-3. Golder Associates, "Study on the Comparative Merits of Overhead Electricity Transmission Lines Versus Underground Cables," PPSMDE081295, May, 2008.

Reference 5.8-4. U.S. Environmental Protection Agency, Tennessee Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants, Website: http://www.epa.gov/oaqps001/greenbk/anayo_tn.html, January 30, 2015.

Reference 5.8-5. U.S. Environmental Protection Agency, EPA Approves Redesignation of Knoxville Area to Attainment for the 2008 8-Hour Ozone Standard, Website: http://yosemite.epa.gov/opa/admpress.nsf/d0cf6618525a9efb85257359003fb69d/c0535b494c0ee0be85257e81004f5475!opendocument, July 13, 2015.

Reference 5.8-6. Nuclear Energy Institute, Life-Cycle Emissions Analysis, Website: http://www.nei.org/Issues-Policy/Protecting-the-Environment/Life-Cycle-Emissions-Analyses, 2015.

Reference 5.8-7. Nuclear Energy Institute, Comparison of Lifecycle Emissions of Energy Technologies, Website: http://www.nei.org/Issues-Policy/Protecting-the-Environment/Life-Cycle-Emissions-Analyses/Comparison-of-Lifecycle-Emissions-of-Selected-Ener, 2015.

Reference 5.8-8. U.S. Census Bureau, DP-1 Profile of General Population and Housing Characteristics: 2010 Demographic Profile Data, Website: http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_DP_DPDP1, 2010.

Reference 5.8-9. U.S. Nuclear Regulatory Commission, "Information Notice 2000-13: Review of Refueling Outage Risk," ADAMS Accession Number ML003752328, September 27, 2000.

Reference 5.8-10. U.S. Bureau of Economic Analysis, RIMS II Multipliers (2010/2010), Table 2.5 Total Multipliers for Output, Earnings, Employment, and Value Added by Industry Aggregation, Website: https://www.bea.gov/regional/rims/rimsii/, 2015.

Reference 5.8-11. AECOM, "Clinch River Site Traffic Assessment, Final Technical Report, Revision 0," Tennessee Valley Authority, March, 2015.

Reference 5.8-12. Broemmel, Jarett, Clark, Terry L., and Nielsen, Shannon, "The Surge Can Succeed," Military Review 87(4): 110-112, 2007.

Reference 5.8-13. U.S Department of Education and National Center for Education Statistics, Local Education Agency (School District) Universe Survey, Website: http://nces.ed.gov/ccd/elsi/, 2014.

Reference 5.8-14. Executive Order 12898 Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, February 11, 1994).

Reference 5.8-15. Federal Bureau of Investigation, Crime in the United States 2013, Table 80, Tennessee, Website: http://www.fbi.gov/about-us/cjis/ucr/crime-in-the-u.s/2013/crime-in-the-u.s.-2013/tables/table-80/table-80-state-cuts/table_80_full_time_law_enforcement_employees_tennessee_by_metropolitan_nonmetropolitan_counties_2013.xls, 2015.

Reference 5.8-16. Federal Bureau of Investigation, Crime in the United States 2013, Table 78, Tennessee, Website: http://www.fbi.gov/about-us/cjis/ucr/crime-in-the-u.s/2013/crime-in-the-u.s.-2013/tables/table-78/table-78-cuts/table_78_full_time_law_enforcement_employees_tennessee_by_city_2013.xls, 2013.

Reference 5.8-17. U.S. Census Bureau, American Fact Finder, 2014 Population Estimates, Website: http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml, 2015.

Table 5.8-1
Preliminary Annual Estimates for Criteria Pollutant Emissions from SMR-Supporting Fossil Fuel Fired Equipment

Pollutant	Annual Emissions (Tons Per Year)
Nitrogen Oxides (NO_x)	37.6
Sulfur Dioxide (SO_2)	20.8
Carbon Monoxide (CO)	4.8
Particulates (PM)	4.0
Volatile Organic Compounds (VOC)	0.6

Table 5.8-2
Comparison of Life-Cycle CO_2 Equivalent Emissions for Different Energy Sources

Source	CO_2 Equivalent Emissions (Tons Per Gigawatt-Hour)
Coal	979
Gas	462
Biomass	253
Solar	53
Geothermal	42
Hydro	26
Nuclear	13
Onshore Wind	12

Source: (Reference 5.8-7)

Table 5.8-3
Law Enforcement Officers and Officer-to-Resident Ratios in Geographic Area of Interest

Counties in Geographic Area of Interest	Total Population in 2010	Additional Population Due to Facility Operation	Total with Additional Population	Number of Sworn Law Enforcement Officers[1]	Current Officer-to-Resident Ratio	Officer-to-Resident Ratio with Additional Population	Percent Increase from Current Officer-to-Resident Ratio
Anderson	75,129	166	75,295	148	1 : 508	1 : 509	0.2
Knox	432,226	310	432,536	851	1 : 508	1 : 508	--
Loudon	48,556	37	48,593	73	1 : 665	1 : 666	0.2
Roane	54,181	107	54,288	63	1 : 860	1 : 862	0.2

[1] Including city police force(s) within each county.

Note:
-- = no change

Sources: (Reference 5.8-15; Reference 5.8-16; Reference 5.8-17)

Table 5.8-4
Fire Fighters and Firefighter-to-Resident Ratios in Geographic Area of Interest

Counties in Geographic Area of Interest	Total Population in 2010	Additional Population Due to Facility Operation	Total with Additional Population	Number of Firefighters (Full time and Volunteer)	Current Firefighter-to-Resident Ratio	Firefighter-to-Resident Ratio with Additional Population	Percent Increase from Current Firefighter-to-Resident Ratio
Anderson	75,129	166	75,295	216	1 : 348	1 : 349	0.3
Knox	432,226	310	432,536	604	1 : 716	1 : 716	--
Loudon	48,556	37	48,593	201	1 : 242	1 : 242	--
Roane	54,181	107	54,288	264	1 : 205	1 : 206	0.5

Note:
-- = no change

Sources: (Reference 5.8-17)

Table 5.8-5
School Enrollments and Teacher/Student Ratios in Geographic Area of Interest

Counties in Geographic Area of Interest	Students Enrolled in Public School System	Full-Time Equivalent Teachers	Pupil/Teacher Ratio	Operations-Related Population Increase - Percent by County	School-Age Population Increase[1]	Percentage of Additional Public School Children per County	Teacher to Student Ratio with Additional Children
Anderson	12,598	925.1	13.62	27	27	0.22	1 : 13.6
Knox	58,815	3705.4	15.98	50	51	0.09	1 : 15.9
Loudon	7369	464.6	15.86	6	6	0.08	1 : 15.9
Roane	7413	475.2	15.60	17	17	0.23	1 : 15.6
Total	86,195	NA	NA	NA	101	0.12	NA

[1] Based on addition of 101 school-aged children within geographic area of interest..

Note:
NA = Not Applicable

Source: (Reference 5.8-13)

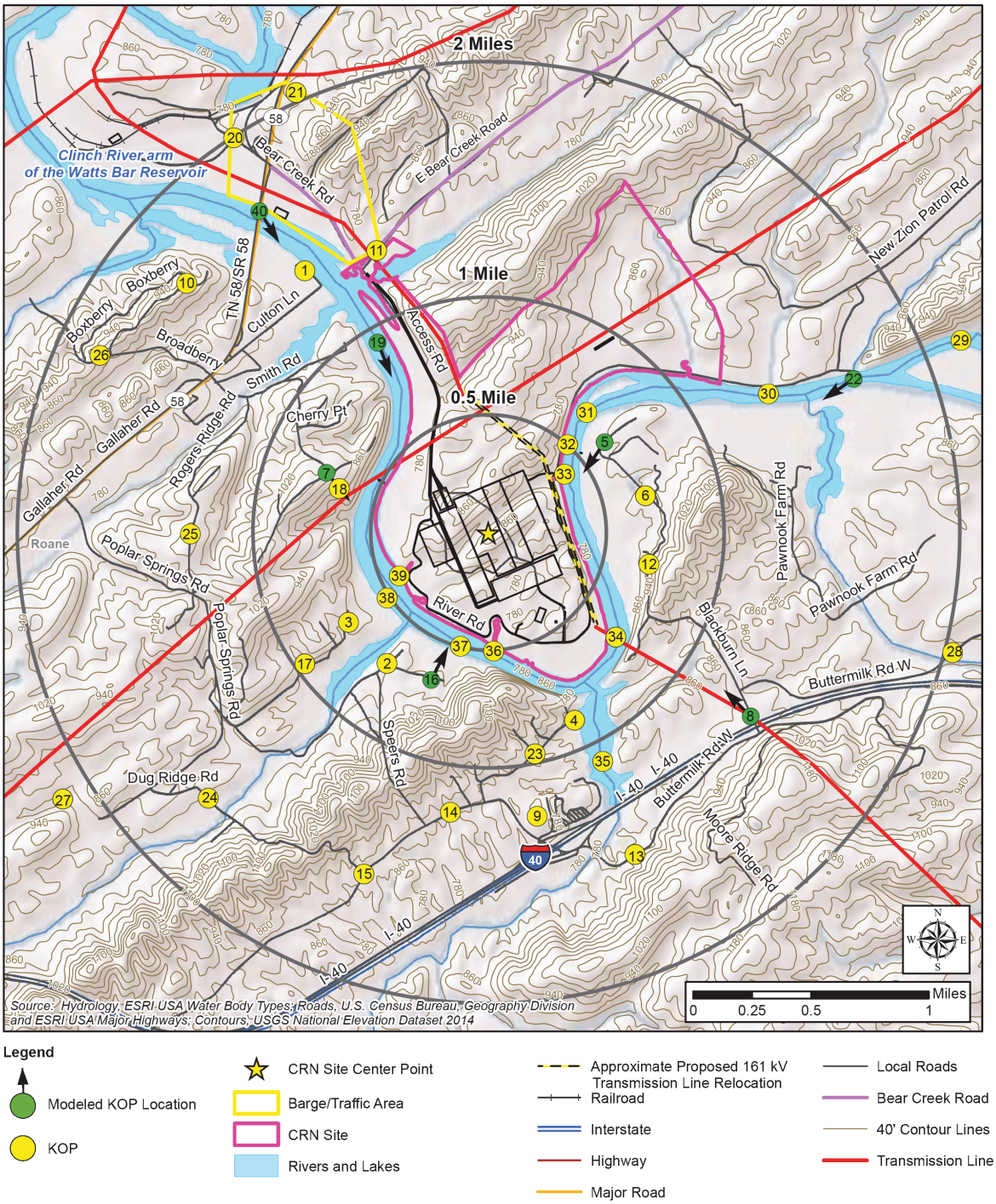

Figure 5.8-1. CRN Site Key Observation Points

Figure 5.8-2. Baseline View from KOP 5

Figure 5.8-3. View from KOP 5 with the CR SMR Project

Figure 5.8-4. View from KOP 5 with the CR SMR Project and the Average Annual Plume

Figure 5.8-5. View from KOP 5 with the CR SMR Project and the Winter Plume

Figure 5.8-6. Baseline View from KOP 7

Figure 5.8-7. View from KOP 7 with the CR SMR Project

Figure 5.8-8. View from KOP 7 with the CR SMR Project and the Average Annual Plume

Figure 5.8-9. View from KOP 7 with the CR SMR Project and the Winter Plume

Figure 5.8-10. Baseline View from KOP 8

Figure 5.8-11. View from KOP 8 with the CR SMR Project

Figure 5.8-12. View from KOP 8 with the CR SMR Project and the Average Annual Plume

Figure 5.8-13. View from KOP 8 with the CR SMR Project and the Winter Plume

Figure 5.8-14. Baseline View from KOP 16

Figure 5.8-15. View from KOP 16 with the CR SMR Project

Figure 5.8-16. View from KOP 16 with the CR SMR Project and the Average Annual Plume

Figure 5.8-17. View from KOP 16 with the CR SMR Project and the Winter Plume

Figure 5.8-18. Baseline View from KOP 19

Figure 5.8-19. View from KOP 19 with the CR SMR Project

Figure 5.8-20. View from KOP 19 with the CR SMR Project and the Average Annual Plume

Figure 5.8-21. View from KOP 19 with the CR SMR Project and the Winter Plume

Figure 5.8-22. Baseline View from KOP 22

Figure 5.8-23. View from KOP 22 with the CR SMR Project

Figure 5.8-24. View from KOP 22 with the CR SMR Project and the Average Annual Plume

Figure 5.8-25. View from KOP 22 with the CR SMR Project and the Winter Plume

Figure 5.8-26. Baseline View from KOP 40

Figure 5.8-27. View from KOP 40 with the CR SMR Project

Figure 5.8-28. View from KOP 40 with the CR SMR Project and the Average Annual Plume

Figure 5.8-29. View from KOP 40 with the CR SMR Project and the Winter Plume